

12-15-1990

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Recommended Citation

Lori L. Swafford *Admissibility of DNA Genetic Profiling Evidence in Criminal Proceedings: The Case for Caution*, 18 Pepp. L. Rev. 1 (1991)
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Admissibility of DNA Genetic Profiling Evidence in Criminal Proceedings: The Case for Caution

I. INTRODUCTION

Since its debut in a Florida courtroom in 1987,¹ DNA "fingerprinting"² evidence has captured the attention of prosecutors, defense attorneys and the popular press.³ As the newest method of establishing identity, DNA profiling has been widely touted as "the most powerful, most accurate piece of forensic evidence that's ever been created."⁴

DNA profiling was developed by molecular biologists for use in the genetic research of inherited diseases.⁵ DNA testing has since been heralded as the answer to legal quandaries ranging from murder to paternity.⁶ Using minute traces of genetic material extracted from seemingly harmless sources such as a single strand of hair, a speck of dried blood, a drop of saliva, or a semen stain on a bedsheet,⁷ DNA

1. *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988). Andrews was the first person in the United States "to be convicted of a crime with the help of DNA evidence." Lewis, *DNA Fingerprints: Witness for the Prosecution*, DISCOVER, June 1988, at 44, 52.

2. While DNA testing is often referred to as DNA "fingerprinting," this term is disfavored because of its tendency to "create unsubstantiated beliefs and expectations in the minds of judges and jurors." Burk, *DNA Fingerprinting: Possibilities and Pitfalls of a New Technique*, 28 JURIMETRICS J. 455, 468-69 (1988). Therefore, this Comment will refer to this technique as either DNA "profiling," "analysis," or "testing."

3. See, e.g., Moss, *DNA—The New Fingerprints*, A.B.A. J., May 1, 1988, at 66 (noting that DNA profiling "could revolutionize law enforcement"); Lewis, *supra* note 1, at 52 (DNA typing is the greatest boon to forensic biology since fingerprinting).

4. Williams, *Conviction By Chromosome*, STUDENT LAW. Dec. 1989, at 26, 29.

5. See White, Lalouel, Lathrop, Leppert, Nakamura & O'Connell, *Mapping Approaches to Gene Identification in Humans*, 147 W.J. MED. 423, 423 (Oct. 1987) (noting the use of DNA testing to diagnose a predisposition toward inheritable genetic diseases such as sickle-cell anemia, Huntington's Disease, and muscular dystrophy).

6. Burk, *supra* note 2, at 455. DNA testing is used in establishing parentage. By comparing the DNA prints of the child and the alleged parents, experts "can establish family blood lines with unprecedented precision." Thompson & Ford, *DNA Typing: Promising Forensic Technique Needs Additional Validation*, TRIAL, Sept. 1988, at 56. While the admissibility of DNA testing in civil actions such as paternity cases is also not fully resolved, this Comment confines its examination to the admissibility of DNA testing in criminal cases, where the need for reliability and precision of scientific methods is greatest.

7. Moss, *supra* note 3, at 66. Urine samples cannot be utilized in the DNA screening process because urine does not contain DNA. Comment, *DNA Identification Tests and the Courts*, 63 WASH. L. REV. 903, 909 n.27 (1988).

testing attempts to identify criminals by "matching" the suspect's own DNA with samples acquired at the crime scene.⁸

Although DNA profiling technology is still in its forensic infancy, the technique has permeated the legal system with amazing speed,⁹ leaving defense attorneys reeling in its wake.¹⁰ Oddly enough, the seemingly resigned complacency of defense attorneys confronted with DNA evidence has fueled DNA's meteoric transition from the scientific laboratory to the court of law.¹¹ Thus, DNA testing experienced a relatively tranquil initiation into the legal system. However, defense attorneys and various segments of the scientific community have recently awakened to potential problems with the reliability of DNA evidence. DNA, like several innovative evidentiary techniques before it, has finally come under attack.¹² The question now seems to be whether DNA has earned its place in court because of its accuracy and reliability as a tool of identification, or whether judges, juries, and defense attorneys, like laypersons, have been dizzied by the whirlwind of scientific terminology and overzealous claims of the media and the commercial laboratories which perform DNA testing.¹³

This Comment will assess the present status of DNA testing, focusing particularly on the legal questions stemming from the technique's strengths and limitations when put to forensic applications. Part II provides a basic explanation of DNA and the scientific principles underlying DNA profiling. This background is essential in order to competently evaluate the reliability and admissibility of DNA test results. Part II also profiles the two distinct methods of DNA typing currently offered by commercial laboratories in the United States. Part III presents a discussion of the two principle legal standards for

8. Moss, *supra* note 3, at 66. DNA profiling offers several advantages over traditional methods of examining biological specimens. For example, DNA profiling is more precise and reliable than blood group typing and can be performed on samples of a much smaller size. Thompson & Ford, *supra* note 6, at 56. See also, Moss, *supra* note 3, at 66-67 (outlining advantages of DNA profiling).

9. Between 1987 and 1989, DNA profiling evidence was utilized in approximately eighty cases throughout the nation. Williams, *supra* note 4, at 26.

10. Houston defense attorney Moses Sanchez, after losing a criminal case in which DNA evidence was introduced, stated:

It's devastating. When an expert comes in and says there's a one in 700 million chance that your man is not the one—and you know he's one of only 30 million black men in the country—it just kills you. It intimidates the jury. The defense bar better get ready.

Taylor, *From One Speck, a Case is Made*, NAT'L L.J., Jan. 16, 1989, at 3, 22.

11. In each of the first three appellate criminal cases in which DNA evidence was admitted by the court, defense attorneys failed to call any expert witnesses to challenge the introduction of the DNA test results. See *infra* notes 174, 195, 206 and accompanying text.

12. See *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923) (inadmissibility of the lie detector test); *United States v. Addison*, 498 F.2d 741 (D.C. Cir. 1974) (inadmissibility of voiceprints).

13. Williams, *supra* note 4, at 26.

the admissibility of novel scientific evidence and the problems associated with each. Part IV analyzes the admissibility of DNA evidence within the framework of each admissibility standard, and concludes that the present state of DNA technology has not yet achieved the level of reliability required by either standard. Part V examines the four criminal decisions¹⁴ involving DNA evidence which have reached the state appellate level thus far. Finally, Part VI delves beyond the parameters of admissibility, focusing on potential abuses associated with DNA profiling. In particular, this Comment will address the constitutional issue of the fourth amendment protection against illegal search and seizure as it applies to the taking of genetic samples. Additionally, in light of DNA's unequalled ability to reveal personal information unrelated to identity, the possibility of a nationwide DNA data bank will be explored in terms of constitutional protections of individual privacy.

II. SCIENTIFIC BACKGROUND

A. A Simplistic Explanation of DNA

The human body is composed of individual units called cells. In turn, each cell contains 46 chromosomes arranged in 23 sets of two. One chromosome per pair is inherited from each parent.¹⁵ It is these chromosomal capsules which hold the genetic information known as deoxyribonucleic acid, commonly referred to as DNA.¹⁶

The DNA molecule¹⁷ is arranged in a double helix configuration. The rungs of this "twisted ladder" consist of genetic building blocks called bases.¹⁸ There are four types of bases, known by the designations "A," "T," "C," and "G." These bases join in pairs in a system-

14. *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988); *Spencer v. Commonwealth*, 238 Va. 563, 385 S.E.2d 850 (1989); *Cobey v. Maryland*, 80 Md. App. 31, 559 A.2d 391 (1989); *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989).

15. Kelly, Rankin & Wink, *Method and Applications of DNA Fingerprinting: A Guide for the Non-Scientist*, 1987 CRIM. L. REV. 105, 106 [hereinafter Kelly]. During meiosis, the process of egg or sperm formation, portions of the chromosomes are rearranged. Thus, a child will possess traits which are recognizably similar, but not identical, to his parents. *Id.* at 108.

16. *Id.* at 105-06. See also, Burk, *supra* note 2, at 456.

17. Contrary to common belief, all molecules are not miniscule. When stretched to its full length, the DNA molecule measures over six feet in length. Note, *The Dark Side of DNA Profiling: Unreliable Scientific Evidence Meets the Criminal Defendant*, 42 STAN. L. REV. 465, 469 (1990).

18. Burk, *supra* note 2, at 457. Each DNA molecule contains approximately three billion base pairs. White & Lalouel, *Chromosome Mapping with DNA Markers*, SCI. AM., Feb. 1988, at 40.

atic fashion: "A" always joins with "T," and "C" always joins with "G."¹⁹ One author likens the structure of DNA to a "zipper" having bases for teeth.²⁰ This zipper of coded information will only zip up with a strand of DNA having a corresponding sequence of bases along the chain. Once the DNA strand is zipped, each sequence of bases along the chain of the DNA molecule is "read" by the cell and translated into a physical characteristic. Thus, all the components of a person's appearance which make him unique—for example, height, build, hair and eye color—are predetermined by DNA.²¹ Each person's molecular pattern of DNA is itself unique.²² It is this factor of undisputed distinctiveness which is the basis of all forms of DNA testing.

B. *The Goal of DNA Profiling*

DNA profiling operates under a very simple premise: No two individuals have identical ordering of DNA base sequences; therefore, two samples which match must necessarily have come from the same person. Inherent in this theory is the assumption that, if there are differences in two DNA samples, the laboratory technician will be able to detect them. This is not an easy task. Because all human beings belong to the same species, they are much more anatomically similar than different.²³ Consequently, the vast majority of DNA base pair sequences do not vary from person to person.²⁴

However, DNA profiling is possible due to the recent discovery of techniques which allow scientists to locate regions of DNA where dramatic variations between individuals do occur. These areas of variation are known as polymorphisms.²⁵

19. Kelly, *supra* note 15, at 106; Burk, *supra* note 2, at 457. While the bases always join with a corresponding mate, each person's DNA has an individualized order of base pairs. Comment, *supra* note 7, at 910. "A," "T," "C," and "G" stand for adenine, thymine, cytosine, and guanine, respectively.

20. Kelly, *supra* note 15, at 106.

21. Comment, *supra* note 7, at 909. DNA is often referred to as a genetic blueprint because it possesses all the information necessary to assemble the entire human body. Thompson & Ford, *supra* note 6, at 58. However, each cell reads only the portion of the blueprint which pertains to its specific function. Burk, *supra* note 2, at 457.

22. Kelly, *supra* note 15, at 108. Identical twins, however, have identical DNA characteristics. Thompson & Ford, *supra* note 6, at 58; Hill & Jeffrey, *Use of Mini-satellite Probes for Determination of Twin Zygosity at Birth*, LANCET, Dec. 21-28, 1985, at 1394.

23. Thompson & Ford, *supra* note 6, at 58. For example, all human beings normally have two arms, two legs, and one head. These common features are the result of similar sequences of DNA shared by all individuals. Lewis, *supra* note 1, at 47.

24. Thompson & Ford, *supra* note 6, at 58.

25. *Id.* The first polymorphic site was discovered by A. Wyman and R. White. Comment, *supra* note 7, at 911 n.34. Since this breakthrough, scientists have identified more than three thousand polymorphic regions. Lander, *DNA Fingerprinting on Trial*, 339 NATURE 501, 501 (1989).

C. Overview of Current DNA Profiling Techniques

Polymorphic DNA segments can be detected and analyzed in two ways. Of the three commercial laboratories²⁶ in the United States which perform DNA profiling tests, Cellmark Diagnostics²⁷ and Lifecodes²⁸ employ the first method, known as "restriction fragment length polymorphism (RFLP) analysis."²⁹ The remaining laboratory, Cetus,³⁰ examines polymorphic segments via an alternative method called "allele specific probe analysis."³¹ Because RFLP and allele specific probe analysis differ greatly in both theory and procedure, a brief explanation of each technique is warranted.

1. RFLP Analysis

This approach involves breaking the chain of DNA into small segments, locating the polymorphic sites,³² and then measuring the length of these polymorphic fragments.³³ Polymorphic fragments vary dramatically in length among different individuals, offering a promising method of identification.³⁴

This process is accomplished in seven basic steps.³⁵ First, a relatively pure³⁶ sample of DNA is extracted from forensic evidence.³⁷

26. Cellmark Diagnostics, Lifecodes Corporation, and Cetus Corporation. Moss, *supra* note 3, at 66-67. A fourth DNA typing laboratory was opened by the FBI in January, 1989. Its services are available free of charge to any law enforcement agency nationwide. During its first year of existence, the FBI lab received over seven hundred requests for DNA profiling. Williams, *supra* note 4, at 31.

