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DNA Fingerprinting and the Need for a National Data Base

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DNA FINGERPRINTING AND THE NEED FOR A NATIONAL DATA BASE

I. Introduction

Forensic science[1] has derived enormous benefits from the latest research in the rapidly expanding field of biotechnology.[2] A new test, commonly known as "DNA[3] fingerprinting," can detect certain highly variable regions in DNA sequences to "provide an individual-specific DNA 'fingerprint' of general use in human genetic analysis."[4] Because of the accuracy of this test[5] and the relative ease in obtaining bodily fluid samples to be tested,[6] DNA fingerprinting is already having a dramatic impact on the conduct of criminal and civil cases.[7] It

1. "Forensic" science refers to what is "belonging to, used in, or suitable to courts of judicature or to public debate." WEBSTER'S NINTH NEW COLLEGIATE DICTIONARY 483 (1989).

2. *See infra* note 3.

3. DNA, which stands for deoxyribonucleic acid, is "the basic hereditary material, . . . [which] determines specific traits in organisms by guiding the production of specific polypeptide chains, one or more of which interact to form a protein molecule." J. BAKER & G. ALLEN, THE STUDY OF BIOLOGY 441-42 (4th ed. 1982) [hereinafter BAKER & ALLEN].

4. Jeffreys, Wilson, & Thein, *Hypervariable 'Minisatellite' Regions in Human DNA*, 314 NATURE 67 (1985) [hereinafter *Hypervariable Minisatellite*].

Ever since the British geneticist Dr. Alec J. Jeffreys of the University of Leicester developed this test in England in 1985, the British police have applied it there in various investigations. *See Hypervariable Minisatellite, supra*, at 67. For example, it was used to resolve an immigration dispute about the exact relationship of a Ghanaian boy to the woman who was proved conclusively to be his mother. Jeffreys, Brookfield, & Semeonoff, *Positive Identification of an Immigration Test-Case Using Human DNA Fingerprints*, 317 NATURE 818 (1985) [hereinafter *Immigration Test-Case*]. The test also helped to convict a man in two rape-murder cases where the police, out of desperation, asked the male residents of the area to submit a blood sample for DNA testing. *See* White & Greenwood, *DNA Fingerprinting and the Law*, 51 MOD. L. REV. 145, 149-50 (1988). The accused, Colin Pitchfork, pursuaded a workmate to substitute his blood for Pitchfork's, but the substitution was discovered, the test was subsequently performed on Pitchfork's blood, and he was convicted. *Id.*

5. Lifecodes Corporation, *infra* note 35, says that when its DNA print matches two specimens, there is "at least a 99[%] certainty that the specimens are from the same person." Moss, *DNA—The New Fingerprints*, 74 A.B.A. J. 66 (May 1988) [hereinafter Moss]. Michael Baird of Lifecodes Corporation testified in one rape case to a match between the DNA in the appellant's blood and the DNA obtained from the semen procured from a vaginal swab of the victim, stating that "the percentage of the population which would have the DNA bands indicated by the samples would be 0.0000012%. In other words, the chance that the DNA strands found in appellant's blood would be duplicated in some other person's cells was 1 in 839,914,540." *Andrews v. State*, 533 So. 2d 841, 843 (Fla. App. 1988).

6. *See infra* notes 85-89 and accompanying text.

7. For example, on September 19, 1989, the New York State Court of Appeals refused to stay an order requiring a suspect in the rape and murder of a 14-year-old Long

can be used for a wide range of legal purposes, such as to implicate[8] or exculpate[9] suspects in criminal cases, to resolve questions of paternity,[10] and to identify the remains of victims.[11]

Island girl to provide a blood sample for DNA analysis. N.Y.L.J., Sept. 20, 1989, at 1, col. 4. The Appellate Division, Second Department, decided on September 12th that the prosecutors had ". . . satisfactorily demonstrated the existence of probable cause to believe that the suspect committed the crime under investigation." *Id.* at 4, col. 3; *see also* Note, *DNA Identification Tests and the Courts*, 63 WASH. L. REV. 903, 905 n.2 (1988) [hereinafter Note, *DNA Identification Tests*].

8. *E.g.*, People v. George Wesley, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (County Ct., Albany County 1988). *Wesley* was New York's first reported case that recognized the reliability of the underlying principles, procedures and technology of DNA fingerprinting and ordered the test to be performed on the defendant. More importantly, the Florida Court of Appeals in *Andrews v. State* upheld the conviction of the defendant for aggravated battery, sexual battery and armed burglary, based on the trial court's conclusion that the DNA identification matching the defendant's blood with the DNA sample acquired from the victim's vaginal swab was credible. 533 So. 2d 841 (Fla. App. 1988).

9. *E.g.*, N.Y. Daily News, Jan. 14, 1989, at 4, col. 1. New York Supreme Court Justice James Cowhey signed orders dismissing rape charges against Sammie Scheff after DNA tests proved that he could not have been the man who raped a woman February 8, 1988, in Greenburgh, New York.

10. *See, e.g.*, *In re Baby Girl S.*, where the New York Surrogate Court concluded that "since it is undisputed that the DNA probe is a blood genetic marker test, it was admitted into evidence under the clear language of Family Court Act § 532 . . . ." 140 Misc. 2d 299, 304, 532 N.Y.S.2d 634, 637 (Sur. Ct. N.Y. County 1988). Specifically, § 532 of the Family Court Act states that

> (a) [t]he court shall advise the parties of their right to one or more blood genetic marker tests and, on the court's own motion or on motion of any party, shall order the mother, her child and the alleged father to submit to one or more blood genetic marker tests by a duly qualified physician or by a laboratory duly approved for this purpose by the commissioner of health to determine whether or not the alleged father can be excluded as being the father of the child. The results of any such blood genetic marker test may be received in evidence where definite exclusion is established by such test. Except in cases where exclusion has been established by another blood genetic marker test, the laboratory and statistical results of the human leucocyte blood tissue test (either separately or in combination with the laboratory and statistical results of any other blood genetic marker test or tests including, without limitation, red blood cell antigens, red blood cell serum protein, and red blood cell enzyme tests) may be received in evidence to aid in the determination of whether the alleged father is or is not the father of the child.

N.Y. FAM. CT. ACT § 532 (McKinney Supp. 1989).

Two recent New York cases exhibit rather novel uses of DNA fingerprints in relation to resolving questions of paternity. In *Alexander v. Alexander*, the court held that a child born out of wedlock who sought to inherit from his putative father's estate could prove his paternity by genetic testing, and the probate court could permit disinterment of the putative father to effect a test. 42 Ohio Misc. 2d 30, 537 N.E.2d 1310 (P. Ct. Franklin County 1988). The court in *King v. Tanner* held that the results of DNA tests on the alleged father, mother and child, indicated with 99.993% certainty that the alleged father was in fact the child's father, and thereby established truth as a defense to the slander claim. 142 Misc. 2d 1004, 539 N.Y.S.2d 617 (Sup. Ct. Westchester County 1989).

11. *See* Baird, Giusti, Meade, Clyne, Shaler, Benn, Glassberg & Balazs, *The Application of DNA-Print for Identification from Forensic Biological Materials*, 2 J. FORENSIC

This Note argues that DNA fingerprinting is an invaluable tool for prosecutors and defense attorneys alike, and that because the benefits to society will outweigh any potential invasions of privacy,[12] a national data base of DNA fingerprints should be established. Part II of the Note explains the scientific theories and the technological processes used to obtain the DNA fingerprint. Part III explores the privacy[13] issues involved in the gathering of the DNA samples, such as its constituting a "search" under the fourth amendment,[14] and the sample's admissibility as evidence under the *Frye* rule.[15] Finally, this Note concludes that a national data base of DNA prints, like traditional fingerprint files, can be used as an accurate identification method in criminal investigations, thereby helping prosecutors to convict guilty parties and defense attorneys to acquit wrongly accused individuals.

II. The Biology and Technology of the DNA Print

A proper understanding of relevant privacy issues is impossible without familiarity with the basic molecular biology and technology employed by the DNA print.[16] The first part of this section will explain some basic principles of genetics on which the DNA test relies,[17] and the second part will discuss the mechanics of producing the DNA fingerprint.[18]

A. The Molecular Biology of DNA

DNA is the basic hereditary material which "determines specific traits in organisms by guiding the production of specific polypeptide[19]

HAEMOGENETICS, 396, 398 (1988) [hereinafter Baird]. Baird briefly described a homicide case in which DNA testing was used to identify the victim. In this case, a car was found abandoned and although the owner of the car was missing and no body was discovered, fragments of brain tissue were found on the grill. A DNA analysis of the brain tissue and the blood of the alleged parents of the victim indicated that it was "160,000 times more likely that the DNA isolated from the brain tissue might have been from the offspring of the two parents than from a random individual." *Id.*

12. For the purposes of this Note, invasions of privacy are limited to potential fourth amendment violations; *see infra* notes 101-31.

13. *Id.*

14. *See infra* notes 101-31 and accompanying text.

15. *See infra* notes 132-65 and accompanying text.

16. For a discussion of the molecular biology involved, see Note, *DNA Identification Tests*, *supra* note 7, at 907-18.

17. *See infra* notes 19-34 and accompanying text.

18. *See infra* notes 35-97 and accompanying text.

19. One or more polypeptide chains interact to form a protein molecule. BAKER & ALLEN, *supra* note 3, at 442.

chains"[20] which interact to form protein molecules.[21] DNA is "the substance of which genes are made."[22] While DNA is the basic material of heredity, a gene is considered "the basic structural and functional unit of heredity."[23] Specifically, a gene is "the segment of DNA that is involved in producing a polypeptide chain."[24] DNA is organized into rod-shaped structures called chromosomes.[25] An ordinary human cell contains twenty-three pairs of matching chromosomes, one chromosome per pair inherited from the mother, and the other from the father.[26]

In 1953, James Watson and Francis Crick discovered that the DNA molecule was a helical polymer[27] composed of two strands.[28] The DNA chains consist of a chemically linked sequence of nucleotides,[29] containing the bases adenine (A), cytosine (C), guanine (G), and thymine (T) on the inside of the helix, which are attached to a repetitive sugar-phosphate chain.[30] The traditional analogy is to a ladder with the bases as rungs and the sugar-phosphate chains as the sides.[31] The bases C and G are always attracted to each other on opposite sides of the chain, as are the bases A and T.[32] The comple-

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20. *Id.*

21. *Id.*

22. B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL, 99 (1983) [hereinafter ALBERTS].

23. BAKER & ALLEN, *supra* note 3, at 442.

24. B. LEWIN, GENES 685 (1985) [hereinafter LEWIN].

25. BAKER & ALLEN, *supra* note 3, at 442. A chromosome is "a discrete unit of the genome carrying many genes, consisting of proteins and a very long molecule of DNA. . . ." LEWIN, *supra* note 24, at 683. "The entire complement of genes in an organism, regardless of their physical arrangement within the cell, is known as the organism's genome." BAKER & ALLEN, *supra* note 3, at 442.