27. Cellmark Diagnostics, based in Germantown, Maryland, was the first American laboratory to introduce the technique developed by British geneticist Alec Jeffreys. Thompson & Ford, *infra* note 29, at 56.

28. Lifecodes Corporation is based in Elmsford, New York. *Id.*

29. Thompson & Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Tests*, 75 VA. L. REV. 45, 64 (1984).

30. *Id.* Cetus Corporation is based in Emeryville, California. Thompson & Ford, *supra* note 6, at 56.

31. Thompson & Ford, *supra* note 29, at 64.

32. This is accomplished through the use of genetic probes. Genetic probes are small pieces of DNA selected specifically because they possess base sequences complementary to the sequence which the scientist desires to lock onto. Thompson & Ford, *supra* note 29, at 63 n.83 and accompanying text.

33. Thompson & Ford, *supra* note 6, at 58. *See also* Thompson & Ford, *supra* note 29, at 63-64.

34. *Id.*

35. *See* Thompson & Ford, *supra* note 29, at 64-76 (outlining seven scientific procedures undertaken in RFLP analysis).

36. The biological material is chemically and enzymatically treated in order to release the DNA. Then the DNA is treated with enzymes and organic solvents in order to purify it. *Id.* at 65. In cases of rape involving more than one perpetrator, DNA profiling results are often inconclusive due to the commingling of seminal fluid from dif-

Next, the DNA is cut into segments with a mixture of restriction enzymes.³⁸ Some, but not most, of the resulting fragments contain polymorphic DNA segments.³⁹

The third step consists of a sorting process known as gel electrophoresis.⁴⁰ The DNA restriction fragments are placed in agarose gel, a substance which closely resembles Jell-O.⁴¹ An electrical current is then sent through the gel, causing the fragments to move toward the opposite end of the tray.⁴² The longer DNA fragments move more slowly through the gel than the shorter DNA fragments.⁴³ Thus, when the electric current is removed, the DNA fragments will have moved different distances and will be dispersed across the gel in correlation to their length.⁴⁴

The fourth step in RFLP analysis is called Southern Blotting.⁴⁵ The array of DNA fragments is transferred from the gel slab onto a thin nylon membrane. This transfer creates a blot.⁴⁶

The fifth step in RFLP analysis is known as hybridization.⁴⁷ In hybridization, a radioactive genetic probe is introduced to the collection of fragments. The probe sorts out the polymorphic segments of DNA—those that will differentiate among individuals—from the millions of other segments. The genetic probe locks onto the polymorphic fragments and excludes all others.⁴⁸ The probe's radio-

ferent sources. However, the combination of seminal and vaginal secretions poses no such problem. See Burk, *supra* note 2, at 464.

37. Thompson & Ford, *supra* note 29, at 65. There are two problems associated with DNA extraction: insufficient quality of DNA and contaminated DNA. *Id.* at 65-67. See also *supra* note 7 and accompanying text (forensic evidence amenable to DNA typing).

38. These restriction enzymes, "biological scissors," seek out particular base sequences, typically four to twelve base pairs in length, and sever the pairs from the remainder of the DNA strand. The severance locations are called restriction fragments. Comment, *supra* note 7, at 912 n.42.

39. Thompson & Ford, *supra* note 29, at 69.

40. *Id.*

41. Burk, *supra* note 2, at 459.

42. Thompson & Ford, *supra* note 29, at 69. The electrical current causes DNA, a negatively charged molecule, to migrate toward the positive pole at the end of the tray. *Id.* at 69 & n.114; Burk, *supra* note 2, at 459.

43. Thompson & Ford, *supra* note 29, at 69. This concept is easily visualized if one thinks of people running through a dense forest carrying batons of varying lengths. Persons carrying the longer batons will naturally have more difficulty navigating through the trees and, therefore, will move more slowly than those carrying the shorter batons. Burk, *supra* note 2, at 459-60.

44. Thompson & Ford, *supra* note 6, at 59.

45. This technique is named for its creator, biologist E.M. Southern. See White & Lalouel, *Chromosome Mapping with DNA Markers*, SCI. AM., Feb. 1988, at 40.

46. Thompson & Ford, *supra* note 29, at 71. The purpose of this transfer is simply to avoid the inconvenience of manipulating the DNA while it is in the "messy" gel. Burk, *supra* note 2, at 460.

47. Thompson & Ford, *supra* note 29, at 71.

48. *Id.* This process is like passing a large magnet over a haystack in order to locate several needles within the mountain of hay. *Id.*

activity ensures that the researcher can locate the position of the fragments on the blot.⁴⁹

Lifecodes' "DNA-Print" test utilizes a single-locus probe. In criminal cases, Cellmark utilizes this same technique.⁵⁰ The single-locus probe is designed to bond with DNA sequences that occur only once on the DNA strand. This technique normally results in a DNA print consisting of two bands.⁵¹

Once the radioactive probe has bound itself to the polymorphic segments, the sixth step in RFLP analysis is undertaken. In this step, called autoradiography, the blot is put on x-ray film.⁵² A pattern of dark bands will appear on the x-ray film, marking the locations of the radioactive probes, and thus, the location of the polymorphic segments of DNA.⁵³

Finally, the DNA print is interpreted. This is accomplished by comparing the pattern of bands from the crime scene specimen with the sample taken from the criminal suspect or victim. The matching of the samples can be performed visually by human technicians or by computer.⁵⁴

2. Allele Specific Probe Analysis

The process utilized by Cetus Corporation is much simpler than RFLP, but not necessarily as useful in criminal cases. Instead of measuring the length of polymorphic segments, this test uses probes to determine whether segments, known as alleles, are present in a DNA sample.⁵⁵

Using extreme heat and cold, the number of alleles in a DNA sample is amplified, creating millions of alleles where only one may have

49. Thompson & Ford, *supra* note 29, at 71-72.

50. *Id.* at 72. Cellmark utilizes a multilocus probe in paternity cases. The multilocus probe seeks out and bonds with DNA sequences in more than one polymorphic locus which results in approximately fifteen interpretable bands. *Id.* This Cellmark test is much more specific, but harder to interpret, than the single-locus probe technique. *Id.*

51. Thompson & Ford, *supra* note 29, at 72. This is because chromosomes come in pairs; one inherited from each parent. However, if both parents have the same blood type, only one band will be produced on the Lifecodes DNA print. *Id.* at 72 & n.125

52. Thompson & Ford, *supra* note 29, at 74.

53. *Id.*

54. *Id.*

55. Thompson & Ford, *supra* note 6, at 62. "If the length polymorphism approach is like using a magnet to find a needle in a haystack, allele specific probes are like using a metal detector to see if a particular type of needle is present or not." *Id.*

been present before.⁵⁶ Next, a probe is added to the sample. If the desired allele is present, the probe will attach itself to it. Finally, the sample is placed on x-ray film, where a dot will appear if the probe has connected with the allele being sought. Thus, the Cetus process gives a simple yes or no answer.⁵⁷ This is somewhat of a drawback, however, for a significant portion of the population may possess the same allele.⁵⁸ Thus, a series of probes is necessary in order to distinguish between individuals with any degree of certainty.

Having reviewed the technology involved, the legal aspects which bear on the admissibility of DNA profiling will now be considered.

III. THE LEGAL STANDARD FOR ADMITTING DNA TYPING EVIDENCE

Before admitting novel scientific evidence,⁵⁹ a court must screen the underlying technique to ensure the reliability of its results. The legal admissibility of DNA typing evidence can be determined only after deciding what legal standard should govern. Traditionally, courts have relied on one of two alternative tests in evaluating the reliability of novel scientific evidence. The majority⁶⁰ of jurisdictions still utilize the test set forth in *Frye v. United States*⁶¹ (the *Frye* test). An increasing minority⁶² of states, however, employ the more liberal standard of the Federal Rules of Evidence (the Federal Rules test).⁶³

A. *The Frye Test*

In 1923, the D.C. Circuit Court of Appeals considered the admissibility of systolic blood pressure evidence⁶⁴ in a case of first impres-

56. *Id.*

57. *Id.*

58. *Id.* As much as 10% of the population may possess any given allele. Note, *supra* note 17, at 475 n.50.

59. Novel scientific evidence refers to scientific procedures and related opinion evidence which have not gained acceptance by the courts. 3 J. WEINSTEIN & M. BERGER, WEINSTEIN'S EVIDENCE § 702[03], at 702-34, 702-35 (1987 & Supp. 1988).

60. Approximately two-thirds of the jurisdictions employ the *Frye* test. Williams, *supra* note 4, at 26. "*Frye* is the leading American authority on the admissibility of scientific evidence. Until very recently, *Frye* was the almost universal view among American courts." Imwinkelried, *A New Era in the Evolution of Scientific Evidence—A Primer on Evaluating the Weight of Scientific Evidence*, 23 WM. & MARY L. REV. 261, 264 (1981) (footnote omitted).

61. 293 F. 1013 (D.C. Cir. 1923).

62. Approximately one-third of all jurisdictions now employ the Federal Rules standard. Williams, *supra* note 4, at 26.

63. See FED. R. EVID. 401, 403, 701, 702, 703.

64. The systolic blood pressure test, predecessor to the polygraph, measured changes in blood pressure thought to occur when the subject told a lie. Note, *The Admissibility of Electrophoretic Methods of Genetic Marker Bloodstain Typing Under the Frye Standard*, 11 OKLA. CITY U.L. REV. 773, 779 n.35 (1986).

sion.⁶⁵ In an eight-paragraph opinion which cited no authority for its conclusion, the court precluded the introduction of the evidence and announced the following standard as the threshold for admissibility: Evidence derived from innovative scientific techniques will be admissible only after the theory has gained general acceptance within the relevant scientific field.⁶⁶ The foundational premise of the *Frye* rule is that "general acceptance" is indicative of reliability.⁶⁷ "Once a procedure is sufficiently established to have gained general acceptance in the particular field in which it belongs, it presumably has gone through an extended period of use and testing within the scientific community and is reliable."⁶⁸

1. Justifications for the *Frye* Test

Beyond the assurance of reliability, several other justifications for the *Frye* test exist. Supporters stress that the concepts underlying novel scientific evidence are often beyond a lay person's ability to understand and critically evaluate. The *Frye* standard attempts to correct this weakness by placing the determination of reliability in the hands of experts familiar with the theory. "In effect, a technical jury passes judgment on the probative value of the evidence before it is presented to a lay jury, which might be unduly swayed by the perceived infallibility of 'science.'"⁶⁹ In this way, the *Frye* test relieves the court of the burden of establishing *per se* reliability. Instead, the judge need only satisfy himself that experts in the relevant field consider the technique reliable.⁷⁰

65. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

66. *Id.* at 1014. In a frequently quoted passage, the court stated:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere 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.

Id.

67. Thompson & Ford, *supra* note 29, at 53.

68. Jonakait, *Will Blood Tell? Genetic Markers in Criminal Cases*, 31 EMORY L.J. 833, 849 (1982).

69. Comment, *supra* note 7, at 933. See *United States v. Addison*, 498 F.2d 741, 743-44 (D.C. Cir. 1974) (scientists are better equipped than courts or lay juries to assess reliability); *People v. Kelly*, 17 Cal. 3d 24, 31, 549 P.2d 1240, 1244, 130 Cal. Rptr. 144, 148 (1976) (scientific community which developed the novel evidentiary technique should determine its reliability).

70. Thompson & Ford, *supra* note 29, at 54 (noting that judges can more easily assess the opinion of experts than the reliability of the technique itself).

Another justification for the *Frye* test is its assurance that at least a minimum number of experts are able to review the reliability of the innovative evidence. This forecloses the possibility that litigants will be unable to challenge the evidence due to an inability to locate knowledgeable experts.⁷¹ Defenders of the *Frye* test also emphasize that the standard eliminates the need to re-examine a novel technique's admissibility in subsequent cases once the issue has been decided.⁷² Finally, the *Frye* standard promotes uniformity in decisions.⁷³

2. Criticism of the *Frye* Test

While the majority of courts have embraced the *Frye* test, the standard has been the target of several "scathing" attacks.⁷⁴ Some critics find fault with the premise of the test. One court derided the *Frye* standard, stating that "[a] determination of reliability cannot rest solely on a process of 'counting [scientific] noses.'" ⁷⁵ Other commentators point to difficulties in applying the test, characterizing it as vague and ambiguous.⁷⁶ Much of the alleged ambiguity is caused by the *Frye* court's failure to quantify the standard by which a scientific technique may be considered "generally accepted."⁷⁷ Courts have also encountered difficulty in identifying the "relevant field" of science to which the technique belongs and from which the elusive

71. *Id.* (citing *United States v. Addison*, 498 F.2d 741, 744 (D.C. Cir. 1974)).