26. *See* White & Lalouel, *Chromosome Mapping with DNA Markers,* 258 SCI. AM. 40 (1988) [hereinafter White & Lalouel].

27. A polymer (Greek for many parts) is a chain of many simpler units formed together in a regular way. R. MORRISON & R. BOYD, ORGANIC CHEMISTRY 437 (4th ed. 1983) [hereinafter MORRISON & BOYD].

28. ALBERTS, *supra* note 22, at 99.

29. Nucleotides are the subunits of DNA. ALBERTS, *supra* note 22, at 56. In nucleotides, "one of several nitrogen-containing ring compounds (often referred to as *bases* . . .) is linked to a five-carbon sugar (either *ribose* or *deoxyribose*) that also carries a phosphate group." *Id.*

30. *Id.* at 99.

31. People v. Wesley, 140 Misc. 2d 306, 310, 533 N.Y.S.2d 643, 646 (County Ct. Albany County 1988).

32. *See* ALBERTS, *supra* note 22, at 99. The number of base-pairs involved here is enormous: "the human chromosomes consist of linear molecules of double-strand DNA with a total length of about three billion base pairs (the chemical subunits that encode information along DNA). A typical gene, a complete unit of genetic information, is miniscule by contrast, encompassing perhaps 10,000 base pairs." White & Lalouel, *supra* note 26, at 40.

mentary base-pairing of the DNA chain provides an explanation for heredity: "[s]ince each strand contains a nucleotide sequence that is exactly *complementary* to the nucleotide sequence of its partner strand, both strands actually carry the same genetic information."[33] One strand can be used as a template for making the other strand, and vice versa.[34]

B. Techniques Used in Producing the DNA Fingerprint

Molecular biologists have noted that there are certain small regions of human DNA which contain highly variable base sequences among different individuals. These variations are called polymorphisms,[35] and are located by DNA probes[36] during genetic analysis.[37] The poly-

33. ALBERTS, *supra* note 22, at 103. Furthermore,

> [a]s a direct consequence of the base-pairing mechanism, it becomes evident that DNA carries information by means of the linear sequence of its nucleotides. Each nucleotide—A, C, T, or G—can be considered as a letter in a simple four-letter alphabet that is used to write out biological messages in a linear 'ticker-tape' form. Animals of different species differ because the respective DNA molecules in their cells carry different nucleotide sequences and thereby different biological messages.

Id. For example, if a certain sequence of DNA is arranged:

CTGATG
GACTAC

both strands carry the same information, and either can be used to duplicate the other strand.

34. *Id.*

35. Lifecodes Corporation, *Background Information: DNA-print Identification Test* 25 [hereinafter Lifecodes]. There are currently three companies in the United States which perform DNA testing: Lifecodes Corporation of Valhalla, New York, Cellmark Diagnostics of Germantown, Maryland, and Cetus Corporation of Emeryville, California. Lifecodes and Cellmark use restriction fragment length polymorphism (RFLP) analysis. *See infra* notes 36-43 and accompanying text. Cetus uses a different technique, called polymerase chain reaction (PCR) to generate cloned DNA at a target sequence and test it with probes. Moss, *supra* note 5, at 67, 69; *see also infra* note 83.

36. A DNA probe is a radioactive single-stranded DNA fragment that is used in hybridization. ALBERTS, *supra* note 22, at 190. Hybridization is simply the process whereby "complementary single strands of DNA . . . reform double helices." *Id.* at 189. Dr. Jeffreys, *supra* note 4, comments that "[g]enetic analysis in man could be simplified considerably by the availability of probes for hypervariable regions of human DNA . . . ." *Hypervariable Minisatellite, supra* note 4, at 67. For more on the use of probes, see *infra* notes 54-57 and accompanying text.

37. *Hypervariable Minisatellite, supra* note 4, at 67. Dr. Michael Baird, Laboratory Manager for Forensic and Paternity Testing at Lifecodes Corporation, *see supra* note 35, testified at a *Frye* hearing in *People v. Lopez* that

> scientists are aware of the function of approximately [10%] of the DNA sequences. For instance, those areas that code for hair or eye color, two arms, two legs, etc. However, the function of approximately [90%] of DNA is unknown. It is these sequences which vary greatly among individuals which are the areas that are detected in genetic fingerprinting. The reason that these areas are detected is simply that those areas that code for a common trait such as hair

morphism consists of "tandem repeats of a short sequence"[38] or "minisatellites."[39] In order to study these minisatellites, geneticists use certain enzymes called restriction endonucleases,[40] which cut the long strands of DNA at specific sites into a series of fragments known as restriction fragments.[41] The number and length of the DNA fragments produced by a particular enzyme "are dependent on where and how often the enzyme's base sequence occurs in the DNA specimen."[42] Because the sequence selected is highly variable, it is unlikely that the number or length of fragments produced will be the same among different people.[43]

These cut fragments are then separated according to size in a process called electrophoresis,[44] by which an electrical current draws the fragments through a gel.[45] At either end of this gel are charged poles, one positive, the other negative,[46] and the DNA, which has a negative

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or eye color do not vary sufficiently among individuals to provide for any meaningful identification test.

People v. Lopez, N.Y.L.J., Jan. 6, 1989, at 29, col. 3 (Sup. Ct., Queens County 1988).

38. *Hypervariable Minisatellite, supra* note 4, at 67; *see supra* notes 29-34 and accompanying text.

39. *Hypervariable Minisatellite, supra* note 4, at 67.

40. These are enzymes which "cleave DNA at sequence specific recognition sites, generating a reproducible pattern of fragments from an individual's DNA." Kanter, Baird, Shaler & Balazs, *Analysis of Restriction Fragment Length Polymorphisms in Deoxyribonucleic Acid (DNA) Recovered from Dried Bloodstains*, 31 J. FORENSIC SCI. 403 (1986) [hereinafter Kanter]. Restriction nucleases are enzymes produced by bacteria which "protect [the bacteria] by degrading [or breaking down] any invading foreign DNA molecules. Each enzyme recognizes a specific sequence of four to six nucleotides in DNA. . . . Many restriction nucleases have been purified from different species of bacteria, and more than 100, most of which recognize different nucleotide sequences, are now commercially available." ALBERTS, *supra* note 22, at 185-86.

41. ALBERTS, *supra* note 22, at 186.

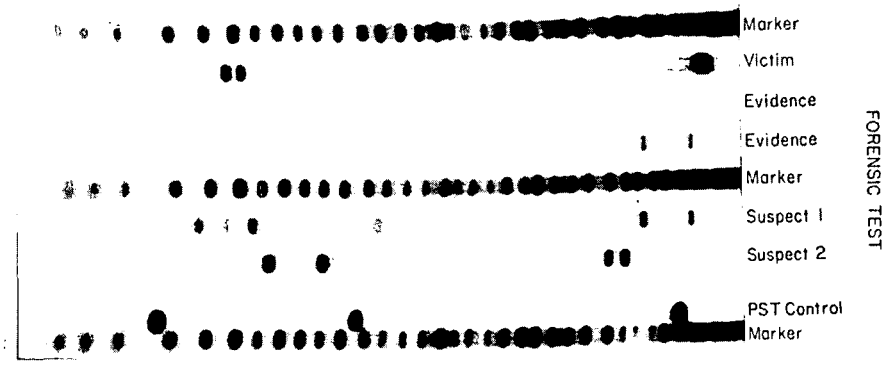
42. Lifecodes, *supra* note 35, at 26.

43. *Id.* For example, a particular enzyme may cut the DNA sequence GTTAAC exactly in the middle, i.e., into GTT AAC. The number of times that this six base sequence, GTTAAC, occurs, and its exact location along a strand of DNA at a particular gene having roughly 10,000 base pairs, will vary greatly among different persons. Hence, the long strand of DNA will be cut in different places for different people, resulting in fragment lengths of various sizes, and consequently producing different patterns of a DNA fingerprint. *See infra* notes 62-66 and accompanying text.

44. Electrophoresis was held admissible as a reliable procedure accepted by the relevant scientific community in People v. Crosby, 116 A.D.2d 731, 498 N.Y.S.2d 31 (2d Dep't 1986) (evidence insufficient to sustain conviction of murder in second degree, but, blood-typing technique known as electrophoresis sufficiently reliable and accepted in scientific community to be utilized in criminal prosecutions).

45. The "electric field draws them through [the] gel, in which their mobility is inversely proportional to their lengths." White, *supra* note 26, at 42. That is, the smaller fragments travel more easily and farther than the larger ones.

46. Lifecodes, *supra* note 35, at 26.



The photograph above shows the result of a DNA-print test for a rape case. The two pieces of evidence examined were a semen stain and a vaginal swab. The DNA pattern from suspect #1 matches that from the evidence, so suspect #1 is included by the test as a possible donor of the semen. The DNA pattern from suspect #2 does not match, and is therefore excluded as a possible donor. (Photograph reproduced with permission of Lifecodes Corporation).

charge, travels from the negative pole toward the positive pole.[47] Because the shorter fragments travel further,[48] they will be closer to the positive pole than will the longer fragments.[49] The result is that the shorter fragments end up at one pole of the gel, and the longer fragments at the other.[50]

In the next step, called Southern blotting,[51] the DNA fragments on the electrophoresis gel are denatured[52] and blotted onto a membrane.[53] The DNA is then hybridized: a "specific, purified sequence of DNA . . . [is] radioactively labeled and used as a probe."[54] This single-stranded radioactive probe is selected to recognize the specific area of the DNA fragment on the membrane that has its complemen-

47. *Id.* Opposite charged particles attract, whereas identically charged particles repel. *Id.*

48. *See supra* note 45 and accompanying text.

49. Lifecodes, *supra* note 35, at 26-27. According to Kanter, it is essential that the DNA used for RFLP analysis have a high molecular weight and not be degraded into smaller fragments. "A visible band on an autoradiogram is obtained only if enough intact copies of the desired fragment are present. Broken fragments will migrate faster and will not be concentrated in a single band after electrophoresis." Kanter, *supra* note 40, at 405.

50. Lifecodes, *supra* note 35, at 27.

51. This procedure is named for Edward M. Southern, who developed it at the University of Edinburgh. White, *supra* note 26, at 42.

52. When a protein is "denatured," it is "heated or exposed to high pH in order to separate its strands." *Id.*

53. *Id.* The membrane or nitrocellulose paper is more stable than the gel for the purposes of the steps after electrophoresis. See *infra* notes 54-57 and accompanying text for an explanation of these steps.

54. Kanter, *supra* note 40, at 406. See *supra* note 36 for definition of a probe.

tary base sequence, and to bind itself to that area.[55] The excess probe is washed away, and the radioactive bands are then visualized by autoradiography—exposure to X-ray film for several days.[56] The film is processed, and black bands appear where the radioactive probes landed.[57]

Certain important points about this technology must now be noted. First, the polymorphisms[58] "are inherited as Mendelian traits,"[59] and therefore, can be used as markers[60] for genetic studies.[61] What this means is that "all fragments in offspring can be traced back to one or other parent, then in turn to their parents . . . and therefore provide a set of stably inherited genetic markers."[62] Hence, the patterns are unique to each individual, except identical twins. The high probability of the accuracy of DNA prints can be explained by a statistical formula, used by population geneticists, known as the Hardy-

55. Lifecodes, *supra* note 35, at 27. Jeffreys explains that "under these hybridization conditions, each probe detects a unique region of the human genome." *Hypervariable Minisatellite*, *supra* note 4, at 68. See *supra* note 25 and accompanying text for further information on genome.

56. Balazs, Baird, Clyne & Meade, *Human Population Genetic Studies of Five Hypervariable DNA Loci*, 44 AM. J. HUM. GENETICS 182, 183 (1989) [hereinafter Balazs].

57. *See* People v. Wesley, 140 Misc. 2d 306, 316, 533 N.Y.S.2d 643, 650 (County Ct., Albany County 1988). Judge Harris wrote a very thorough explanation of this entire procedure in his opinion in *Wesley*, borrowing almost exclusively from Lifecodes, *supra* note 35. There is also a control band of size markers used in the test, for comparison with the results of the hybridization: "[a]ppropriate size markers . . . [are] included in each gel." Kanter, *supra* note 40, at 404. The resulting autoradiograph shows black bands where the probes landed according to size, measured in kilobases (kb), or thousands of base pairs. *Id.* at 405 fig. 1.

58. *See supra* note 35 and accompanying text. An alternate definition of polymorphism is "the simultaneous occurrence in the population of genomes showing allelic variations." LEWIN, *supra* note 24, at 690. An allele is "one of several alternate forms of a gene occupying a given locus on the chromosome." *Id.* at 681. For example, an allele for eye color would be blue, brown or green eyes.

59. Mendelian traits are named after Gregor Johann Mendel, whose breeding experiments on garden peas in Austria between 1856 and 1863 formed the basis of genetic inheritance studies. *See* BAKER & ALLEN, *supra* note 3, at 446-54. "One very important feature of Mendelian genetics: *its predictions are statistical expectations based only on probability. Id.* at 452 (emphasis in original); *see also infra* notes 61-66 and accompanying text.

60. A genetic marker describes "a gene that is of interest . . . one being used in a mapping experiment or identifying a particular region." LEWIN, *supra* note 24, at 42. Because there are about 100,000 genes on the 23 pairs of human chromosomes, genetic markers greatly aid genetic research. *See* White, *supra* note 26, at 40.

61. Giusti, Baird, Pasquale, Balazs & Glassberg, *Application of Deoxyribonucleic Acid (DNA) Polymorphisms to the Analysis of DNA recovered from Sperm*, 31 J. FORENSIC SCI., 409-10 (1986) [hereinafter Giusti].

62. *Hypervariable Minisatellite*, *supra* note 4, at 71.

Weinberg equilibrium.[63] The probes used in the tests have frequencies allocated to them which represent how often the region detected by the probe would randomly appear in the general population.[64] The Hardy-Weinberg equilibrium

> has long been accepted by geneticists and provides a method of calculating how often different varieties of genes such as blood type, etc. should be found in a population sample. If a frequency that a particular gene appears in a population sample is not within what would be expected under the Hardy-Weinberg equilibrium, then the population sample is not valid.[65]

A population is in equilibrium "when there is no correlation between the allele contributed by the mother and the allele contributed by the father at a particular locus. That is, the alleles are independent of each other."[66]

The second important point about DNA technology is that the probes are locus-specific,[67] that is, they recognize only their own discrete sequences and nothing more. Gene probes have been isolated to find areas of DNA carrying defective gene codes for such disorders as Huntington's chorea, Duchenne muscular dystrophy, Down's syn-

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63. *See* People v. Lopez, N.Y.L.J., Jan. 6, 1989, at 29, col. 1 (Sup. Ct., Queens County 1988).

64. *Id.*

65. *Id.*

66. People v. Castro, No. 1508-87 (Sup. Ct. N.Y., Bronx County, Aug. 14, 1989) (LEXIS, N.Y. library, Cases file). There are four major assumptions necessary for the Hardy-Weinberg equilibrium to hold. First is random mating, i.e., "the mating of individuals of any two genotypes is the combining of independent events . . . ." R. TAMARIN, PRINCIPLES OF GENETICS 598 (1982) [hereinafter TAMARIN]. Second is no selection, i.e., "no genotype will result in an individual with a better survival or reproduction than individuals of any other genotype . . . ." *Id.* at 599. Third, is large population size, i.e., "[t]he larger the population, the greater the probability that a random sample of a generation's gametes will accurately represent the allelic frequency in the population." *Id.* The American Association of Blood Banks specifies that a minimum of only 200 individuals is necessary to produce a valid statistical analysis; the probes used by Lifecodes in the *Lopez* case were tested against a data base of approximately 1000 individuals. *Lopez*, N.Y.L.J., Jan. 6, 1989, at 29, col. 1. Fourth, is no mutation or migration. Mutation and migration are the change in allelic and genotypic frequencies "by the loss or addition of alleles through genetic mutation or through migration (immigration and emigration) of individuals from or into a population." TAMARIN, *supra*, at 599. This fourth assumption is that there is no such allelic loss or addition in the population. *Id.* For a thorough discussion of population genetics, see also People v. Castro, No. 1508-87 (Sup. Ct. N.Y., Bronx County Aug. 14, 1989) (LEXIS, N.Y. library, Cases file) at 21-25.

67. A locus is "the specific position occupied by a particular gene or alternative forms of a gene on a chromosome." People v. Wesley, 140 Misc. 2d 306, 314, 533 N.Y.S.2d 643, 649 (County Ct., Albany County 1988). The Human Gene Mapping Conference assigns a locus for every gene site accepted by it. For further discussion of the Human Gene Mapping Conference, see *infra* note 151.

drome, cystic fibrosis, sickle cell anemia, and severe red blood cell disorders known as thalassemias.[68] Because each probe binds *only* to its own complementary base sequence, it can not locate anything other than that particular sequence. A DNA print analysis cannot detect genetic disorders *unless* the tester uses the specific probe for the base sequence associated with that disorder. Also, "[a]utoradiographic patterns created by DNA fingerprinting show nothing concerning a person's intelligence, sex, or outward physical appearance."[69] Further, the autoradiograph "contains no information regarding the sex or even the species of the donor."[70]

Third, this method proves more effective than traditional ABO blood testing and the sensitive testing on human leukocyte antigens (HLA),[71] the most polymorphic protein system known.[72] In general,

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68. Lifecodes, *supra* note 35, at 20.

69. Note, *DNA Fingerprinting: Possibilities and Pitfalls of a New Technique*, 28 JURIMETRICS J. 455, 471 (1988) [herinafter Note, *DNA Fingerprinting*].

70. L.A. Times, Mar. 11, 1987, at 13, col. 1. Dr. Jeffreys, who pioneered the technique, *see supra* note 2 and accompanying text, stated: "[i]f you took samples from half a dozen gorillas and half a dozen people, you couldn't tell them apart. . . . They'd just be a series of lines on an X-ray." *Id. See also* photograph, *supra* page 329.

Additionally, the accuracy of the identification can be increased by using more probes. Baird, *supra* note 11, at 396. Lifecodes estimates that by using four probes, the "combined discrimination potential . . . is greater than [10 to the eighth power]," i.e., the probability of matching by chance is less than one in one hundred million.

71. "Leukocytes" is another term for white blood cells. P. GIANNELLI & E. IMWINKELROD, SCIENTIFIC EVIDENCE 586 (1986) [hereinafter SCIENTIFIC EVIDENCE]. White blood cells "determine the body's immune system, a line of defense against infection. They determine whether the body will accept grafted tissue in a transplant." *Id.* at 586 (citing Sussman, *Up-To-Date Blood Testing for Paternity and Nonpaternity*, 24 TRAUMA 12 (1982)). An antigen is "any molecule whose entry into an organism provokes synthesis of an antibody. . . ." LEWIN, *supra* note 24, at 681. "Antigens may be any class of substances—proteins, carbohydrates, etc." BAKER & ALLEN, *supra* note 3, at G-2. An antibody is a protein "produced within leukocytes and other cells in animals in direct response to the presence of a foreign substance (antigen) within the body. *Antibodies are specific to the particular antigen that elicited their production.*" *Id.* (emphasis added).

In HLA testing, the analyst is concerned with four loci on chromosome six, which code for the production of these antigens. ALBERTS, *supra* note 22, at 1000; *see also infra* note 72. The analyst first separates red and white blood cells from the given sample, and performs a toxicity test—the white cells are tested against known HLA antisera. SCIENTIFIC EVIDENCE, *supra*, at 587. An antiserum "contains a heterogeneous mixture of antibodies . . . ." ALBERTS, *supra* note 22, at 181. The specificity of an antiserum for a particular antigen can be sharpened by removing unwanted antibody molecules, but the nonuniform composition of the antiserum has limited its usefulness. *Id.* at 182. "In a positive test, the white cells die; the effect of the corresponding antiserum on the white cell antigen is toxic." SCIENTIFIC EVIDENCE, *supra*, at 587. The analyst tests the white blood cells against 120 to 180 different known antisera, and if, in his judgment, 80-100% of the white cells are dead, a positive test is reported. *Id.* Since antibodies are specific to the particular antigen that elicited their production, when a particular known antiserum produces a positive test result, the antigens present are thus determined. See *id.* at 586-89

protein analysis of old bloodstains is difficult because most markers suitable for typing persist only for a very short time; because many of the proteins degrade or break down within a few weeks, the accuracy of identification decreases accordingly, so that for two- and three-year old bloodstains, the proteins cannot be typed.[73] Various problems exist using HLA testing, one of which is that it "has not been widely accepted for bloodstain identification."[74] In particular, HLA testing is troublesome because white blood cells tend to be less durable than red cells, and many HLA laboratories will only perform the test if they receive the sample within twenty-four to seventy-two hours after it is drawn.[75] Furthermore, another major problem involves the antisera. An antiserum "contains a heterogeneous mixture of antibodies . . . ."[76] Problems with HLA testing occur because of "[t]he well known cross reactivity of HLA antisera, and the fact that many serums contain a number of different antibody specificities, can cause serious difficulties of interpretation in inexperienced hands."[77] Conversely, "DNA, which is chemically more stable than proteins, appears to persist significantly longer in dried bloodstains."[78] Another problem with protein analysis such as HLA testing is the occurence of false positives and false negatives. The antigens, which may be any

for a more detailed discussion of the procedure; *see also* R. GAENSSLEN, SOURCEBOOK IN FORENSIC SEROLOGY, IMMUNOLOGY, AND BIOCHEMISTRY 628 (1983) [hereinafter GAENSSLEN].