72. Note, *supra* note 64, at 779. See also *Reed v. State*, 283 Md. 374, 388, 391 A.2d 364, 371 (1978) ("Without the *Frye* test or something similar, the reliability of an experimental scientific technique is likely to become a central issue in each trial in which it is introduced, as long as there remains serious disagreement in the scientific community over its reliability.').

73. *People v. Kelly*, 17 Cal. 3d 24, 31, 549 P.2d 1240, 1244-45, 130 Cal. Rptr. 144, 148-49 (1976). The court stated that: "Individual judges whose particular conclusions may differ regarding the reliability of particular scientific evidence, may discover substantial agreement and consensus in the scientific community." *Id.* at 31, 549 P.2d at 1245, 130 Cal. Rptr. at 149. See also, *Reed*, 283 Md. at 387-88, 391 A.2d at 370-71 (pointing out that decisional inconsistency is avoided).

74. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 COLUM. L. REV. 1197, 1206 (1980) (citing Moenssens, *Polygraph Test Results Meet Standards for Admissibility as Evidence*, in LEGAL ADMISSIBILITY OF THE POLYGRAPH 14, 19 (N. Ansley ed. 1975) ("archaic"); Conrad, *Landmarks and Hallmarks in Scientific Evidence*, in SOURCEBOOK IN CRIMINALISTICS 37, 38 (C. Hormachea ed. 1974) ("antiquated on the day of its pronouncement").

75. *United States v. Williams*, 583 F.2d 1194, 1198 (2d Cir. 1978) ("In testing for admissibility of a particular type of scientific evidence, whatever the scientific 'voting' pattern may be, the courts cannot in any event surrender to scientists the responsibility for determining the reliability of that evidence.').

76. See Giannelli, *supra* note 74, at 1223. See also *Williams*, 583 F.2d at 1198 (noting that "[d]ifficulty in applying the 'Frye test' has led a number of courts to its implicit modification").

77. See Giannelli, *supra* note 74, at 1205, 1210-11. See also Note, *supra* note 64, at 780.

"general acceptance" of experts must be drawn.⁷⁸

However, the most compelling argument against *Frye* is that it requires the exclusion of valuable scientific evidence until such time as it attains widespread acceptance.⁷⁹ This delay between development in the laboratory and introduction to the courtroom is viewed by some as a frustration of the search for truth and justice.⁸⁰ These criticisms have led some jurisdictions to abandon the *Frye* test in favor of more liberalized standards of admissibility which focus on the weight of the evidence rather than its reputation in the scientific community.⁸¹

B. *The Federal Rules Test*

The principal alternative to the *Frye* test is the relevancy standard contained within the Federal Rules of Evidence.⁸² Under the Federal Rules test, novel scientific evidence is treated in the same manner as other evidence. The fact that the evidence is derived from an innovative technique is not necessarily a bar to admissibility.⁸³ Under the relevancy approach, the validity of novel scientific evidence is ana-

78. See Gianelli, *supra* note 74, at 1208-10. One author stated:

"Deciding what is the proper field to which a novel test belongs is in itself a chore. Most novel tests represent new approaches to the solution of old problems by a process which is unknown, or belongs to a different field. Because of this, the person developing a novel test frequently finds himself on the fringes of his scientific discipline, and perhaps overlapping into other disciplines."

Moenssens, *supra* note 74, at 17.

79. See Gianelli, *supra* note 74, at 1223-24; Imwinkelried, *supra* note 63, at 265. "During the 1970's, *Frye* proved to be a formidable barrier to the introduction of prosecution scientific evidence. . . . Defense counsel invoked *Frye* so successfully that the commentators almost unanimously deplored the fact that *Frye* banned many promising forensic techniques from the courtroom." Imwinkelried, *supra* note 63, at 263.

80. *Id.* at 265 & n.39 (citing *United States v. Sample*, 378 F. Supp. 44, 53 (E.D. Pa. 1974) (refusing to apply *Frye* test in probation revocation case)).

81. See Gianelli, *supra* note 74, at 1228-31 (current acceptance of the *Frye* test).

82. MCCORMICK ON EVIDENCE §§ 202, 203 (2d ed. 1972). See also 3 J. WEINSTEIN & M. BERGER, WEINSTEIN'S EVIDENCE § 702[03] (1980) (advocating a balancing approach weighing probative value of novel scientific evidence against other factors such as the necessity of the evidence and the possibility of utilizing limiting instructions).

83. Rule 401 defines relevant evidence as "evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence." FED. R. EVID. 401.

Under Rule 402, "all relevant evidence is admissible, except as otherwise provided by the Constitution of the United States, by Act of Congress, by these rules, or by other rules prescribed by the Supreme Court pursuant to statutory authority. Evidence which is not relevant is not admissible." FED. R. EVID. 402.

lyzed in terms of its probative value.⁸⁴ Expert testimony regarding novel scientific evidence is generally admissible if it is helpful to the trier of fact and probative of a material issue.⁸⁵ However, this evidence will be excluded if the probative value of the evidence "is substantially outweighed by the danger of unfair prejudice."⁸⁶

1. Probative Value

The threshold of admissibility under the Federal Rules test is a demonstration that the proffered evidence has some degree of probative value. In order to be probative, evidence must be relevant.⁸⁷ Relevance, in turn, necessarily depends upon reliability.⁸⁸ Because most judges are unable to evaluate the reliability of a scientific technique based on either prior experience or logical inference, the court is usually forced to rely on the opinions of scientific experts.⁸⁹

While general acceptance of the technique by experts in the relevant field (the *Frye* standard) would fulfill the requirement of reliability and, hence, probative value, no such "general acceptance" is required under the Federal Rules.⁹⁰ In fact, the opinion of one qualified expert may be enough to establish probative value under the Federal Rules test.⁹¹ Thus, in comparison to *Frye*, the Federal Rules provide a more lenient standard, favoring the admissibility of evidence.⁹²

2. Dangers of Unfair Prejudice

While a particular piece of evidence may be probative, it is not necessarily admissible. The Federal Rules grant the court discretion to exclude evidence upon finding that the danger of admitting the evidence substantially outweighs its probative value.⁹³ The principal

84. Giannelli, *supra* note 74, at 1235.

85. See FED. R. EVID. 702 (testimony by experts).

86. See FED. R. EVID. 403 (exclusion of relevant evidence on grounds of prejudice).

87. FED. R. EVID. 401. See also Giannelli, *supra* note 74, at 1247 n.379. ("Under the relevancy approach, the validity of a novel technique is analyzed in terms of its probative value. If a technique is not valid or reliable, results derived from that technique are not considered probative.")

88. See *United States v. Ridling*, 350 F. Supp. 90, 94-95 (E.D. Mich. 1972) ("acceptance of the basic theory is part of the process of making the evidence relevant"); *State v. Williams*, 388 A.2d 500 (Me. 1978) ("voiceprint" analysis held sufficiently reliable to be relevant).

89. Giannelli, *supra* note 74, at 1235-36.

90. See also Strong, *Questions Affecting the Admissibility of Scientific Evidence*, 1970 U. ILL. L.F. 1, 22. ("in the case of scientific evidence the court will generally be forced to accept the probative value of the evidence as what a qualified expert testifies it to be") (emphasis in original).

91. Giannelli, *supra* note 74, at 1236.

92. See Comment, *supra* note 7, at 935-38.

93. FED. R. EVID. 403. The rule states that: "Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prej-

danger associated with the introduction of novel scientific evidence is its tendency to mislead the jury. In spite of this latitude, courts tend to apply the test liberally and admit most evidence.⁹⁴

IV. APPLICATION OF THE LEGAL STANDARDS TO DNA PROFILING

A. *Admissibility of DNA Profiling Under the Frye Test*

In assessing the admissibility of DNA profiling under the *Frye* standard, uncertainties abound. Uncertainties, not only as to the end result, but also as to the standard itself. Indeed, where a court ends up is largely determined by its choice of a starting point.⁹⁵ The first step which a court must take in applying the *Frye* test to DNA evidence is to determine the relevant field in which DNA profiling belongs.⁹⁶

Like many other scientific techniques, DNA profiling is not easily compartmentalized within the exclusive domain of a single profession or scientific field.⁹⁷ The areas of molecular biology, genetics, population genetics, chemistry, biology, and biochemistry have been suggested as suitable choices for DNA profiling.⁹⁸ While these categories seem appropriate at first glance, there are problems associated with each of them.

By selecting fields such as biology and chemistry, the judiciary would be drawing an arena which is too broad, encompassing a majority of scientists who have little or no practical experience with DNA profiling techniques. If this were in fact the relevant field, DNA profiling would not be able to garner the general acceptance necessary under *Frye* because the majority of these scientists have no connection with DNA testing.

However, narrowing the field to those scientists who perform DNA testing is likewise an untenable position. Such a category is still too

udice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence." *Id.*

94. Comment, *supra* note 7, at 935-36. See also *United States v. Baller*, 519 F.2d 463, 466 (4th Cir. 1975) ("it is better to admit relevant scientific evidence in the same manner as other expert testimony and allow its weight to be attacked by cross-examination and refutation"), *cert. denied*, 423 U.S. 1019 (1975).

95. See *United States v. Williams*, 583 F.2d 1194, 1198 (2d Cir. 1978) (finding that "[s]election of the 'relevant scientific community,' appears to influence the result"), *cert. denied*, 439 U.S. 1117 (1979).

96. Thompson & Ford, *supra* note 29, at 55-56.

97. See *supra* note 78 and accompanying text.

98. See *People v. Wesley*, 140 Misc. 2d 306, 332, 533 N.Y.S.2d 643, 659 (Albany County Ct. 1988).

broad, for it primarily embraces molecular biologists and geneticists who have employed the technique only in the research laboratory, a setting fundamentally unlike a forensics crime lab where accurate results are crucial. Indeed, scientific researchers are exceedingly tolerant of error, secure in the knowledge that unanticipated results will be verified through a highly repetitive research process.⁹⁹ Moreover, most scientific research will, in all likelihood, be duplicated by other researchers working independently on the same project.¹⁰⁰ Thus, any error in theory or technique utilized by the researcher will usually be brought to light.

Forensic laboratories, by contrast, lack such safeguards. Errors in DNA testing could quite easily go undetected if the results are not diametrically opposed to the prosecutor's theory. The suspects to whom other evidence points the finger of guilt, and thus the individuals most in need of accurate testing results, would therefore be at great risk of injustice.¹⁰¹

Therefore, due to the medical researcher's high threshold for error, perhaps their general acceptance also should not be the standard by which to gauge the admissibility of DNA analysis in criminal cases. It has been suggested that a better choice for the "relevant field" would be scientists who are experienced in making critical decisions based on the results of a single DNA test: medical diagnosticians, for example.¹⁰²

However, problems exist with this selection as well. While scientists involved in medical diagnosis may be experienced in DNA typing, their experience consists exclusively of performing DNA analysis on clean, fresh genetic samples.¹⁰³ Unfortunately, the samples presented to crime labs are usually less pristine. In fact, contaminated specimens are the rule rather than the exception in the crime lab.¹⁰⁴ For example, DNA samples derived from crime scenes may be subject to bacterial contamination,¹⁰⁵ physiological alteration,¹⁰⁶

99. Thompson & Ford, *supra* note 29, at 56.

100. *Id.*

101. *Id.* at 57.

102. *Id.* at 56-57.

103. *Id.* at 56. See also *id.* at 66-67 (examining reliability of DNA typing on contaminated samples).

104. *Id.* at 56. In discussing his experience with DNA samples in both research and forensic laboratories, one scientist explained that, in a research laboratory, sterility of the sample is a paramount concern. Accordingly, if a sample accidentally falls on the floor, it typically is not used. However, "in forensics, all of the samples have been on the floor, so you don't really know what you've got." Cooke, *Standards Sought for DNA Testing*, NEWSDAY, June 15, 1989, at 27.

105. Bacterial contamination can cause erroneous hybridization of the DNA molecule, resulting in the appearance of false and misleading bands on the x-ray which, if gone undetected, could result in "false positive" findings. See Comment, *supra* note 7, at 921.

106. The chemicals contained in many detergents have been shown to produce

and degradation due to time lapse or exposure to the elements.¹⁰⁷

Thus, DNA profiling is destined to fail the *Frye* standard unless the relevant field is narrowed further and defined as those forensic scientists acquainted with the analysis of DNA samples for forensic uses. Since forensic DNA analysis is a recent scientific development, the number of such experts is, as would be expected, quite limited. In fact, apart from a sparse grouping of scientists within subdivisions of environmental biology, physical anthropology, and evolutionary biology, the only scientists with relevant experience in testing "dirty" samples are those employed by the commercial laboratories which market their techniques to law enforcement agencies nationwide.¹⁰⁸ Therein lies a further problem.

The *Frye* standard necessarily contemplated that the experts whose acceptance is determinative of admissibility would be impartial.¹⁰⁹ However, most cases involving DNA evidence to date have suffered a distinct lack of impartial expert witnesses.¹¹⁰ In fact, defense attorneys have lost several battles against the admissibility of DNA largely because of their inability to locate expert witnesses other than those associated with the commercial laboratories. Faced with favorable testimony from the prosecution's witnesses and with no witnesses testifying for the defense at all, there is a danger that

aberrations in DNA, causing inaccurate test results. DNA samples utilized for forensic purposes are especially prone to contamination from detergents because such samples are frequently culled from clothing or carpets which have been previously cleaned with detergents. Thompson & Ford, *supra* note 29, at 66.

107. *Id.* at 65-66. While DNA has been extracted from a 2400 year old Egyptian mummy, see Paabo, *Molecular Cloning of Ancient Egyptian Mummy DNA*, 314 NATURE 644 (1985), in reality, such DNA samples are too degraded to be useful in DNA profiling. Thompson & Ford, *supra* note 29, at 66 n.93.

108. Thompson & Ford, *supra* note 29, at 56. Experts familiar with contaminated genetic specimens are scattered throughout various academic disciplines. However, their shared experience constitutes the only common denominator among them. *Id.* at 56 n.65.

109. General acceptance is not achieved by the expert opinion of one individual, especially if that expert is not impartial. See, e.g., *People v. Tobey*, 401 Mich. 141, 146, 257 N.W.2d 537, 539 (1977) (admission of voiceprint evidence held reversible error since expert witnesses were not "disinterested and impartial"). *But cf.* *United States v. Wright*, 17 C.M.A. 183, 37 C.M.R. 447 (1967) (testimony of the developer of voiceprint technology stating in essence that the method was virtually infallible was admitted by the court).

110. For instance, Dr. Michael Baird, manager of forensic testing for the Lifecodes Corporation and Dr. Alec Jeffreys, developer of the technique used by Cellmark, have been called upon extensively to testify for the prosecution in several *Frye* hearings. Baird's testimony was a cornerstone of the prosecution's case in *People v. Castro*, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (N.Y. Sup. Ct. 1989). See also *infra* notes 181-85 and accompanying text.

some courts may mistakenly conclude that the "general acceptance" standard of *Frye* has been met on this basis alone.¹¹¹

Granted, prosecutors have also called upon the testimony of biologists and geneticists unassociated with commercial laboratories. However, because these scientists are unfamiliar with the testing of contaminated DNA specimens, they do not constitute members of the "relevant field" and their general acceptance is irrelevant under *Frye*. Thus, at this stage, the only relevant testimony comes from biased experts who "naturally paint a rosy picture of the test and its accuracy."¹¹²

Unless this "bias factor" is treated by the judiciary as merely an issue of weight rather than admissibility, the number of qualified experts within the relevant field will be severely limited. This being the case, the widespread consensus of experts envisioned by *Frye* will become illusory, replaced by the opinions of a few unbiased experts, assuming any can be found.¹¹³

At present, there is no suitable relevant field from which to garner general acceptance. Given this gaping hole in the case for admitting DNA evidence, the judiciary should hesitate before admitting DNA evidence under *Frye*.

Should a court be successful in delineating a relevant field suitable for application of the *Frye* test, the next step would be to evaluate whether the scientists working in that field have generally accepted DNA profiling analysis as reliable.¹¹⁴ Before this can be accomplished, however, the court must decide another threshold question: namely, what must be accepted.¹¹⁵

There is an ongoing debate as to whether the *Frye* standard mandates a finding of general acceptance of the scientific technique, the theory underlying the technique, or both.¹¹⁶ The D.C. Circuit Court of Appeals has interpreted *Frye* as requiring acceptance of the theory.¹¹⁷ Other courts, however, refer exclusively to acceptance of the

111. See *infra* notes 167-238 and accompanying text for a discussion of appellate court decisions to date.

112. See Burk, *supra* note 2, at 468. Currently, the corporations marketing DNA profiling are earning \$40 million per year. Unger, *Court Challenge Casts Pall over DNA Testing Industry*, NEWSDAY, July 30, 1989 (Business), at 47.

113. Giannelli, *supra* note 74, at 1209-10.

114. *Id.* at 1210-11.

115. *Id.* at 1211.

116. *Id.*

117. *United States v. Addison*, 498 F.2d 741 (D.C. Cir. 1974). The court stated: "The *Frye* standard . . . requires that the [theory] from which the deduction is made be sufficiently established to have gained general acceptance in the particular field in which it belongs." *Id.* at 743 (brackets in original) (quoting *Frye v. United States*, 293 F. 1013, 1014 (1923)). See also *United States v. Alexander*, 526 F.2d 161, 163 n.3 (8th Cir. 1975) (requiring "general acceptance in the relevant scientific community of the theory underlying such technique").

technique.¹¹⁸

By focusing on one aspect to the exclusion of the other, courts are able to manipulate the *Frye* standard to fit their desired conclusion. The reliability of the theory behind DNA analysis is not disputed. DNA analysis has proven itself reliable in the realm of genetic research.¹¹⁹ By defining the *Frye* standard as requiring general acceptance of only the theory underlying DNA profiling, the courts are able to ignore the shortcomings of the various techniques when applied to contaminated samples in a forensic lab. The *Castro*¹²⁰ court broke ground by recognizing the need to ensure the reliability of both the theory and the technique.¹²¹ To do otherwise would emasculate the *Frye* standard, stripping it of the ability to screen out reliable theories that fall apart under realistic testing conditions.

Finally, having decided what must be accepted and by whom, the court must then endeavor to assess whether DNA profiling evidence has, in fact, achieved general acceptance in the relevant field.¹²² While it seems evident that both the theory and the techniques employed in DNA profiling must be examined, the present commercialized nature of DNA testing makes it difficult, if not impossible, to evaluate the techniques employed to derive a criminal identification.

Both Lifecodes and Cellmark, as business entities competing for shares in an extremely lucrative field, keep their laboratory techniques confidential in order to safeguard their respective trade secrets.¹²³ By asserting their proprietary rights, the commercial laboratories are able to shield their techniques from the scientific community at large.¹²⁴ In fact, in some of the DNA *Frye* hearings to date, the only scientists who have reviewed the testing procedures used by the commercial laboratories were hand-picked by the laboratories themselves. Furthermore, defense attorneys have been systematically denied access to the laboratory notes and other internal documentation concerning the procedures employed.¹²⁵

118. Giannelli, *supra* note 74, at 1211-12 (citing *People v. Law*, 40 Cal. App. 3d 69, 84, 114 Cal. Rptr. 708, 718 (1974); *United States v. Stifel*, 433 F.2d 431, 438 (6th Cir. 1970), *cert. denied*, 401 U.S. 994 (1971); *Reed v. State*, 283 Md. 374, 385, 391 A.2d 365, 370 (1978)).

119. See Kelly, *supra* note 15, at 110.

120. *People v. Castro*, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (N.Y. Sup. Ct. 1989).

121. For a general discussion of the *Castro* opinion, see *infra* notes 223-38 and accompanying text.

122. Giannelli, *supra* note 74, at 1215.

123. Thompson & Ford, *supra* note 29, at 59.

124. *Id.* at 59-60.

125. See Cooper, *DNA Case Is First Before a State High Court*, 11 NAT'L L.J., July

Because of their self-imposed vow of silence, the commercial laboratories have placed themselves in a contradictory situation. The laboratories send their experts to *Frye* hearings to attest to their technique's general acceptance among the scientific community. At the same time, however, the laboratories assert their right to confidentiality, and thus shield themselves from the critical eye of scientists unassociated with the corporations.¹²⁶

This "two-faced" approach to admissibility may pose less of a problem in the future due to the recent emergence of studies conducted by independent researchers with the consent of the commercial laboratories.¹²⁷ However, until such time as these independent studies become widespread, the commercial laboratories' assertion of proprietary rights will adversely impact the likelihood that DNA profiling has been generally accepted. Currently, general scientific acceptance cannot occur given the atmosphere of secrecy which shrouds DNA profiling technology from public view.

B. Admissibility of DNA Profiling under the Federal Rules

Although the Federal Rules test does not require general acceptance of the evidence, and therefore constitutes a more liberal standard of admissibility than the *Frye* test, DNA profiling fails to meet this basic standard of admissibility as well. When closely examined, the probative value of DNA profiling evidence is substantially outweighed by the danger of unfair prejudice which may result from its admissibility.

1. Probative Value

Under the Federal Rules test, probative value is necessarily a function of reliability.¹²⁸ Thus, while the Federal Rules test abandons the general acceptance standard of *Frye*, the court must still inquire as to the reliability of the novel scientific technique. The primary authority on the reliability of scientific evidence under the Federal Rules test is *United States v. Williams*.¹²⁹ In deciding whether to admit voiceprint technology into evidence, the court focused on five indicia of reliability: (1) the potential for error associated with the new tech-

3, 1989, at 14, col. 3 (discussing *Spencer v. Commonwealth*, 238 Va. 563, 385 S.E.2d 850 (1989), in which trial court denied defense attorney access to information regarding Lifecodes' technique). For a general discussion of the *Spencer* opinion, see *infra* notes 187-98 and accompanying text.

126. Thompson & Ford, *supra* note 29, at 60.

127. One such study conducted by the California Association of Crime Lab Directors questioned the reliability of the Cellmark technique. Daily J., Feb. 28, 1990, at 1, col. 4. The study concluded that Cellmark declared erroneous matches in 2% of the blind samples. *Id.*

128. See *supra* notes 87-88 and accompanying text.

129. 583 F.2d 1194 (2d Cir. 1978).

nology; (2) the presence and observation of testing standards; (3) the degree of care in which the test has been performed and the test's susceptibility to abuse; (4) whether the technique bears an analogous relationship to other scientific techniques which have been deemed admissible; and (5) the existence of "fail-safe" characteristics.¹³⁰ If the *Williams* definition of reliability is valid, DNA profiling fails the Federal Rules test for admissibility. Accordingly, each of these factors will be addressed.

To begin with, the rate of error associated with DNA profiling has not been determined; however, given two factors, it is presumably quite high. First, DNA prints are often "ambiguous or difficult to interpret."¹³¹ Although DNA prints are often likened to the computer barcodes utilized by supermarkets, the comparison is strained. In reality, the bars on DNA prints are much less well-defined than product codes, and "look a lot more like fuzzy caterpillars."¹³² Moreover, two DNA profiles from the same person may look slightly different from each other. Likewise, two DNA profiles from separate individuals may look surprisingly similar.¹³³

Thus, the profiling expert is placed in a difficult position. In setting the threshold for declaring a match, he must allow himself sufficiently wide "latitude of acceptance" in order to compensate for minor variations between prints of the same person, while at the same time guard against the danger of mistakenly declaring a match.¹³⁴ At present, there are no uniform guidelines regarding matching standards.¹³⁵ Therefore, the fate of criminal suspects may hinge on the subjective interpretation of a single lab technician.¹³⁶

The other factor which indicates that DNA profiling is subject to a high rate of error is its reliance on statistical predictors. Scientists must rely on statistical probabilities in declaring matches because DNA tests compare only small segments of DNA.¹³⁷ It is crucial to bear in mind that no person's DNA is unique at any particular loca-

130. *Id.* at 1198-99.

131. Thompson & Ford, *supra* note 29, at 80.

132. See Sherman, *DNA Tests Unravel?*, 12 NAT'L L.J., Dec. 18, 1989, at 1, 24, col. 4.

133. Thompson & Ford, *supra* note 29, at 87-88. Minor variations in DNA prints are commonly referred to as "slop." *Id.* at 87.

134. *Id.* at 87-88.

135. *Id.* at 88; Sherman, *supra* note 132, at 24, col. 4 ("Different labs use different matching rules And there is no scientific consensus yet on what is appropriate.").