72. Kanter, *supra* note 40, at 406. Furthermore, "[t]he loci that code for these [proteins] are the most *polymorphic* known in higher vertebrates; that is, within a species, there is an extraordinarily large number of different alleles (alternative forms of the same gene) at each locus, each allele being present in a relatively high frequency." *Id.*; *see also* ALBERTS, *supra* note 22, at 1001 (emphasis in original). Kanter notes that "[c]urrent technology allows the typing of a wide range of polymorphic protein markers in blood, including red cell enzymes, red cell antigens, and serum proteins. Only a fraction of these markers are sufficiently stable for use in bloodstain analysis." Kanter, *supra* note 40, at 406. Because these protein markers tend to be unstable, they are of limited use for typing purposes.

73. *Id.* at 406-07.

74. *Id.*

75. SCIENTIFIC EVIDENCE, *supra* note 71, at 588 (citing *Note, Human Leukocyte Antigen Testing: Technology Versus Policy in Cases of Disputed Parentage,* 36 VAND. L. REV. 1587, 1592 (1983)). In addition, "[b]ecause of the delicacy of white cells, there are doubts about the applicability of HLA procedures to the analysis of dried bloodstains. There has been some experimentation to determine the feasibility of typing dried stains for HLA antigens, but critics question the adequacy of the experiments conducted to date." SCIENTIFIC EVIDENCE, *supra* note 71, at 589 (footnotes omitted).

76. ALBERTS, *supra* note 22, at 181.

77. GAENSSLEN, *supra* note 71, at 628. See *supra* note 71 for the discussion on antisera in ALBERTS, *supra* note 22, at 181-82.

78. Kanter, *supra* note 40, at 407.

class of substances, such as proteins or carbohydrates,[79] can react with certain materials such as wool, nylon and denim, and changes occurring in dried protein can alter the test results.[80] This wide margin of error does not occur with the DNA test because "degraded DNA does not produce any bands on an autoradiograph"[81]—either

79. BAKER & ALLEN, *supra* note 3, at G-2.

80. Kanter, *supra* note 40, at 407.

81. *Id.* One recent New York case, however, excluded DNA prints because of problems in the resulting prints possibly caused by the contamination of the samples. People v. Castro, No. 1508-87 (Sup. Ct. N.Y., Bronx County, Aug. 14, 1989) (LEXIS, NY library, Cases file). The defendant was accused of stabbing to death 20 year-old Vilma Ponce, who was seven months pregnant at the time, and her two-year old daughter. *Id.* at 1. The defendant's watch had bloodstains on it. *Id.* He stated that the blood was his own; the People, intending to prove that the origin of the bloodstain was the blood of the adult victim and not the defendant, sought to introduce evidence of the DNA identification test. *Id.* The court ordered that a pre-trial hearing be held in accordance with Frye v. United States, 293 F. 1013 (D.C. Cir. 1923), and People v. Middleton, 54 N.Y.2d 42, 429 N.E.2d 100, 444 N.Y.S.2d 581 (1981), to determine the admissibility of new scientific evidence. *Castro*, No. 1508-87, at 1-2. *Frye* held that new scientific evidence will not be admitted unless it is sufficiently accepted in its particular field. 293 F. at 1014; *see also infra* notes 132-37 and accompanying text. The *Castro* court noted that it was unaware of any case which has held the evidence of DNA identification to be inadmissible under *Frye*. *Castro*, No. 1508-87, at 4. The court then provided a three pronged analysis to aid the resolution of the issues presented: 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? 2) are 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? 3) did the testing laboratory perform the accepted scientific techniques in analyzing the forensic samples in this particular case? *Id.* at 7.

The court stated that the first two prongs of the analysis deal exclusively with the *Frye* issues, which alone are insufficient to place this type of evidence before a jury. *Id.* at 8. Rather, the critical question in these cases is the third prong, which questions the testing procedures performed in a particular case. *Id.* As for the first prong, the court concluded that evidence established the unanimity among all scientists and lawyers that the theory behind DNA identification is correct. *Id.* at 9. The court then examined the technique used in obtaining the DNA print, and concluded that tests to determine inclusion or exclusion of samples are reliable and meet the *Frye* standard of admissability. *Id.* at 13-32. The court stated, however, that the defense successfully demonstrated that the testing laboratory failed to perform the accepted scientific techniques and experiments in several respects in this particular case. *Id.* at 34. For example, autoradiographs 11 and 12 were the result of hybridization to determine the sex of the person whose blood was on the watch. Male and female controls, however, were not employed in the sex typing; one of the expert witnesses testified that no reputable laboratory would even consider doing sex typing unless both controls were used. Because of this defect, these autoradiographs were deemed inadmissible. *Id.* at 36-37. Also, in autoradiograph five, the hybridization shows three bands in the victim's lane, and five in the watch lane. The three bands in the victim's lane also appeared in the watch lane. However, the existence of the two bands in the watch lane and not in the victim's lane is significant; if the bands were of human origin, then one would have to conclude that the DNA from the victim and from the watch came from two different sources. There was insufficient evidence submitted to conclude that these two bands were the result of bacterial contamination. Experiments

the print is correct, or it does not exist.[82]

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with bacterial probes should have been conducted to see if these two bands were contaminents, and not human DNA. However, because they cannot now be performed (presumably because there is no more of the forensic sample remaining from the watch on which to perform new tests), the evidence is deemed insufficient to determine if there is a match between the victim's blood and the watch blood at the locus tested in that autoradiograph. *Id.* at 38-39. The court then concluded that "the credible testimony having clearly established that the testing laboratory failed to conduct the necessary and scientifically accepted tests, the evidence demonstrating an inclusion is inadmissible as a matter of law." *Id.* at 40.

Although this holding may at first appear to undermine the use of DNA tests in criminal cases, it in fact merely requires that the laboratory performing the technique in the given case has complied with accepted scientific procedures. This holding mandates no more than the type of challenge which would ordinarily be brought by defense attorneys against the use of DNA fingerprinting. Additionally, the court suggested certain pre-trial hearing procedures be followed:

> The proponent, whether defense or prosecution, must give discovery to the adversary, which must include: 1) Copies of autorads, with the opportunity to examine the originals. 2) Copies of laboratory books. 3) Copies of quality control tests run on material utilized. 4) Copies of reports by the testing laboratory issued to proponent. 5) A written report by the testing laboratory setting forth the method used to declare a match or non-match, with actual size measurements, and mean or average size measurement, if applicable, together with standard deviation use. 6) A statement by the testing lab, setting forth the method used to calculate the allele freqency in the relevant population. 7) A copy of the data pool for each loci examined. 8) A certification by the testing lab that the same rule used to declare a match was used to determine the allele frequency in the population. 9) A statement setting forth observed contaminants, the reasons therefore, and tests performed to determine the origin and the results thereof. 10) If the sample is degraded, a statement setting forth the tests performed and the results thereof. 11) A statement setting forth any other observed defects or laboratory errors, the reasons therefore and the results thereof. 12) Chain of custody documents.

Id. at 44-45.

But cf. Spencer v. Commonwealth, Nos. 890096, 890097 (Sup. Ct. Va., Sept. 22, 1989) (LEXIS, VA library, Cases file) where the Virginia Supreme Court upheld a capital murder conviction in a vicious rape-murder case. After briefly describing the technique used in obtaining the DNA fingerprint, the court stated: "[b]ecause the undisputed evidence supports the trial court's conclusion that DNA testing is a reliable scientific technique and that the tests performed here were properly conducted, we hold that the trial court did not err in admitting in evidence the results of the DNA testing." *Id.* at 29-30.

82. The major reason for the test producing no results is the inadequacy of the sample size presented for testing. Currently, 50 microlitres of blood are required in order to perform the test, or approximately 10 microlitres of semen. Sensabaugh & Crim, *Forensic Biology—Is Recombinant DNA Technology in its Future?*, 31 J. FORENSIC SCI. 393, 395 (1986) [hereinafter Sensabaugh]. A microlitre is one millionth of a litre. Fifty microlitres of blood corresponds to a stain roughly the size of a quarter; 10 microlitres of semen corresponds to a stain about the size of a dime. Note, *DNA Identification Tests, supra* note 7, at 918-19. *But see*, Gully & Bird, *Regulation of the Biomedical Applications of Recombinant DNA Research*, 19 U. RICH. L. REV. 1, 6 n.23: "DNA can be obtained from any cell since identical DNA is present in all tissues of the body in equal amounts. If additional DNA is required, the cells can be cultured. Since DNA replicates before each cell division, the amount of DNA doubles with each division in culture." Appar-

In addition to being more accurate than traditional blood grouping tests[83] and the HLA analysis, DNA testing can apply to a wider range of biological material. In fact, DNA analysis has already been performed on two and three year-old bloodstains,[84] semen samples,[85] and an aborted fetus in a rape case;[86] additional sources for DNA are bone

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ently Cetus Corporation, *see supra* note 35, uses a similar technique called polymerase chain reaction, or PCR technology, whereby an enzyme called polymerase is used to "amplify" the target DNA sequence by creating a million or more copies of them. Moss, *supra* note 5, at 69; *see also* Higuchi, von Beroldingen, Sensabaugh & Erlich, *DNA Typing from Single Hairs*, 332 NATURE 543 (1988).

> The most common method of DNA analysis, that of restriction fragment length polymorphism (RFLP), requires microgram amounts of relatively undegraded DNA for multi-locus typing, and hundreds of nanograms for single-locus comparisons. Such DNA frequently cannot be obtained from forensic samples such as single hairs and blood stains, or from anthropological, genetic or zoological samples collected in the field. To detect polymorphic DNA sequences from single human hairs, we have used the polymerase chain reaction (PCR), in which specific short regions of a gene can be greatly amplified *in vitro* from as little as a single molecule of DNA.

Id. (footnotes omitted). This technique is different from the one used by Lifecodes and Cellmark. *See supra* notes 35-57 and accompanying text.

In a telephone interview on Feb. 23, 1989, Karen Wexler, Public Relations Associate of Lifecodes, explained the tradeoff involved with the two techniques: RFLP analysis, *supra* notes 35-57 and accompanying text, can provide better accuracy because the probes used look for sequences of DNA found only in roughly one in one hundred persons; when four or more probes are used, the accuracy of the test is multiplied. It is important, however, to use DNA of high molecular weight, i.e., DNA that has not degraded into smaller fragments, so that the technician performing the test has sufficient DNA with which to work, and thus can control the site of the cuts made by the enzymes. *See also supra* note 49. PCR technology, Wexler explained, can be used with very small samples of DNA. The results with PCR technology, however, are not as accurate because the DNA sequences amplified are not as variable in the general population. *See supra* note 35.