136. Thompson & Ford, *supra* note 29, at 88; Sherman, *supra* note 132, at 24, col. 4.

137. Sherman, *supra* note 132, at 25, col. 2.

tion.¹³⁸ Only the pattern of DNA in its entirety is unique.¹³⁹ DNA researchers "agree that it is possible that there could be two or more people with the same few lines of the same length in the same places."¹⁴⁰ Thus, the reliability of DNA profiling depends on the researcher's ability to examine multiple segments and accurately calculate the probability that a match at any given locus is a random product of chance.¹⁴¹ Currently, there are no uniform standards for determining the likelihood of a coincidental match.¹⁴² A greater concern, however, centers around the sufficiency of population data bases, in terms of both size and racial diversity.

In order to achieve an accurate distribution of alleles representative of the population at large, the data base must be composed of a sizable, freely-mixing community.¹⁴³ Studies based on small homogeneous populations will produce misleading results that do not necessarily hold true for the overall population.¹⁴⁴ Presently, however, there is no consensus among scientists as to the minimum size data bank necessary to ensure reliable results.¹⁴⁵ Surprisingly, one set of statistics which has been repeatedly cited in support of DNA profiling reliability was derived from a study of only twenty people.¹⁴⁶ Although studies done by Lifecodes have drawn upon a much larger data base, critics still voice doubts as to the sufficiency of the sample population.¹⁴⁷

Similar concerns arise in relation to the racial and ethnic compositions of the data bases used by the commercial laboratories. Recognizing that each racial group will contain more of certain alleles than the overall population, the commercial laboratories divide the data base populations by race.¹⁴⁸ Nonetheless, critics claim that this safeguard is inadequate by itself because it operates under the mistaken assumption that ethnic and racial groups mate purely at random within the confines of their racial or ethnic classification.¹⁴⁹ The system thus fails to account for subpopulations within each group which

138. Note, *supra* note 17, at 488.

139. *Id.*

140. Sherman, *supra* note 132, at 25, cols. 2-3 (stressing that researchers are currently unsure as to how often various band patterns occur within a certain population).

141. Note, *supra* note 17, at 488.

142. *Id.*

143. *Id.* at 489.

144. *Id.*

145. *Id.*

146. Burk, *supra* note 2, at 465-66. This study is often cited for the proposition that the chance of a coincidental match between two individuals is one in thirty billion.

147. *Id.* at 466. Lifecodes has published two studies which were based on populations of seven hundred and nine hundred people each. Note, *DNA Typing: A Rush to Judgment*, 24 GA. L. REV. 669, 678 n.44 (1990).

148. Note, *supra* note 17, at 489.

149. *Id.* at 489-90.

tend to be heavily inbred, thus possessing more alleles in common than the population at large.¹⁵⁰

With regard to the second *Williams* factor, the DNA profiling industry is sorely lacking in the area of standardization and regulation. Beyond the deficiencies in matching standards, there are no uniform regulations to govern the procedures employed by the commercial laboratories.¹⁵¹ While the commercial laboratories have established procedural standards of their own, these self-imposed standards do little to ensure the reliability of the industry as a whole.

The third factor proposed by the *Williams* court entails an evaluation of the care with which the procedure is performed, and its potential for abuse. Of course, the inquiry into the carefulness of the technicians will have to be undertaken on a individualized basis. However, such inquiries may be meaningless without standardized procedures against which a particular laboratory's performance can be compared. Moreover, the potential for abuse of DNA profiling is great. For example, psychological researchers have shown that, in the matching stage, the crucial decision as to the degree of similarity necessary for a "match" may be affected by the priorities of the laboratory scientist.¹⁵² In other words, police criminologists, whose goal is to assist the state in prosecution, may select a much lower matching threshold than would a commercial laboratory which, because of its commercial interest in stressing the uniqueness of the DNA pattern, may set an unusually high standard for matching.¹⁵³

The fourth *Williams* factor, whether there exists an analogous relationship to other routinely admitted scientific evidence, does little to establish DNA as a reliable scientific technique. In fact, it is very difficult to find a similar technique with which any analogy to DNA would be appropriate. Some analogies possibly could be drawn between DNA and gel electrophoresis.¹⁵⁴ However, such comparisons

150. Sherman, *supra* note 132, at 25, col. 3. For example, DNA probability calculations assume that "Mexican-American Hispanics are just as likely to have children with Cuban-American Hispanics as they are with each other and that Caucasian Catholics, Protestants, and Jews mate randomly." *Id.*

151. Dr. Eric Lander notes that DNA testing facilities are "virtually unregulated—with the paradoxical result that clinical laboratories must meet a higher standard to be allowed to diagnose strep throat than forensic labs must meet to put a defendant on death row." Sherman, *supra* note 132, at 24, col. 3 (citations omitted).

152. Thompson & Ford, *supra* note 29, at 88 (citing Bruner, *On Perceptual Readiness*, 64 PSYCH. REV. 123 (1957)).

153. Thompson & Ford, *supra* note 29, at 88-89.

154. For a general discussion of this gel electrophoresis, see Jonakait, *supra* note 68, at 833.

would not necessarily aid in the admissibility of DNA profiling technology because gel electrophoresis has a tortured history of its own, having been declared inadmissible in both California¹⁵⁵ and Michigan.¹⁵⁶

The final *Williams* factor, whether “fail-safe” characteristics exist, is likewise unfulfilled by current DNA profiling techniques. While the genetic profiles of the parents serve as an inherent control mechanism in paternity testing, no such built-in safety net exists in the arena of forensic DNA testing.¹⁵⁷ “Forensic samples are of unknown origin and thus have countless numbers of possible alleles. Therefore, all of the controls for the forensic test must be imposed from the outside.”¹⁵⁸

2. Danger of Unfair Prejudice

If, after considering the reliability factors proposed by *Williams*, a court finds DNA profiling to be probative, it would then have to consider the dangers that would accompany the admission of DNA profiling in a jury trial.

As with any other novel scientific evidence, the greatest danger associated with DNA profiling evidence is its potential to mislead the jury.¹⁵⁹ The possibility that the jury will be dazzled by the scientific glitter of DNA profiling technology is certainly great. As one appellate court noted, the scientific evidence which accompanies DNA, “unlike that presented with fingerprint, footprint or bite mark evidence, is highly technical, incapable of observation, and requires the jury to either accept or reject the scientist’s conclusion that it can be done.”¹⁶⁰ Thus, a jury faced with DNA’s highly technical process and accompanying statistical interpretations will likely accept the testimony of the expert witnesses without question.¹⁶¹ Critics caution that DNA casts a looming shadow over other more traditional methods of proof such as alibis and eyewitness testimony when presented to a jury of laypersons.¹⁶²

Moreover, the necessity of presenting statistical evidence to the

155. *People v. Brown*, 40 Cal. 3d 512, 709 P.2d 440, 220 Cal. Rptr. 637 (1985).

156. *People v. Young*, 425 Mich. 470, 391 N.W.2d 270 (1986).

157. Note, *supra* note 17, at 511.

158. *Id.*

159. See *United States v. Addison*, 498 F.2d 741, 744 (D.C. Cir. 1974) (novel evidence may “assume a posture of mystic infallibility in the eyes of a jury of laymen”).

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

161. This appears to be the case already, as indicated by glowing magazine and newspaper reports which praise DNA as a catalyst of quick jury verdicts: “It took the jury twelve minutes to find Jones guilty.” *Williams, supra* note 4, at 26.

162. Gest, *Convicted By Their Own Genes*, 105 U.S. NEWS AND WORLD REP., Oct. 31, 1988, at 70 (stating that juries are unable to treat DNA profiles as “just one piece of evidence to be considered”).

jury along with DNA evidence also raises the danger of unfair prejudice. Studies have shown that jurors often misinterpret statistical information.¹⁶³ Recognizing this problem, many courts have excluded statistical evidence as more prejudicial than probative.¹⁶⁴ Banning statistical evidence in the case of DNA, however, would pose a far greater danger. Jurors might then assume that a DNA match conclusively links the defendant to the evidence. Therefore, until DNA testing advances to a higher degree of precision, its utility as an evidentiary tool in jury trials is questionable.

Finally, "an exaggerated popular opinion of the accuracy of a particular technique [could make] its use prejudicial or likely to mislead the jury."¹⁶⁵ Once again, DNA falls easily into this trap, as media reports unabashedly proclaim that "DNA can rule out everyone else in the world as a possible perpetrator of a crime."¹⁶⁶

In applying the Federal Rules balancing test, DNA has little probative value due to its unproven reliability. Furthermore, given the complexity of the technique and its tendency to mislead the jury, the probative value of DNA evidence is substantially outweighed by the dangers of unfair prejudice.

Thus, when examined closely, DNA profiling evidence fails to meet the admissibility standards under either *Frye* or the Federal Rules test. However, in struggling with this admissibility puzzle, the courts have employed innovative interpretations of both standards, often resulting in the admissibility of DNA profiling evidence.

V. JUDICIAL ACCEPTANCE OF DNA PROFILING EVIDENCE

To date, only four criminal cases involving the admissibility of

163. For example, one study indicated that jurors mistakenly reasoned that if a defendant's blood type is found in only ten percent of the population, there is a ninety percent chance that he is guilty. Thompson & Schumann, *Interpretation of Statistical Evidence in Criminal Trials*, 11 HUMAN BEHAV. 167, 170 (1987).

164. See *State v. Carlson*, 267 N.W.2d 170 (Minn. 1978) (statistical probability evidence improperly received, but not prejudicial); *People v. Macedonio*, 42 N.Y.2d 944, 366 N.E.2d 1355, 397 N.Y.S.2d 1002 (1977) (admission of blood-type evidence held reversible error); see also *People v. McMillen*, 126 Mich. App. 211, 336 N.W.2d 895 (1983) (admission of blood-type evidence held harmless error); *People v. Robinson*, 27 N.Y.2d 864, 265 N.E.2d 543, 317 N.Y.S.2d 19 (1970) (admission of blood-type evidence held harmless error).

165. *United States v. Baller*, 519 F.2d 463, 466 (4th Cir.), cert. denied, 423 U.S. 1019 (1975).

166. Marx, *DNA Fingerprinting Takes the Witness Stand*, 240 SCIENCE 1616 (1988). See also Moss, *supra* note 3, at 69-70 ("disputing the technology is like disputing the law of gravity").

DNA profiling evidence have climbed to the state appellate level.¹⁶⁷ Of these four, two were decided in *Frye* jurisdictions. The other two, decided in Florida and Virginia, rested on the more liberal foundation of the Federal Rules test.

A. *Admissibility of DNA Profiling Evidence under the Federal Rules Test*

1. *Andrews v. State*

Reaching the appellate level in 1988, the *Andrews*¹⁶⁸ case was one of the first criminal cases to utilize the controversial DNA evidence. Tommie Lee Andrews was charged with aggravated battery, burglary, and sexual battery.¹⁶⁹ The victim never saw her assailant, who "jumped on top of her, and covered her face with a sleeping bag."¹⁷⁰ Police arrested Andrews, who was subsequently convicted by a trial court which, over protests by the defense, admitted into evidence findings of a DNA profile that linked Andrews to the rape.¹⁷¹

The defendant appealed the trial court decision. However, the defense did not mount a serious attack on the admissibility of DNA, choosing instead to focus its challenge on the methods used by the commercial laboratory that conducted the test.¹⁷² The court of appeals, however, deemed a review of both questions necessary. Therefore, the court examined the admissibility of DNA evidence,¹⁷³ although it received little assistance from defense counsel who failed to call a single expert witness.¹⁷⁴

Following a lengthy discussion of the two standards of admissibility for scientific evidence, the court decided to employ the Federal Rules test.¹⁷⁵ After pronouncing DNA evidence "helpful to the jury,"¹⁷⁶ the court commenced its inquiry into the probative value of the DNA profiling evidence. Here, the court utilized the indicia of reliability set forth in a federal third circuit opinion, *United States v. Down-*

167. *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988); *Spencer v. Commonwealth*, 238 Va. 563, 385 S.E.2d 850 (1989); *Cobey v. Maryland*, 80 Md. App. 31, 559 A.2d 391 (1989); *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989).

168. 533 So. 2d 841 (Fla. Dist. Ct. App. 1988).

169. *Id.* at 842.

170. Moss, *supra* note 3, at 66. The fact that the victim was prevented from seeing her attacker's face made the admissibility of DNA evidence a crucial aspect of the state's case. *Id.*

171. 533 So. 2d at 843.