83. For example, these classifications include types A, B or O.

84. *See generally*, Kanter, *supra* note 40.

85. *See* Giusti, *supra* note 61, at 410-13. Giusti explains the procedure used to analyze the semen samples. One-hundred twenty volunteers donated blood and semen samples for comparison studies. *Id.* Additionally, 10 volunteer couples participated in the semen sample studies. Semen was recovered from the female volunteers following sexual activity, and isolated from any vaginal fluids present. Blood from the male and female volunteers, as well as the isolated sperm were analyzed and the resulting hybridization patterns were compared. *Id.* at 410. The sperm and male blood patterns were identical for each individual, and as evidenced by the different pattern of the female sample, did not contain female cells or DNA. *Id.* at 415. The ability to segregate the semen from the vaginal fluid in the sample, and to perform the DNA test accurately on both fluids, shows its enormous importance in rape cases.

86. People v. Bailey, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (County Ct., Albany County 1988) (cases consolidated). In paternity testing, an autoradiograph of the child's, the mother's and the putative father's DNA is made. First, the bands common to the mother and child are identified; then the remaining bands on the child's graph must match the father. *See Immigration Test-case*, *supra* note 4, at 819.

marrow, amniotic fluid, tissue, and tooth pulp.[87] Furthermore, noncellular body fluids, such as saliva, urine, and sweat may carry testable amounts of DNA.[88]

One final point regarding DNA testing is that the Parentage Testing Committee of the American Association of Blood Banks (AABB) has approved a set of standards for quality controls to assure the accuracy of the DNA print test.[89] Additionally, the Forensic DNA

87. *See* Lifecodes Fee Schedules for Forensic and Paternity Cases (available at Fordham Urban Law Journal office). Lifecodes performs DNA testing on these materials, and provides different fee schedules depending on which material is used and how it is obtained.

88. Michaud, *DNA Detectives*, N.Y. Times, Nov. 6, 1988, § 6 (Magazine) at 70, 72. *See also* HASTINGS CENTER REP. 1988 at 3 (Oct./Nov.). Legislation has been introduced in Northern Ireland's House of Commons to take mouthswabs in DNA tests; mouthswabs qualify as "nonintimate body samples" for which consent is not necessary. *Id.*

89. People v. Wesley, 140 Misc. 2d 306, 323-24, 533 N.Y.S.2d 643, 654 n.16 (County Ct., Albany County 1988). Dr. Baird of Lifecodes, *supra* note 35, testified that "he was one of the chief formulators and proponents of these guidelines and that they are currently fully adhered to by Lifecodes even prior to their anticipated adoption by the full Board of the American Association of Blood Banks." *Id.* at 325, 533 N.Y.S.2d at 654. The following standards have been approved for the Parentage Testing Committee at the AABB on May 23, 1988.

AABB PARENTAGE TESTING COMMITTEE STANDARDS FOR TESTS INVOLVING DNA POLYMORPHISM

I. DNA loci used in parentage testing shall meet the following criteria prior to reporting results.
   A. DNA loci shall be validated by family studies to demonstrate that the loci exhibit Mendelian Inheritance and low frequency of mutation and/or recombination, less than 0.002 (2 per 1000).
   B. The chromosomal location of the polymorphic loci used for parentage testing shall be recorded in the Yale Gene Library or by the International Human Gene Mapping Workshop.
   C. Polymorphic loci shall be documented in the literature stating the restriction endonuclease and probes used to detect the polymorphism, the conditions of hybridization and size(s) of variable and constant fragments.
   D. The type of polymorphism detected shall be known (i.e. single locus, multi-locus, simple diallelic, or hypervariable).

II. A method shall be available to assure complete endonuclease digestion of DNA for testing.

III. Size markers with discrete fragments of known size shall span and flank the entire range of the DNA loci being tested.

IV. A human DNA control of known size shall be used on each electrophoretic run.

V. Autoradiographs or membranes shall be read independently by two or more individuals.

VI. DNA reports shall contain at the minimum:
   A. Name of the DNA locus tested as defined by the Nomenclature of the International Human Gene Mapping Workshop.
   B. Probe used to detect the polymorphism.
   C. Restriction endonuclease used to cut the DNA.

Analysis Panel released its report containing recommendations and guidance in the use of DNA technology.[90] Such standards and procedural safeguards provide the type of uniformity in testing conditions which are necessary if a national database is to be established.

DNA testing, however, has certain drawbacks. One is that moisture and bacteria degrade DNA and can make typing impossible.[91] Ideally, samples should be air-dried, and refrigerated or frozen, in order to preserve the sample and prevent possible contamination.[92] Other environmental factors whose effects require more research and experimentation are light,[93] heat,[94] and radiation.[95] Another drawback is the inability to test if the sample is too small.[96]

III. Privacy Issues Implicated by DNA Testing

A major fear of the opponents of DNA testing is that it infringes on an individual's right to privacy.[97] For the most part, however, this fear is unjustified because the resulting DNA print yields no invasive,

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D. Reported allelic fragments shall be listed by size or allelic description (alpha numeric).

VII. Confirmatory testing by an independent laboratory shall be possible for all DNA loci. These laboratories shall meet AABB standards for parentage testing using DNA probes.

90. N.Y.L.J., Sept. 5, 1989, at 2, col. 5. The report is not yet available for inspection.

91. Moss, *supra* note 5, at 68. "Moisture accelerates the degrading of the sample by breaking down the cellular structure and exposing the DNA to the elements." Note, *DNA Identification Tests*, *supra* note 7, at 920 n.83.

92. Moss, *supra* note 5, at 67.

93. Sensabaugh, *supra* note 83, at 395-96. Ultraviolet light is known to cause mutation in DNA sequences. *Id.*

94. *Id.* at 395.

95. Gaensslen, *supra* note 71, at 38. Muller discovered in 1927 that X-radiation can induce mutations (structural changes in genetic materials) in *Drosophilia* flies.

96. Moss, *supra* note 5, at 67; *see also supra* note 84.

97. For example, Colleen O'Connor, a spokeswoman for the American Civil Liberties Union, expressed concern that DNA testing will be misused. N.Y. Newsday, Nov. 25, 1988, at 9, col. 1. O'Connor fears that DNA analysis of crime scene evidence would be used wrongfully to determine skin, eye, and hair color and thus create an unfounded suspicion that a person committed a crime; for example "you could have police round up whole groups of blacks for questioning when they have no probable cause to do that otherwise . . . ." *Id.* This fear is largely unfounded, however, both because of the procedural safeguards such as search warrants and probable cause, discussed *infra* at notes 123-31 and accompanying text, and more importantly because of the limited information obtained from a DNA print. In a telephone conversation on April 14, 1989, Karen Wexler, Public Relations Associate for Lifecodes Corporation, *supra* note 35, explained that the DNA print contains no information about physical characteristics of the person whose blood or semen is analyzed. She confirmed that it is not possible merely to test a blood sample and conclude that it came from a black male with black hair; all forensic samples must be *compared* with samples from a person being tested in order to determine if a match is possible.

substantive information,[98] and because of the procedural safeguards associated with searches and seizures.[99]

A. DNA Test as a Search under the Fourth Amendment

The fourth amendment to the United States Constitution guarantees citizens the right "to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures," and affirms that "no warrant shall issue, but upon probable cause . . . ."[100] The terms "searches" and "seizures" have been interpreted by the courts in numerous cases.[101] A "seizure" has been comparatively easy to define; it is usually said to occur when "there is some meaningful interference with an individual's possessory interests in . . . property."[102] The term "search," however, is more difficult to define. Prior to 1967, courts spoke of searches as "ordinarily impl[ying], a quest by an officer of the law, a prying into hidden places for that which is concealed."[103] Analysis up to this point had focused on the *place* of the search as being within or without a "constitutionally protected area."[104] The Supreme Court's decision in *Katz v. United*

98. *See supra* note 70 and accompanying text.

99. *See infra* notes 101-31 and accompanying text.

100. U.S. CONST. amend. IV.

101. *See infra* notes 103-11 and accompanying text.

102. United States v. Jacobsen, 466 U.S. 109, 113 (1984) (citing United States v. Place, 462 U.S. 696 (1983)).

103. State v. Coolidge, 106 N.H. 186, 191, 208 A.2d 322, 326 (1965). *See also* Silverman v. United States, 365 U.S. 505, 511 (1961) ("[a]t the very core [of the fourth amendment] stands the right of a man to retreat into his own home and there be free from unreasonable governmental intrusion"); Lanza v. New York, 370 U.S. 139 (1962) (public jail is not equivalent of "house," within constitutional protection, where one can claim constitutional immunity from search or seizure of his person, papers or effects); United States v. Lee, 274 U.S. 559 (1927) (search of motorboat by Coast Guard as incident of lawful arrest on high seas held not to violate Constitution); Hester v. United States, 265 U.S. 57 (1924) (protection accorded by fourth amendment to the people in their "persons, houses, papers and effects" is not extended to open fields).

104. Katz v. United States, 389 U.S. 347, 350 (1967). Typical of this reasoning was the Court's assertion in *Hester* that "the special protection accorded by the [f]ourth [a]mendment to the people and their 'persons, houses, papers and effects' is not extended to the open fields." 265 U.S. at 59. Similarly, in Olmstead v. United States, 277 U.S. 438 (1928), the Court held that putting a tap on telephone wires in order to eavesdrop on defendant's conversations did not amount to a fourth amendment search because the "wires are not part of his house or office any more than are the highways along which they are stretched." *Id.* at 465. These and other decisions evolved into a "doctrine" that in order for there to be a "[f]ourth [a]mendment search, the police must have physically intruded into 'a constitutionally protected area.' These areas were those enumerated in the fourth amendment itself: 'persons' . . . 'houses,' including apartments, hotel rooms, garages, business offices, stores, and warehouses; 'papers,' such as letters; and 'effects,' such as automobiles." W. LAFAVE, SEARCH AND SEIZURE: A TREATISE ON THE

States[105] became the seminal case in search and seizure analysis. *Katz* rejected the mechanical "incantation of the phrase 'constitutionally protected area' "[106] and held that "the fourth amendment cannot be translated into a general constitutional 'right to privacy.' "[107] Instead, the Court adopted a new formulation of fourth amendment protection: "[w]hat a person knowingly exposes to the public, even in his own home or office, is not a subject of [f]ourth [a]mendment protection . . . . But what he seeks to preserve as private, even in an area accessible to the public, may be constitutionally protected."[108] Justice Harlan, in his concurring opinion, explained that he understood the majority opinion to mean that "there is a twofold requirement, first that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as 'reasonable.' "[109] This holding, however, seems to have caused more confusion than clarity in its application to fourth amendment questions.[110]

FOURTH AMENDMENT § 2.1(a), at 302-03 (1987) (footnotes omitted) [hereinafter LAFAVE].