172. *Id.*

173. *Id.*

174. Sherman, *supra* note 132, at 24.

175. *Andrews*, 533 So. 2d at 843-47. However, in a brief footnote, the court asserted that DNA evidence would satisfy the requirement of the *Frye* test, were it to be employed. *Id.* at 847 n.6.

176. *Id.* at 849.

ing.¹⁷⁷ These factors, while not identical, are similar to those promulgated by *Williams*.¹⁷⁸

The court first addressed DNA's "relationship to more established modes of scientific analysis."¹⁷⁹ Noting DNA's solid reputation for reliability in terms of medical research, the court found that such nonjudicial use is a valid indicator of DNA reliability.¹⁸⁰ Nowhere in its evaluation of DNA's reliability, however, did the court attempt to delineate possible factors which might make a perfectly acceptable tool of medical research wholly inappropriate for use in the criminal courtroom.

Next, the court examined scientific literature pertaining to the reliability of DNA. Once again, though, the inquiry was less than thorough. The court relied exclusively on the testimony of a scientist employed by a commercial laboratory who stated that he "was unaware of any [publications] that argue against the test's reliability."¹⁸¹

Finally, the court heard testimony concerning the rate of error associated with DNA profiling techniques. The court adopted the view that "if there was something wrong with the process, it would ordinarily lead to no result being obtained rather than an erroneous result."¹⁸² Upon these findings, the court held that DNA testing is reliable, and therefore, probative.¹⁸³

The court then turned its attention briefly to the possible danger of unfair prejudice associated with the admission of DNA profiling evidence. While recognizing that DNA profiling involves highly techni-

177. 753 F.2d 1224 (3d Cir. 1985) (involving the admissibility of expert testimony as to the accuracy of an eyewitness account offered by the defendant). These factors include "the novelty of the new technique, i.e., its relationship to more established modes of scientific analysis, the existence of . . . specialized literature . . . expert witnesses, and . . . nonjudicial uses." *Id.* at 238-39 (citing J. WEINSTEIN & M. BERGER, WEINSTEIN'S EVIDENCE § 702[03]).

178. *United States v. Williams*, 583 F.2d at 1198-99 (2d Cir. 1978). See *supra* notes 129-30 and accompanying text.

179. *Andrews*, 533 So. 2d at 849.

180. *Id.* at 849-50.

181. *Id.* at 850.

182. *Id.* at 850-51. Had the defense called expert witnesses of its own, the court's conclusion might have been much different. For example, geneticist James Geyer claims that commercial laboratories are in error at least two percent of the time in paternity cases, which are much more conducive to DNA profiling than are criminal cases. According to Dr. Geyer, he has sent DNA samples to two different labs, only to have one lab declare that "the putative father was definitely—with astronomically high odds—the father," while the second lab maintained "that the father was definitely—again, with astronomically high odds—not the father." *Chicago Tribune*, Jan. 29, 1990, at 4, col. 7.

183. *Andrews*, 533 So. 2d at 849-50.

cal concepts which could overwhelm a jury, the court asserted that this factor "requires courts to proceed with special caution, [but] it does not of itself render the evidence unreliable."¹⁸⁴ Furthermore, the court dismissed without debate the danger associated with allowing the testimony of potentially biased expert witnesses, adding that "neither *Frye* nor our evidence code require impartiality."¹⁸⁵

The court of appeals thus affirmed the decision of the trial court, holding DNA profiling evidence admissible in criminal proceedings.¹⁸⁶

2. *Spencer v. Commonwealth*

In a bifurcated jury trial held in October of 1989, the Virginia Supreme Court addressed the DNA admissibility question on appellate review.¹⁸⁷ Timothy Wilson Spencer had been convicted and sentenced to death in three separate trials stemming from the rapes and murders of three women.¹⁸⁸ Two of those convictions, "based on DNA fingerprinting and precious little other evidence,"¹⁸⁹ were the subject of earlier appeals.¹⁹⁰

Spencer challenged the admissibility of the DNA test results, claiming that the state had failed to establish the general acceptance and reliability of DNA profiling.¹⁹¹ In assessing the admissibility of the DNA evidence, the court declined to follow the *Frye* test,¹⁹² choosing instead to employ a relevance standard.¹⁹³ In this appeal, the court held the DNA evidence admissible, without analysis, relying on its prior admissibility holdings in *Spencer I* and *Spencer II*.¹⁹⁴

184. *Id.*

185. *Id.* at 849 n.9.

186. *Id.* at 850-51.

187. *Spencer v. Commonwealth*, 238 Va. 563, 385 S.E.2d 850 (1989), *cert. denied*, 110 S. Ct. 1171 (1990) [hereinafter *Spencer III*].

188. *Cooper*, *supra* note 125, at 14.

189. *Id.*

190. The Virginia Supreme Court issued three separate opinions: *Spencer v. Commonwealth*, 238 Va. 275, 384 S.E.2d 775 (1989), *cert. denied*, 110 S. Ct. 759 (1990) [hereinafter *Spencer I*]; *Spencer v. Commonwealth*, 238 Va. 295, 384 S.E.2d 785 (1989), *cert. denied*, 110 S. Ct. 1171 (1990) [hereinafter *Spencer II*]; *Spencer III*, *supra* note 187.

191. 238 Va. at 573, 385 S.E.2d at 855-56. Spencer unsuccessfully advanced this same argument in *Spencer I* and *Spencer II*. *Id.* at 573, 385 S.E.2d at 856.

192. Spencer urged the court to employ the *Frye* standard in reaching its verdict on the admissibility of DNA profiling evidence. *Id.* at 573 n.5, 385 S.E.2d at 856 n.5. The court rejected the adoption of the *Frye* test, relying on its holding in *Spencer I*. *Id.* (citing *Spencer I*, 238 Va. at 290 n.10, 384 S.E.2d at 783 n.10). The court noted, however, that DNA testing would pass the *Frye* test if it were applied. *Id.*

193. *Id.* at 573 n.5, 385 S.E.2d at 856 n.5. This relevancy standard, set forth in *O'Dell v. Commonwealth*, 234 Va. 690, 695-96, 364 S.E.2d 491, 504-05 (1988), bears only a slight resemblance to the Federal Rules test. However, it does necessitate a finding of reliability, and therefore, it is most appropriately dealt with in this section.

194. *Spencer*, 238 Va. at 573, 385 S.E.2d at 856 (citing *Spencer I*, 238 Va. at 290, 384 S.E.2d at 783; *Spencer II*, 238 Va. at 315, 384 S.E.2d at 797).

It is necessary, therefore, to review those decisions in order to ascertain the basis for the court's reliability finding.

In both *Spencer I* and *Spencer II*, the court's ultimate determination of the reliability of DNA profiling evidence was based almost exclusively on testimony of state witnesses. As in *Andrews*, the defense was unable to locate any expert witnesses of its own to contradict the state's claims of reliability.¹⁹⁵ Worse yet, the defense conceded that "DNA tests are accepted 'as reliable within the scientific community,'" and that "the trial court had little choice but to accept the DNA printing evidence."¹⁹⁶ While these concessions were obviously damaging to the defendant's position, they should not have foreclosed the admissibility question.

The *Spencer* court erroneously equated the lack of defense witnesses with reliability. Moreover, the court failed to consider factors of unfair prejudice, including the inherent bias of some of the state's witnesses¹⁹⁷ and the use of statistical evidence.¹⁹⁸ Thus, the court dispensed with the Federal Rules requirement of balancing probative value against unfair prejudice.

In sum, both the *Andrews* and *Spencer* courts misapplied the Federal Rules test in determining the admissibility of DNA profiling evidence. Unfortunately, the courts have not fared significantly better in their application of the *Frye* standard to the DNA controversy.

B. Admissibility of DNA Profiling Evidence Under *Frye*

1. *Cobey v. Maryland*

Following closely on the heels of *Andrews*, the Maryland Court of Special Appeals took up the issue of DNA admissibility in the case of *Cobey v. Maryland*.¹⁹⁹ The defendant, Kenneth S. Cobey, was

195. 238 Va. 275, 289, 384 S.E.2d 775, 782-83 (1989); 238 Va. 295, 314-15, 384 S.E. 2d 785, 796-97 (1989).

196. 238 Va. 275, 289-90, 384 S.E.2d 775, 782-83 (1989) (citations omitted). The defense did maintain, nonetheless, that the court "should hold off until another day any decision that DNA printing is acceptable evidence in the courts of Virginia." *Id.* at 290, 384 S.E.2d at 783.

197. Dr. Michael Baird who testified for the state in *Spencer I*, and Dr. McElfresh who testified for the state in *Spencer II* and *Spencer III*, were both employed by the commercial laboratory (Lifecodes) which performed the DNA testing. *Spencer I*, 238 Va. at 289, 384 S.E.2d at 782; *Spencer II*, 238 Va. at 313, 384 S.E.2d at 796-97; *Spencer III*, 238 Va. at 573-74, 384 S.E.2d at 856-57.

198. *Spencer I*, 238 Va. at 289, 384 S.E.2d at 782; *Spencer II*, 238 Va. at 314, 384 S.E.2d at 797.

199. 80 Md. App. 31, 559 A.2d 391 (1989).

charged with raping a young woman in September of 1985.²⁰⁰ Cobey was stopped by police while driving the victim's car from the scene. A subsequent investigation revealed facts which led to his arrest on charges stemming from the sexual assault.²⁰¹

Over Cobey's objection, the trial court admitted into evidence the results of a DNA test which declared a match between the defendant's blood sample and a semen stain on the victim's clothes.²⁰² As was the case in *Andrews*, defense attorneys challenged only the methodology utilized in the DNA test. However, the court declared that "the novelty of the question requires that we address both the frontal assault on Cellmark's methodology as well as the admission into evidence generally of DNA fingerprints."²⁰³

Under the guidance of *Frye*, the court proceeded to analyze the admissibility of DNA. The court reviewed the trial court testimony of five expert witnesses for the state who testified that DNA is generally accepted within the scientific community.²⁰⁴ However, the court failed to elaborate on any of this testimony, and focused instead on the lack of contradictory evidence.²⁰⁵ This left the impression that defense counsel's failure to locate expert witnesses of its own may have allowed the state to prevail by default.

In addition to the defendant's failure to present expert testimony, the court was influenced by the acceptance of DNA evidence in other jurisdictions.²⁰⁶ Unfortunately, this reliance on judicial precedent is a dubious basis by which to gauge general acceptance under the *Frye* test. In fact, "this use of prior judicial decisions undercuts the rationale supporting *Frye*—that those *most qualified* to judge the validity of a technique should have the determinative voice."²⁰⁷

The *Frye* test depends on general acceptance by the scientific community, not the judiciary. Moreover, by looking to *Andrews* for support, the court did not achieve even a second-hand finding of general acceptance, because the *Andrews* court applied the more liberal Federal Rules test, which obviates the need to prove general acceptance.

Adding further to the opinion's appearance of superficiality, the

200. *Id.* at 33, 559 A.2d at 391-92.

201. *Id.* at 34, 559 A.2d at 392. The defendant was tried twice on the sexual offenses and related charges. The first judgment was reversed and remanded for a new trial. *Id.* at 33 n.2, 559 A.2d at 391 n.2. See also *Cobey v. State*, 73 Md. App. 233, 533 A.2d 944 (1987). This appeal is the result of the second trial. *Id.*

202. 80 Md. App. at 34, 559 A.2d at 392.

203. *Id.*

204. *Id.*

205. *Id.* at 35, 559 A.2d at 392, 398.

206. *Cobey*, 80 Md. App. at 35, 559 A.2d at 392 (citing *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988); *People v. Wesley*, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (N.Y. Co. Ct. 1988)).