105. 389 U.S. 347 (1967).

106. *Id.* at 350.

107. *Id. But cf.* Griswold v. Connecticut, 381 U.S. 479 (1965). In *Griswold*, the Supreme Court discussed various specific guarantees in the Bill of Rights that have "penumbras" creating zones of privacy. Among those guarantees listed were the first amendment's right of association, the third amendment's prohibition against quartering of soldiers during peacetime without the consent of the owner, the fourth amendment's right of freedom from "unreasonable searches and seizures," the fifth amendment's self-incrimination clause, and the ninth amendment's "non-disparagement clause." *Id.* at 483-84. An article written in 1890 by Samuel Warren and Louis Brandeis, *The Right of Privacy*, 4 HARV. L. REV. 193 (1890), is generally considered the first recognition of a general constitutional right to privacy. The authors wrote of intrusion by newspapers into the private affairs of individuals, and advocated protection, under tort law, for dissemination or use of facts related to an individual's private life. *Id.* at 197. They did not consider governmental intrusion.

The Supreme Court in Whalen v. Roe, 429 U.S. 589 (1977), averred that those cases characterized as protecting "privacy" involved two different but connected interests: "[o]ne is the individual interest in avoiding disclosure of personal matters, and another is the interest in independence in making certain kinds of important decisions." *Id.* at 599-600 (footnotes omitted); *see also infra* notes 192-96 and accompanying text. DNA printing falls more appropriately into the former category, concerning disclosure of personal matters, than the latter category, which is concerned with family and marital privacy.

108. Katz v. United States, 389 U.S. 347, 351-52 (1967) (citations omitted).

109. *Id.* at 361 (Harlan, J., concurring).

110. *See* LAFAVE, *supra* note 104, at § 2.1(b), at 307.

> [I]t can hardly be said that the Court produced clarity where theretofore there had been uncertainty. If anything, the exact opposite has occurred. The pre-*Katz* rule, though perhaps 'unjust,' was 'a workable tool for the reasoning of the courts.' But the *Katz* rule, which the Court has since . . . stated as the reasonable 'expectation of privacy' . . . test, is by comparison 'difficult to apply.' In short, the *Katz* 'opinion offers little to fill the void it has thus created.'

Given this framework, the Court has classified the withdrawal of a blood sample to test for blood alcohol as a search under the fourth amendment.[111] The Court explained in *Schmerber v. California*[112] that "[s]uch testing procedures plainly constitute searches of 'persons,' and depend antecedently upon seizures of 'persons,' within the meaning of [the fourth] [a]mendment."[113] Numerous other courts have also held that the withdrawal of blood is a search.[114] More recently, the Supreme Court in *Skinner v. Railway Labor Executives' Association*[115] concluded that urinalysis is also properly considered a search under the fourth amendment.[116]

Id.

111. *See* Schmerber v. California, 384 U.S. 757 (1966). Schmerber had been arrested at a hospital while receiving treatment for injuries suffered in an automobile accident which occurred while he was driving. *Id.* at 758. At the direction of police, a blood sample was withdrawn from his body by a physician at the hospital. *Id.* Analysis of the blood indicated that he was intoxicated, and a report of this analysis was admitted in evidence at his trial, over his objection. *Id.* at 759. Schmerber was then convicted of driving while intoxicated. *Id.* at 758. The case held that because the police already had probable cause to arrest the petitioner for drunk driving, they had reason to believe that evidence of high levels of alcohol in his blood would be found sufficient for them to procure a sample of his blood, and that any delay for the purpose of obtaining a warrant would only result in the destruction of such evidence. *Id.* at 770-71.

112. 384 U.S. 757 (1966).

113. *Id.* at 767. See *supra* note 103 and accompanying text for discussion of seizure.

114. *See, e.g.*, United States v. Harvey, 701 F.2d 800 (9th Cir. 1983) (unless suspect is unconscious or incapable of appreciating significance of arrest, fourth amendment requires a valid and formal arrest of suspect before removal of blood sample); Department of Transp. v. McFarren, 514 Pa. 411, 525 A.2d 1185 (1987) (obtaining of a blood, urine or breath sample is a search and seizure); People v. Corsini, 207 Cal. App. 3d 514, 207 Cal. Rptr. 686 (1984) (taking a blood sample from a conscious injured motorist does not violate fourth amendment provided it is done in a medically approved manner, and is incident to a lawful arrest and is based on a reasonable belief that the person is intoxicated).

115. 109 S. Ct. 1402 (1989).

116. That case involved the constitutionality of regulations promulgated by the Federal Railroad Administration (FRA) requiring blood and urine tests of employees following certain major train accidents or incidents. The Court recognized that the chemical analysis of urine, like blood, can reveal many private medical facts about an individual, and that the collection and testing of urine "intrudes upon expectations of privacy that society has long recognized as reasonable . . . ." *Id.* at 4328. The Court held that the compelling governmental interest served by the regulations outweighed the employees' privacy concerns, and that the regulations did not violate the fourth amendment. *Id.* Similarly, in its companion case, National Treasury Employees' Union v. von Raab, 109 S. Ct. 1384 (1989), the Court upheld a drug-screening program implemented by the United States Customs Service requiring urinalysis tests from Customs Service employees seeking transfer or promotion to positions having direct involvement in drug interdiction or requiring the incumbent to carry firearms or to handle classified information; *see also* McDonnell v. Hunter, 809 F.2d 1302 (8th Cir. 1987) (urinalysis is search and seizure within meaning of fourth amendment); Spence v. Farrier, 807 F.2d 753 (8th Cir. 1986) (same); Bostic v. McClendon, 650 F. Supp. 245 (N.D. Ga. 1986) (governmental taking of urine specimen is "seizure" within meaning of fourth amendment); Capua v. City of

By applying these same principles, DNA testing is properly classified as a search, and the "reasonable expectation" standard of *Katz* must be applied.[117] As the court in *Capua v. City of Plainfield*[118] stated, "[t]he essential purpose of the [f]ourth [a]mendment is to 'impose a standard of reasonableness upon the exercise of discretion by government officials in order to 'safeguard the privacy and security of individuals against arbitrary invasions by government officials.' "[119] The court's analysis of urinalysis is similarly relevant when applied to the taking of blood, tissues, or other bodily fluids in order to determine the pertinent "personal information" contained therein which could be revealed by using a particular probe or set of probes with a DNA print test. A decisive factor to consider is that the autoradiograph or DNA fingerprint merely provides a visual record of the presence and length of certain highly variable and specialized nucleotide sequences which may or may not be present in a particular individual, to be compared with a human DNA control of known size.[120] Hence, the fact that little substantive information actually appears on the resulting autoradiograph substantially reduces the privacy concern with respect to the disclosure of personal information, such as physical size, or the color of a person's skin, hair or eyes.[121]

The declaration of a particular procedure as a "search" does not preclude its evidentiary use. The Supreme Court in *New Jersey v.*

Plainfield, 643 F. Supp. 1507 (D.N.J. 1986) (governmental taking of urine specimen constitutes search and seizure within meaning of fourth amendment).

117. This Note assumes that the test will be performed on blood or semen, not saliva. *See supra* note 89 and accompanying text.

118. 643 F. Supp. 1507 (D.N.J. 1986).

119. *Id.* at 1512 (quoting Delaware v. Prouse, 440 U.S. 648, 653-54 (1979)). The *Capua* court then stated that "[b]oth blood and urine can be analyzed in a medical laboratory to discover numerous physiological facts about the person from whom it came . . . . As with blood, each individual has a reasonable expectation of privacy in the personal 'information' bodily fluids contain. For these reasons governmental taking of a urine specimen constitutes a search and seizure in the meaning of the [f]ourth [a]mendment." *Id.* at 1513.

120. *See generally* AABB guidelines, *supra* note 89; *see also* photograph, *supra* at page 329.

121. In a telephone interview on April 14, 1989, Karen Wexler, Public Relations Associate of Lifecodes Corporation, confirmed that the resulting DNA prints contain no personal information about the person tested. She explained that although current technology is able to recognize the genes for hemoglobin and certain hormones, it is now not possible to identify the genes that make physical characteristics, so it is impossible to perform a DNA test on a blood sample and conclude, for example, that it came from a black man with black hair. Wexler emphasized the fact that the area of the DNA which is analyzed does not give any physical characteristics of the donor. She stressed that these tests are performed by *comparing* the DNA of a forensic sample, with the sample of a known individual to see if the two match. *See supra* note 70 and accompanying text.

T.L.O.[122] explained that although the fourth amendment demands all searches and seizures to be reasonable, what is reasonable depends on the context of the search.[123] This requires balancing the individual's invasion of privacy against the government's need for the search.[124] In New York paternity or support proceedings, a court can order the mother, child, and putative father to "submit to one or more blood genetic marker tests by a duly qualified physician or by a laboratory duly approved for this purpose by the commissioner of health to determine whether or not the alleged father can be excluded as being the father of the child."[125] DNA fingerprinting, therefore, would qualify as a legitimate test which could be ordered in such a situation.[126]

Similarly, in criminal cases, a search warrant would be the required means of procuring blood for examination. The applicable New York statute provides for the taking of blood, hair, or other bodily materials from a defendant, pursuant to court order.[127] The New York Court of Appeals in *In re Abe A.*[128] set forth a balancing test to scrutinize the procurement of a blood sample from a suspect, pursuant to a court order, for scientific analysis in connection with a crime. The court held that before a court can issue an order compelling a blood sample, the prosecution must establish: "(1) probable cause to believe the suspect has committed the crime, (2) a 'clear indication' that relevant

122. 469 U.S. 325 (1985).

123. *Id.* at 337.

124. *Id.* The Court elaborated: "[o]n one side of the balance are arrayed the individual's legitimate expectations of privacy and personal security; on the other, the government's need for effective methods to deal with breaches of public order." *Id.* The Court held that a search of a student's property by school officials did not violate the fourth amendment.

125. N.Y. FAM. CT. ACT § 532(a) (McKinney Supp. 1989); *see also* N.Y. CIV. PRAC. L. & R. § 3121(c). New York's statutes allow inclusionary results only if HLA is one of the tests performed. *See supra* notes 10, 72-82 and accompanying text. Until DNA testing is specifically addressed by the statute, it can be admitted only if HLA is also performed. For a survey of the use of genetic testing, see Kaye & Kanwischer, *Admissibility of Genetic Testing in Paternity Litigation: A Survey of State Statutes*, 22 FAM. L.Q. 109 (1988).

126. DNA testing is subject to the limits noted *supra* note 114.

127. N.Y. CRIM. PROC. LAW § 240.40(2)(b)(v) provides:

> [u]pon motion of the prosecutor, and subject to constitutional limitation, the court in which an indictment, superior court information, prosecutor's information, information, or simplified information charging a misdemeanor is pending . . . may order the defendant to provide non-testimonial evidence. Such order may, among other things . . . [p]ermit the taking of samples of blood, hair or other materials from his body in a manner not involving an unreasonable intrusion thereof or a risk of serious physical injury thereto.

N.Y. CRIM. PROC. LAW § 240.40(2)(b)(v) (McKinney 1982 & Supp. 1990); *see also infra* notes 129-31 and accompanying text.

128. 56 N.Y.2d 288, 437 N.E.2d 265, 452 N.Y.S.2d 6 (1982).

material evidence will be found, and (3) the method used to secure it is safe and reliable."[129]

Under the *Abe A.* balancing test, therefore, if sufficient other evidence establishes probable cause linking a suspect to a crime, as the first prong requires, then the accuracy of identification which the DNA test provides (e.g., in a rape case) would always satisfy the second prong, and a search warrant would issue to obtain a blood sample for further evidence.[130]

B. Admissibility Under *Frye v. United States*

The case which set the standard for the admissibility of evidence derived from new scientific techniques was *Frye v. United States.*[131] The court held that "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 par-

129. *Id.* at 291, 437 N.E.2d at 266, 452 N.Y.S.2d at 7. The court, in requiring the second criterion here, followed Schmerber v. California, 384 U.S. 757 (1966), which required "a clear indication that in fact [desired] evidence will be found . . . ." *Id.* at 770. *But see* United States v. Montoya de Hernandez, 473 U.S. 531 (1985) ([a]t the international border, routine searches of the persons and effects of entrants are not subject to any requirement of reasonable suspicion, probable cause, or warrant). The *Abe A.* court continued: "[i]n addition, the issuing court must weigh the seriousness of the crime, the importance of the evidence to the investigation and the unavailability of less intrusive means of obtaining it, on the one hand, against concern for the suspect's constitutional right to be free from bodily intrusion on the other. Only if this stringent standard is met . . . may the intrusion be sustained." 56 N.Y.2d at 291, 437 N.E.2d at 266, 452 N.Y.S.2d at 7. The court continued, asserting that "that the New York search warrant statute, N.Y. CRIM. PROC. LAW § 690.05(2) (McKinney 1984), empowers a criminal court "to conduct a search . . . of a designated person, for the purpose of seizing designated property," which, as defined in N.Y. CRIM. PROC. LAW § 690.10(4) (McKinney 1984) "[c]onstitutes evidence or tends to demonstrate that an offense was commited or that a particular person participated in the commission of an offense." *Id.* The court concluded that "[i]t requires no reach then to hold that the blood samples which are the target of order in the proceeding before us now come well within these provisions." *Id.* at 294, 436 N.E.3d at 268, 452 N.Y.S.2d at 9. Although the New York search warrant statute does not specifically address taking blood samples, the court reasoned that "[n]omenclature notwithstanding, if the application and the relief comport with all the requisites of a search warrant, it may be taken for what it is." *Id.* (citing with approval People v. Marshall, 69 Mich. App. 288, 300, 244 N.W.2d 451, 458 (1976)).

130. Additionally, the removal of blood for analysis does not violate the fifth amendment privilege against self incrimination. The Court in Schmerber v. California, 384 U.S. 757 (1966), held that "the [fifth amendment] privilege protects an accused only from being compelled to testify against himself, or otherwise provide the [s]tate with evidence of a testimonial or communicative nature, and that the withdrawal of blood and use of the analysis in question in this case did not involve compulsion to these ends." *Id.* at 761 (footnote omitted).

131. 293 F. 1013 (D.C. Cir. 1923).

ticular field in which it belongs."[132] This holding "imposes a special burden—the technology must be *generally accepted by the relevant scientific community.*"[133]

The New York Court of Appeals in *People v. Middleton*[134] spoke of the *Frye* test as "not whether a particular procedure is unanimously endorsed by the scientific community, but whether it is generally acceptable as reliable."[135] One problem with the *Frye* test is that

> [a] literal reading of *Frye v. United States* would require that the courts always await the passing of a 'cultural lag' during which period the new method will have had sufficient time to diffuse through scientific discipline and create a requisite body of scientific opinion needed for acceptability. This delay, according to critics, deprives the courts of reliable evidence.[136]

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132. *Id.* at 1014.

133. Giannelli, *Frye v. United States, a Half-Century Later*, 80 COLUM. L. REV. 1197, 1205 (1980) (emphasis in original) [hereinafter Giannelli]. Giannelli states that "[t]he reliability of evidence derived from a scientific principle depends upon three factors: (1) the validity of the underlying principle, (2) the validity of the technique applying that principle, and (3) the proper application of the technique on a particular occasion." *Id.* at 1200-01.

134. 54 N.Y.2d 42, 429 N.E.2d 100, 444 N.Y.S.2d 581 (1981).

135. *Id.* at 49, 429 N.E.2d at 103, 444 N.Y.S.2d at 584.

136. Giannelli, *supra* note 134, at 1223 (quoting MALETCKOS & SPIELMAN, *Introduction of New Scientific Methods in Court*, in LAW ENFORCEMENT SCIENCE & TECHNOLOGY 957, 958) (footnotes omitted)).

A recent commentator has proposed a new test to "resolve [the] long-standing debate about whether scientific evidence should be subject to the same rule of relevancy as any other evidence or to the test of *Frye v. United States*, which is still followed in most jurisdictions." Black, *A Unified Theory of Scientific Evidence*, 56 FORDHAM L. REV. 595, 601 (1988) [hereinafter Black]. The author speaks of the scientific question as one of "*validity*, with the answer depending on accepted scientific practice and the soundness and cogency of the entire pattern of reasoning leading to the expert's conclusion." *Id.* (emphasis in original) (footnote omitted). The legal question, he states, "relates to how much *reliability* the law requires, with the answer depending on legal standards." *Id.* at 600 (emphasis in original) (footnote omitted). The solution he proposes is a modification of Rule 702 of the Federal Rules of Evidence "to require explicitly that testimony be based on valid scientific reasoning *and* that it be reliable enough to satisfy threshold legal requirements for admissibility." *Id.* at 611 (emphasis in original). Rule 702 presently states that "[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise." FED. R. EVID. 702. Black proposes to amend this rule by adding the following twofold test: "[w]hen the witness offers testimony based on scientific knowledge, such testimony shall be admitted only if the court determines that the opinion: 1) is based on scientifically valid reasoning; and 2) is sufficiently reliable that its probative value outweighs the dangers specified in Rule 403." Black, *supra*, at 611. Black cites People v. Collins, 94 Misc. 2d 794, 405 N.Y.S.2d 365 (1987), as one of the few courts which used the type of validity and reliability approach which he advocates. *Id.* at 644-45. That court held that " 'the standard which must be applied to the admissibility

The court in *United States v. Downing*,[137] in considering the admissibility of new scientific evidence which had "no established 'track record' in litigation,"[138] enumerated certain factors a court should examine, such as the "relationship [of the new technique] to more established modes of scientific analysis . . . [and] [t]he existence of a specialized literature dealing with the technique."[139] These factors, the court stated, "bear on the likelihood that the scientific basis of the new technique has been exposed to critical scientific scrutiny."[140] The court held that the admission of expert testimony is not automatic, but conditional,[141] and that the court retains the authority under Rule 403 of the Federal Rules of Evidence "to exclude any relevant evidence that would unduly waste time or confuse the issues at trial."[142]

Members of the relevant scientific community have done a substantial amount of research in this area, and have published their findings.[143] In *People v. Wesley*,[144] New York's first case to discuss DNA

. . . of any scientific test, is the twofold test of reliability and general scientific acceptance.' " *Id.* at 645 (quoting *Collins*, 94 Misc. 2d at 706, 405 N.Y.S.2d at 367).

137. 753 F.2d 1224 (3d Cir. 1985).

138. *Id.* at 1238.

139. *Id.*

140. *Id.* at 1238-39.

141. *Id.* at 1226. Under FED. R. EVID. 702, the admission is conditioned on the balancing of two factors: 1) the reliability of the scientific principle upon which the expert relies, and its potential for aiding the jury to resolve the disputed issue; and 2) the likelihood that the testimony may "overwhelm or mislead the jury." *Id.*

142. *Id.* Because of the high statistical accuracy associated with DNA testing, the question of overwhelming the jury could arise. In the trial of Victor Lopez, the "Forest Hills Rapist," DNA analysis was admitted into evidence, and Lopez was convicted. N.Y. Newsday, Oct. 20, 1988, at 7, col. 1. After the verdict, some jurors commented on the weight of the DNA evidence: "[the] [j]ury forewoman . . . said that she would not have voted for the conviction without the DNA evidence. . . . Another juror . . . said that the DNA evidence was 'just icing on the cake.' " *Id.* at 31, col. 2. Although there is the possibility that juries will overestimate the weight given to DNA analysis, the same possibility exists with regard to *any* evidence introduced at trial, and Rule 403 of the Federal Rules of Evidence allows the exclusion of any relevant evidence that would cause unfair prejudice, confuse the issues, mislead the jury, or unduly waste time.

143. *See, e.g.*, *Hypervariable Minisatellite*, *supra* note 4; *Immigration Test-case*, *supra* note 4; White, *supra* note 26; Kanter, *supra* note 40; Giusti, *supra* note 61; Jeffreys, Wilson & Thein, *Individual-specific 'Fingerprints' of Human DNA*, 316 NATURE 76 (1985) [hereinafter *Individual-specific Fingerprints*]; Jeffreys, Wilson, Thein, Weatherall & Ponder, *DNA 'Fingerprints' and Segregation Analysis of Multiple Markers in Human Pedigrees*, 39 AM. J. HUM. GENETICS 11 (1986); Baird, Balazs, Giusti, Miyazaki, Rubenstein & Sussman, *Allele Frequency Distribution of Two Highly Polymorphic DNA Sequences in Three Ethnic Groups and its Application to the Determination of Paternity*, 39 AM. J. HUM. GENETICS 489 (1986); Odelberg, Demers, Westin & Hossaini, *Establishing Paternity Using Minisatellite DNA Probes When the Putative Father is Unavailable for Testing*, 33 J. FORENSIC SCI. 921 (1988); Wainscoat, Pilkington, Peto, Bell & Higgs, *Allele-Specific DNA Identity Patterns*, 75 HUM. GENETICS 384 (1987). *But see* N.Y. Times, Jan. 29, 1990, at 1, col. 1 ("Some Scientists Doubt the Value of 'Genetic Fingerprint' Evidence").

fingerprinting and its forensic uses, an expert witness[145] testified that experimentation has shown that heat, humidity, and ultraviolet light do not seem to affect adversely the integrity of DNA and the DNA print test.[146] Assuming that the test would be performed by Lifecodes Corporation[147] if so ordered by the court,[148] all of the probes used by Lifecodes are known in the scientific community and have been evaluated by independent scientists.[149] Furthermore, all the probes used by Lifecodes have been accepted and published by the Human Gene Mapping Conference.[150] The court in *People v. Wesley*[151] concluded that

> DNA [f]ingerprinting—its underlying principles, procedures and technology—is a scientific test that is reliable and has gained general acceptance in the scientific community and in the particular fields thereof in which it belongs—to wit, molecular biology, popu-

144. 140 Misc. 2d 306, 533 N.Y.S.2d 643 (County Ct., Albany County 1988).