207. Giannelli, *supra* note 74, at 1218-19 (emphasis in original).

court neglected any mention of the proper field from which the trial court gleaned a finding of general acceptance. Nonetheless, after a general discussion of the DNA profiling procedure, the court ruled that the trial court did not err in admitting the DNA evidence.²⁰⁸

2. *State v. Schwartz*

On November 3, 1989, the Minnesota Supreme Court broke new legal ground by becoming the first state appellate court in the nation to exclude DNA profiling evidence in a criminal trial. The watershed case, *State v. Schwartz*,²⁰⁹ arose from the brutal stabbing of a young woman in May of 1988.²¹⁰ Armed with a valid search warrant, law enforcement officials retrieved a blood-stained pair of jeans from the defendant's home.²¹¹ A similarly soiled shirt, allegedly belonging to the defendant, was found near the crime scene.²¹² DNA profiling analysis was performed on these items, resulting in a match between the victim's blood and the blood-stained clothing.²¹³ These findings were introduced in the trial court on the state's motion, over the objection of defendant Schwartz. However, simultaneously with granting the state's motion to admit DNA evidence, the court certified three admissibility questions to the Minnesota Court of Appeals, which immediately certified these same questions to the Minnesota Supreme Court.²¹⁴

After determining that the admissibility issue would be governed by the *Frye* standard,²¹⁵ the supreme court turned to the question of general acceptance of DNA profiling. As a first step toward this goal, the court noted DNA's general acceptance among medical researchers.²¹⁶ While this information is noteworthy, it is of little use in assessing the admissibility of DNA unless medical research is the relevant field from which general acceptance is to be drawn. As this Comment has previously discussed,²¹⁷ such a choice would be unwise. Nowhere in its opinion, however, did the court reveal its selection of

208. *Cobey*, 80 Md. App. at 43, 559 A.2d at 398.

209. 447 N.W.2d 422 (Minn. 1989).

210. *Id.* at 423.

211. *Id.*

212. *Id.*

213. *Id.* at 423-24.

214. *Id.* at 424-25.

215. Although the court briefly entertained a discussion on the merits of the Federal Rules approach, it concluded that the *Frye* standard "facilitates more objective and uniform rulings." *Id.* at 424.

216. *Id.* at 425.

217. See *supra* notes 102-07 and accompanying text.

a relevant field for purposes of evaluating general acceptance under *Frye*.

Still searching for general acceptance, the court recited a string of decisions from other jurisdictions which have admitted DNA evidence.²¹⁸ However, unless the judiciary is the relevant field, this inquiry is a futile exercise as well. Nevertheless, on these bases, the court held that DNA profiling analysis is generally accepted.²¹⁹

Despite its finding of general acceptance, the Minnesota Supreme Court refused to admit the proffered DNA evidence.²²⁰ After reviewing the trial court testimony of twelve expert witnesses, the court determined that the commercial laboratory's methodology was unreliable, prone to false positives, and deficient in control procedures.²²¹ Thus, the court held that DNA test results are admissible only if derived in laboratories that comply with appropriate standards and controls, and whose testing data and results are available to defense counsel.²²²

3. *People v. Castro*

While the case of *People v. Castro*²²³ is not an appellate court decision, it nonetheless merits discussion since the *Castro* hearing has been referred to as "the most comprehensive and extensive legal examination of DNA forensic identification tests held to date in the United States."²²⁴ In fact, the *Frye* hearing in *Castro*, which concluded in August of 1989, constituted the first denial of admittance of DNA evidence by a trial court.

The defendant, Joseph Castro, was charged with the stabbing deaths of a young mother, seven months pregnant, and her two-year-old daughter.²²⁵ During the arrest, an observant police officer noticed a speck of blood on Castro's wristwatch.²²⁶ Although Castro claimed that the blood was his own, DNA profiling tests performed on the sample concluded that the blood in fact belonged to the adult

218. 447 N.W.2d at 425-26 (citing *Cobey v. State*, 80 Md. App. 31, 559 A.2d 391 (Md. Ct. Spec. 1989); *People v. Castro*, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (N.Y. Sup. Ct. 1989); *People v. Wesley*, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (N.Y. Co. Ct. 1988); *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988)).

219. 447 N.W.2d at 426.

220. *Id.* at 428. The court stated that: "While we agree with the trial court that forensic DNA typing has gained general acceptance in the scientific community, we hold that admissibility of specific test results in a particular case hinges on the laboratory's compliance with appropriate standards and controls, and the availability of their testing data and results." *Id.*

221. 447 N.W.2d at 426-28.

222. *Id.* at 428.

223. 144 Misc. 2d 956, 545 N.Y.S.2d 985 (N.Y. Sup. Ct. 1989).

224. *Id.* at 956-57, 545 N.Y.S.2d at 985.

225. *Id.* at 957, 545 N.Y.S.2d at 985.

226. *Id.*

victim.²²⁷ The admissibility of these test results was the subject of the pretrial hearing and the court's decision.

The *Castro* hearing, which lasted over three months and produced five thousand pages of recorded testimony,²²⁸ was the first proceeding in which the defense mounted a serious attack on the admissibility of DNA. In contrast to previous cases in which the testimony of the states' expert witnesses went unchallenged,²²⁹ the *Castro* defense called five expert witnesses of its own.²³⁰

In analyzing the admissibility of DNA, the court formulated its own interpretation of the *Frye* standard, breaking it down into two basic inquiries: 1) "Is there a theory, which is generally accepted in the scientific community, which supports the conclusion that DNA forensic testing can produce reliable results?" and, 2) "[A]re there techniques or experiments that currently exist that are capable of producing reliable results in DNA identification and which are generally accepted in the scientific community?"²³¹ Beyond the requirements of *Frye*, the court ruled that a pretrial hearing should be held in all cases involving DNA evidence to determine the answer to the following question: "Did the testing laboratory perform the accepted scientific techniques in analyzing the forensic samples in this particular case?"²³²

In evaluating the court's formulation of *Frye*, several deficiencies are immediately apparent. The court disregarded the need for general acceptance of the technique when put to forensic application.²³³

227. *Id.* at 957, 545 N.Y.S.2d at 985-86.

228. *Id.* at 957, 545 N.Y.S.2d at 986.

229. See, e.g., *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988); *Spencer v. Commonwealth*, 238 Va. 563, 385 S.E.2d 850 (1989); *Cobey v. Maryland*, 80 Md. App. 31, 559 A.2d 391 (1989). See also *supra* notes 174, 185, 195, 206 and accompanying text.

230. 144 Misc. 2d at 958, 545 N.Y.S.2d at 986. Testifying for the defense were: Dr. Conrad Gilliam, an expert in genetics and molecular genetics; Dr. Lorraine Flaherty, an expert in molecular genetics and quality control; Dr. Eric Lander, an expert in genetics and population genetics; Dr. Phillip Green, an expert in genetics and population genetics; and Dr. Howard Cooke, an expert on genetic probes. *Id.*

231. *Id.* at 959, 545 N.Y.S.2d at 987.

232. The court summarily dismissed the issue of the forensic reliability of DNA profiling. Quoting from a University of Virginia Law Review, the court stated that: "There is nothing controversial about the theory underlying DNA typing. Indeed, this theory is so well accepted that its accuracy is unlikely even to be raised as an issue in hearings on the admissibility of the new tests." *Id.* at 961, 545 N.Y.S.2d at 989 (quoting *Thompson & Ford*, *supra* note 29, at 60-61).

233. *Id.* at 959-60, 545 N.Y.S.2d at 987-88. The court noted that "[a] scientist may have no trouble accepting the general proposition that DNA typing can be done reliably, yet still have doubts about the reliability of the test being performed by a particular laboratory." *Id.* at 973, 545 N.Y.S.2d at 995 (quoting *Thompson & Ford*, *DNA*

Moreover, the court engaged in an act of legal wizardry when it found that the second prong of the *Frye* inquiry was satisfied. By the *Castro* court's own definition, novel scientific evidence must be supported by techniques that *currently* exist and are capable of producing reliable results.²³⁴ While noting that two experts testified that DNA profiling would be able to produce reliable results in "approximately six months,"²³⁵ the court nonetheless held that DNA profiling met the *Frye* requirements.²³⁶ In an attempt to reconcile this seemingly fatal contradiction, the court stated that "to breathe any meaning into the opinion of these highly respected and rather brilliant scientists one must conclude that the test is presently reliable and will remain so for the next six months."²³⁷

In its final determination, however, the court found that despite DNA's general acceptance in the scientific community, the laboratory had failed to apply proper techniques in this instance. Accordingly, the court foreclosed the possibility of admitting the DNA evidence in *Castro's* case.²³⁸

After reviewing these ground-breaking cases, it is apparent that a trend toward admissibility of DNA is forming. However, a common scheme of legal analysis on which to base such decisions has not yet been established. Until such a consensus is reached, the doubts surrounding the admissibility of DNA will remain. Beyond these questions of admissibility, however, looms an equally large but often overlooked issue: the constitutionality of DNA profiling as an instrument of criminal justice.

VI. CONSTITUTIONAL CONSIDERATIONS

In addition to challenging the reliability of DNA evidence, criminal defendants are also likely to challenge the constitutionality of the DNA identification process. Presently, at least three bases exist upon which an unconstitutionality claim could be premised.

The first constitutional concern associated with the forensic use of DNA profiling is one of "fundamental fairness."²³⁹ In examining the economics of DNA profiling in the courtroom, it is clear that prosecutors have a distinct advantage over defendants. This is because the

Typing: Acceptance and Weight of the New Genetic Identification Tests, 75 VA. L. REV. 45, 57-58 (1989)).

234. 144 Misc. 2d at 958, 545 N.Y.S.2d at 987.

235. *Id.* at 972, 545 N.Y.S.2d at 995.

236. *Id.* at 973, 545 N.Y.S.2d at 995.

237. *Id.* at 972-73, 545 N.Y.S.2d at 995.

238. *Id.* at 977, 545 N.Y.S.2d at 997-98. Rather than relying on objective matching standards, the Lifecodes laboratory had "eyeballed" the match. Williams, *supra* note 4, at 29.

239. Williams, *supra* note 4, at 31.

FBI laboratory offers its DNA profiling skills to law enforcement agencies free of charge.²⁴⁰ Defense attorneys, on the other hand, will likely utilize commercial laboratories. For many defendants, the cost of DNA profiling by commercial firms will be prohibitively high.²⁴¹ Moreover, a sizable number of criminal defendants are indigent. The Supreme Court has held that the state must provide indigent defendants with the instruments necessary to prepare an adequate defense.²⁴² Thus, if DNA profiling technology becomes a commonplace evidentiary technique, the doctrine of equality may require that the state provide funding to such defendants, giving them access to both DNA testing and expert witnesses.²⁴³ It is questionable whether the judiciary budget can bear such a burden at the present time.²⁴⁴

The second area of concern stems from the dangerous combination of a national obsession with fighting crime together with the aura of infallibility which has surrounded the DNA profiling technique since its media debut.²⁴⁵ Because of DNA's unequalled potential to identify criminal suspects, critics of DNA profiling fear that frustrated law enforcement officials, lacking sufficient evidence to make arrests, may be tempted to obtain genetic samples from suspects in violation of their constitutional rights.²⁴⁶

The United States Supreme Court has stated that police officers may obtain blood samples for the purpose of determining intoxication without the consent of the subject.²⁴⁷ However, in most situations, such extractions cannot be performed absent a warrant obtained pursuant to a finding of probable cause.²⁴⁸ Even without a warrant, though, extraction of blood will not constitute an illegal search and

240. *Id.* See also *supra* note 26.

241. See Sherman, *supra* note 132, at 25. Cellmark charges \$490 for each DNA test, and \$1000 per day for expert testimony. Lifecodes is only marginally less expensive, charging \$325 per test and \$750 for expert witnesses. *Id.*

242. Burk, *supra* note 2, at 470 (citing *Britt v. North Carolina*, 404 U.S. 226 (1972); *Griffin v. Illinois*, 351 U.S. 12 (1956)).

243. The Supreme Court has already held that states may have to pay for an indigent defendant's psychiatric evaluation and corresponding expert testimony. *Ake v. Oklahoma*, 470 U.S. 68 (1985).

244. For instance, one public defender's office recently spent over \$50,000 in preparation for a trial involving DNA evidence. The defense attorney now "concedes that it is unlikely that the . . . [p]ublic [d]efender's office is going to spend \$50,000 defending the next person prosecuted with DNA." Williams, *supra* note 4, at 32.

245. See *supra* notes 3, 4 and accompanying text.

246. For a general discussion of this constitutional issue, see Burk, *supra* note 2, at 470-71.

247. *Schmerber v. California*, 384 U.S. 757, 770-72 (1966).

248. See *Katz v. United States*, 389 U.S. 347, 356-57 (1967).

seizure if the situation presents both "exigent circumstances" and probable cause for the invasion of the suspect's reasonable expectation of privacy.²⁴⁹

Thus, blood samples may always be taken provided there is probable cause to believe that a suspect is intoxicated. The rapid decrease in the suspect's blood-alcohol ratio over time provides the element of exigency. No such exigent circumstances exist, however, in relation to DNA sampling. In contrast to the variability of blood-alcohol levels, each person's genetic code remains static over his entire lifetime.²⁵⁰ Thus, there is no danger that crucial evidence will be destroyed while the wheels of justice slowly churn out a search warrant.

While it may appear, therefore, that the individual is protected against bodily invasions designed to yield DNA samples by the safeguard of "detached scrutiny by a neutral magistrate,"²⁵¹ this protection is far from being a legal certainty. In 1968, the United States Supreme Court, in *Terry v. Ohio*,²⁵² sanctioned a limited search on less than probable cause where necessary to confirm or dispel an officer's suspicion that a suspect is concealing a weapon.²⁵³ These searches are commonly referred to as "*Terry* frisks," attesting to the intended brevity of the search contemplated by the *Terry* Court.

Thus, the facts of *Terry* necessitated a ruling only on the permissibility of investigatory detention on less than probable cause. The Supreme Court has yet to issue a ruling on the constitutionality of brief, in-field detention of suspects for identification purposes. However, in *Hayes v. Florida*,²⁵⁴ the Court went as far as to say that, "a brief detention in the field for the purpose of fingerprinting, where there is only reasonable suspicion not amounting to probable cause, is [not] necessarily impermissible under the Fourth Amendment."²⁵⁵ The Court did, however, stop short of holding that compulsory identification procedures could occur under circumstances lacking probable cause.²⁵⁶

The Supreme Court, therefore, has entertained the idea of enlarging one of the "few specifically established and well-delineated exceptions" to the traditional requirements of the fourth amendment in

249. *Schmerber*, 384 U.S. at 770-71.

250. Absent mutation, a person's DNA will remain exactly the same throughout his life, and even after his death. Thompson & Ford, *supra* note 29, at 62. Chemotherapy also might alter DNA to a slight degree. Burk, *supra* note 2, at 470 n.68.

251. See *Katz*, 389 U.S. at 356.

252. 392 U.S. 1 (1968).

253. *Id.* at 30-31.

254. 470 U.S. 811 (1985).

255. *Id.* at 816.

256. See *id.* at 816-18.

the case of fingerprinting.²⁵⁷ However, even if the Court ultimately rules that in-field detention without probable cause for the purpose of fingerprinting is constitutional, the extension of that premise to include genetic sampling would be a clear violation of the spirit of *Terry v. Ohio*.²⁵⁸ Two basic tenets support this premise.

First, the Supreme Court has expressly stated that *Terry* frisks are constitutional within the fourth amendment only if the procedures employed are "the least intrusive means reasonably available to verify or dispel the officer's suspicion in a short period of time."²⁵⁹ DNA profiling is most often performed using samples of fresh blood. Given the fact that this method of identification requires probing beneath the surface of the suspect's skin, DNA profiling techniques are obviously more intrusive than traditional fingerprinting methods.²⁶⁰

Furthermore, the Court has held that the "reasonableness" of a particular search or seizure shall be determined by balancing an agency's need for the evidence against the magnitude of the invasion of a suspect's personal privacy.²⁶¹ Traditionally, the ruler against which the level of intrusion was measured was the degree to which the body was physically invaded. However, this standard may be outdated and inappropriate in its application to DNA profiling, which involves not only a physical invasion, but a psychological invasion as well. This psychological invasion is due to DNA's unmatched ability to expose personal and private details wholly unrelated to physical identification of the suspect.²⁶²

Given this extreme level of intrusiveness, it is evident that DNA profiling easily surpasses both the degree of invasion associated with fingerprinting and the needs of the police to conduct an in-field identification procedure without a warrant. Thus, these factors strongly indicate that DNA profiling should not be considered in the same category as less intrusive identification techniques, should the Court choose to expand the scope of *Terry*. In fact, because of DNA's ability to reveal personal information, the fourth amendment's protections against unreasonable searches and seizures should apply to a greater, rather than lesser, degree in the case of DNA profiling.²⁶³

257. Note, *supra* note 17, at 528 (quoting *Katz*, 389 U.S. at 351).

258. *Id.* at 529.

259. *Florida v. Royer*, 460 U.S. 491, 500 (1983).

260. Note, *supra* note 17, at 529-30.

261. *Id.* at 528 (citing *Davis v. Mississippi*, 394 U.S. 721, 727-28 (1969)).

262. For a detailed discussion of this issue, see *infra* notes 266-81 and accompanying text.

263. Note, *supra* note 17, at 527.

Finally, even if the Court determines that DNA evidence was properly obtained under the fourth amendment, one further constitutional issue remains, the consequences of which are likely to reverberate beyond courtroom walls and throughout the population at large. Currently, the groundwork is being laid for a nationwide computer network which will store the genetic profiles of certain criminal offenders who have been convicted of sexual or violent offenses.²⁶⁴

Civil libertarians are concerned that such a data bank system is extremely prone to abuse.²⁶⁵ Specifically, it is feared that the profiles contained within DNA data banks could be used to discriminate against individuals, depriving them of rights and privileges such as health benefits and employment opportunities.

Genetic discrimination is, indeed, a very real threat. DNA is a powerful tool for investigative intelligence. DNA is able to reveal, with chilling accuracy, facts about a person's past, present, and future, which he himself might not know.²⁶⁶ For instance, DNA can mark an individual as a carrier of AIDS, prove that he is adopted or of unknown parentage, and confirm that he is predisposed to develop certain genetic illnesses.²⁶⁷ "As scientists decipher the molecular misprints that determine our medical fate, these most intimate of details may be sought after by outsiders with a financial stake in knowing them."²⁶⁸

Should the information contained in DNA data banks be made available to, or inadvertently fall into the hands of, either insurance companies or employers, the results could be devastating on both an individual and a community level. For example, employers could use DNA data in order to screen out job applicants who might be susceptible to various occupational hazards, in order to reduce corporate group-health premiums.²⁶⁹

Another group who might be interested in accessing information contained within DNA data banks is insurance companies. The insurance industry survives by classifying people by risk, charging

264. Sherman, *supra* note 132, at 25. State legislatures in California, Colorado, Nevada, and Virginia have all instituted procedures for collecting blood samples from selected prisoners for use in developing DNA data banks. *Id.*

265. *Id.*

266. As noted previously, the reliability of DNA profiling as an instrument of genetic research is not disputed. See *supra* note 119 and accompanying text.

267. Address of John K. Van de Kamp, Attorney General of California, at the California Criminalistics Institute Seminar on DNA Identification, Los Angeles, California, at 3 (Jan. 7, 1988) [hereinafter Van de Kamp].

268. Green, *Discrimination by DNA; Possible Consequences of Genetic Testing*, 22 HEALTH 86, 86 (1990).

269. *Id.* Because group-health premiums are based on the group's actual health care costs, "it's in an employer's economic interest to avoid hiring heavy healthcare [sic] users." *Id.*

greater premiums to those in high-risk categories. In addition, insurance companies engage in the routine practice of refusing to cover "pre-existing conditions." Thus, an individual whose DNA profiling information is revealed to insurance companies may be precluded from coverage of genetic illnesses which he has a potential to develop, or worse yet, be denied health coverage altogether.²⁷⁰

This type of discrimination is not the product of civil libertarians' fertile imaginations. In fact, the potential for misusing genetic information was dramatically revealed in the early 1970s in connection with sickle-cell anemia, a genetic blood disorder to which blacks are especially prone. In a well-intentioned, but ultimately misguided attempt to detect carriers of the disease, several states²⁷¹ drafted legislation designed to screen the black community for the trait.²⁷² Lack of confidentiality provisions in these bills led to abuses of the information obtained, and ultimately to discrimination against persons whose names were contained within the screening files.²⁷³ Beyond the obvious potential for abuse by employers and the insurance industry, DNA data banks also lend themselves to abuse by the criminal justice system itself. For example, California Attorney General John Van de Kamp has pointed to a real possibility that such data banks would create a temptation for frustrated law enforcement agents to "engage in genetic fishing expeditions."²⁷⁴ For instance, Van de Kamp postulated that if researchers' theories are correct in linking criminal tendencies to chromosomal deficiencies, "there will surely come a day when a desperate detective tries to run a search for every person with that deficiency in the vicinity of a series of un-

270. See *id.* Geneticist Paul Billings claims that this method of establishing risk could be grossly unfair to such individuals, even though they possess a genetic tendency to develop a particular disease. According to Billings, genes express themselves in highly variable manners, and although a person may be predisposed to a particular disease, he may ultimately be affected to only a slight degree. *Id.* This variability will most certainly be overlooked by insurers in evaluating applicants for coverage.

271. Twelve states and the District of Columbia enacted sickle-cell anemia screening legislation between 1970 and 1972. See Comment, *Confidentiality of Genetic Information*, 30 UCLA L. REV. 1283, 1292 n.55 & 1292-93 n.61 (1983). By 1973, the number of state screening programs had risen to eighteen. *Id.* at 1292 n.56.

272. For a general discussion and critical evaluation of these screening programs and their effects, see P. REILLY, *GENETICS, LAW, AND SOCIAL POLICY* 154 (1977).

273. Corporations which gained access to those files used the information gleaned therefrom to screen out job applicants whom they perceived to be high insurance risks. Green, *supra* note 268, at 86. Moreover, persons who carried only the sickle-cell trait, as opposed to the active disorder itself, were disqualified from airline positions and military enlistment, and were subjected to unreasonably high health insurance premiums. *Id.*

274. Van de Kamp, *supra* note 267, at 4.

solved murders.”²⁷⁵

Supporters of the DNA information network do not envision such an intrusive data bank system.²⁷⁶ The proposed DNA data bank system would store only the genetic profiles of certain criminals.²⁷⁷ However, Professor E. Donald Shapiro of New York School of Law cautions that, as DNA data banks proliferate, information will be kept not only on violent criminals, but on citizens from other segments of the population as well.²⁷⁸ Professor Shapiro stresses that the FBI’s fingerprint files, which were originally intended for identification of criminals alone, now also contain the fingerprints of ordinary, law-abiding citizens.²⁷⁹ Furthermore, commercial laboratories have already instituted plans for their own private DNA data banks. Currently, the Lifecodes corporation is promoting its own version of a DNA storage bank, which has been referred to as a “baby bank.”²⁸⁰ The company hopes to entice parents to buy storage space in its data bank for genetic information which could be used to identify their children in the event of a kidnapping.²⁸¹

While supporters of the proposed DNA data bank stress that the system would be strictly safeguarded against unauthorized intrusions, similarly safeguarded computer files have been violated repeatedly.²⁸² Furthermore, in this age of interlocking data bases, “[e]fforts to safeguard data bases will at best be short-lived; history has proved that where there’s a larcenous will, there is also a way.”²⁸³

Thus, in assessing the use of DNA in the legal arena, the courts must not allow the power of scientific technology to overshadow the fundamental concepts of personal freedom and individual rights. They must come to the realization that a technological advancement which performs flawlessly in the laboratory may nonetheless remain unsuitable for application in the courtroom.

VII. CONCLUSION

By its very nature, scientific evidence creates both excitement and

275. *Id.*

276. *Id.*

277. Gest, *supra* note 162, at 70.

278. *DNA Fingerprinting Called Privacy Threat*, Wall Street Journal, Feb. 6, 1990, at B1.

279. “[W]e started off fingerprinting criminals . . . [now] a large percentage of the population have their fingerprints in a data bank at the FBI. And genetic fingerprinting is the next step . . .” *Id.*

280. Kohlberg, *Experts Debate Banking Babies*, UPI, Feb. 3, 1990.

281. *Id.* Other proposed uses include storage of DNA samples of persons who are at high risk for disfiguring accidents, such as airline pilots. *Id.*

282. Bingham, *Visions of Tomorrow; Menaces in the Info Age*, TIME, Feb. 1989, at 78.

283. *Id.*

concern. DNA profiling is no exception. Given its potential as an instrument of justice, the courts have understandably strived to avoid unnecessary caution and undue delay in moving DNA profiling technology toward admissibility. At the same time, however, the judiciary must be cognizant of the technical limitations of the test and the dangers which lurk in the unknown. Despite the wondrous possibilities associated with DNA which could revolutionize criminal investigation, the benefits will not be without cost. While DNA testing may be fully suited to scientific research, it has not proven itself to be reliable in forensic situations. Hopefully, the judiciary will rethink its interpretation of the standards of legal admissibility as applied to DNA profiling, keeping in mind that their decisions will alter people's lives and legal positions. To do otherwise is to turn the courtroom into a research laboratory and defendants into guinea pigs. Until such time as further studies on the reliability of DNA are conducted, the legal community should approach DNA testing with cautious optimism.

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