145. The expert was Dr. Michael L. Baird, Director of Paternity and Forensic Evaluation for Lifecodes Corporation, and member of the DNA subcommittee of the Parentage Testing Committee of the American Association of Blood Banks.

146. *Wesley*, 140 Misc. 2d at 325, 533 N.Y.S.2d at 655. *But see supra* notes 92-97 and accompanying text. Recognition that these factors could adversely affect the production of the DNA print by degrading the DNA does not mean that the test or the principles on which it is based is not generally accepted in the scientific community. Rather, because the relevant scientific community has notice of such possible reactions, it can issue guidelines on the handling of samples, *e.g.*, in criminal proceedings, samples taken from the crime scene itself, and those taken directly from a suspect, or in a civil proceeding, from a putative father for paternity testing. *See supra* note 93 and accompanying text.

147. *See supra* note 35. Its location in Valhalla, New York would make Lifecodes the most convenient choice for courts in the New York area, and also for courts in the Northeastern and Atlantic states. In New York, Lifecodes performed the DNA tests in *Wesley*, 140 Misc. 2d 306, 533 N.Y.S.2d 643, People v. Lopez, N.Y.L.J. Jan. 6, 1989, at 29, col. 1 (Sup. Ct. Queens County 1988), and a Westchester rape prosecution against Sammie Scheff, which excluded him from suspicion. N.Y. Daily News, Jan. 14, 1989, at 4, col. 1. Lifecodes also performed the test in Andrews v. State, 533 So.2d 841 (Fla. App. 1988).

148. *E.g.*, N.Y. CRIM. PROC. LAW § 240.40(2)(b)(v) (McKinney 1982 & Supp. 1989), *supra* note 128; N.Y. CRIM. PROC. LAW §§ 690.05-.10 (McKinney 1984), *supra* note 130; N.Y. FAM. CT. ACT § 532 (McKinney Supp. 1989), *supra* note 10.

149. *Wesley*, 140 Misc. 2d at 325, 533 N.Y.S.2d at 655. In fact, several of the probes used by Lifecodes in its identification test were developed by scientists outside of the corporation.

150. *Id.*

> The Human Gene Mapping Conference is a prestigious international organization of scientists that has adopted the responsibility of mapping the human genome. It meets every two years for the purpose of registering newly discovered gene (allele) loci and probes and assigning names or numerical designation to them. Listing with the Human Gene Mapping Conference of a locus or a probe is equivalent to general acceptance thereof by the scientific community.

Id. at 322, 533 N.Y.S.2d at 653-54.

151. 140 Misc. 2d 306, 533 N.Y.S.2d 643.

> lation genetics and diverse other branches of genetics, chemistry, biology, and biochemistry.[152]

Wesley is not the only court which accepts the reliability of DNA tests as evidence. In *Andrews v. State,*[153] a Florida appellate court recently upheld a conviction of aggravated battery and sexual battery obtained in the trial court with the use of DNA fingerprints. The court, in holding the evidence admissible, looked at factors which supported its reliability: its utilization for approximately ten years as a reliable, well-established procedure which was performed in laboratories worldwide; its use in the diagnosis, treatment and study of genetically inherited diseases;[154] and the existence of a specialized volume of scientific literature in support of the procedure.[155] The court also commented on judicial recognition of this type of evidence in other courts.[156]

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152. *Id.* at 332, 533 N.Y.S.2d at 659 (footnote omitted). The court noted initially that the admissibility of DNA fingerprinting was a matter of first impression in New York; therefore

> it was necessary herein that a *Frye* hearing be held to determine the admissibility of this new kind of scientific evidence. Because of the . . . overwhelming implications of DNA fingerprinting, it was necessary that this hearing be both extensive and intensive, so that a record be produced of a quality and thoroughness sufficient for the Court of Appeals ultimately to decide this matter. This resulted in a sharply contested hearing . . . entailing the testimony of numerous witnesses prominent in the scientific fields of molecular biology, population genetics, and other diverse areas of genetics and human genetics, producing a transcript of over [1,000] pages.

Id. at 309, 533 N.Y.S.2d at 644-45. Based on the findings of the hearings and the evidence presented at trial, the *Wesley* court concluded that the test is reliable and acceptable in the New York courts.

A New York Surrogate Court relied on *Wesley* in a determination of paternity suit, *In re* Baby Girl S., 140 Misc. 2d 299, 532 N.Y.S.2d 634 (Sur. Ct., N.Y. County 1988). The court noted that *Wesley*, being a criminal case, required a hearing on the test's reliability and general acceptance (which hearing was duly held), but that § 532(a) of the Family Court Act "specifically provides for the admission into evidence of blood genetic marker tests." 140 Misc. 2d at 303-04, 532 N.Y.S.2d at 637.

153. 533 So. 2d 841 (Fla. App. 1988).

154. *Id.* at 849. The court stated that "[t]his extensive nonjudicial use of the test is evidence tending to show the reliability of the technique." *Id.* at 849-50; *see also id.* at 848 n.7, where the court quotes extensively from MOENSSENS, INBAU & STARRS, SCIENTIFIC EVIDENCE IN CRIMINAL CASES (3d ed. 1986) [hereinafter MOENSSENS], that the techniques used here were subject to extensive experimentation and verification by scientists who did not choose to offer the techniques to forensic investigators as soon as their hypotheses were formulated. The court also noted that neither *Frye* nor the Florida evidence code required impartiality of expert witnesses. 533 So. 2d at 849 n.9 (citing Giannelli, *supra* note 134, at 1216). *See also infra* note 162 and accompanying text.

155. 533 So. 2d at 849-50.

156. *Id.* at 850 n. 10 (citing *In Re* Baby Girl S., 140 Misc. 2d 299, 532 N.Y.S.2d 634 (Sur. Ct., N.Y. County 1988) (paternity case); State v. Apanovitch, 33 Ohio St. 3d 19, 514 N.E.2d 394 (1987) (capital case), where one of the justices, wondered why the State

Furthermore, a New York court in *People v. Lopez*[157] held a pretrial *Frye* hearing in order to present evidence with regard to the results of a DNA print comparison conducted by Lifecodes to be used against Lopez, who was charged with rape, sodomy and burglary.[158] In admitting the DNA print comparison, the court found that the technique used by Lifecodes passed the three requirements of *Frye*: namely, that the scientific principles underlying the test have been established by the scientific community, that its theoretical application was generally accepted in the relevant scientific community, and that the technology had been applied correctly and in conformance with accepted scientific principles in Lopez's case.[159] The court set guidelines to facilitate admissibility of this evidence, and stated that the "most persuasive aspect of the test . . . is the frequencies attributed to the particular probes."[160] While recognizing that *Frye* does not require impartiality, the court found that any probe used in genetic fingerprinting tests should pass peer review of independent experts who had no financial stake in the acceptance of the test.[161]

Although DNA testing implicates a suspect's fourth amendment and privacy rights, there are procedural safeguards which adequately protect him. Initially, a valid search warrant with all of its required formalities[162] must be properly executed before a blood sample can be obtained. Furthermore, before the evidence can be admitted, a *Frye* hearing or other inquiry, is necessary to insure the validity of the scientific evidence and its reliability in a legal forum.[163] The court can also exercise its discretion and exclude the evidence under Rule 403 of the Federal Rules of Evidence;[164] for example, if the court finds that

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had not ordered the test performed: "[i]t is unfortunate that the state failed to utilize these procedures, which could have made the issue of this defendant's guilt or innocence far less murky." 514 N.E.2d at 405-06 n.4, 33 Ohio St. 3d at 31 n. 4 (Brown, J., concurring in part and dissenting in part).

157. N.Y.L.J., Jan. 6, 1989, at 29, col. 1 (Sup. Ct., Queens County 1988).

158. *Id.*

159. *Id.* Dr. Kevin McElfresh, whom the court qualified as an expert in the field of population genetics, testified as to the "reliability of the frequencies allocated to each probe," or how often the regions detected by the probe would randomly appear in the general population. He concluded that the frequencies determined by the probes used fell in the expected statistical range, and further testified that the probes were tested against a database of approximately 1000 individuals; the American Association of Blood Banks requires a minimum of only 200 individuals to allow for a valid statistical analysis.

160. *Id.*

161. *Id; see also supra* note 155.

162. For example, the Court in Schmerber v. California, 384 U.S. 757 (1966), implied that obtaining blood from a suspect *after* his arrest did not violate his fourth amendment right; *see also supra* notes 128-31 and accompanying text.

163. *See supra* notes 134, 137.

164. FED. R. EVID. 403; *see also supra* note 143 and accompanying text.

the evidence unfairly prejudices or confuses the jury, it could conceivably exclude the evidence.

Given these procedures and the protections they afford, a DNA fingerprint will not violate a suspect's fourth amendment rights. Furthermore, because the test does not reveal any invasive or private information, the DNA fingerprint does not violate a suspect's right to privacy.

IV. Need for a National DNA Data Base

A. Benefits of a National DNA Data Base

The accuracy of identification which is possible with DNA fingerprinting, and its use in inculpating criminals or exculpating wrongly accused suspects are strong arguments in favor of obtaining blood samples from suspected violent criminals for inclusion in a data base. The court in *People v. Wesley*[165] summarized the advantages of utilizing this new technology: the "immediate advantage" of DNA fingerprinting is "the claimed certainty of identification."[166] If it is acceptable in criminal courts, it will "revolutionize the administration of criminal justice."[167] Where applicable, it would "reduce to insignificance the standard alibi defense" and would also "tend to reduce the importance of eyewitness testimony."[168] Furthermore, the court added that DNA fingerprinting could "constitute the single greatest advance in the 'search for truth,' and the goal of convicting the guilty and acquitting the innocent, since the advent of cross-examination."[169]

A further benefit will be in the area of clogged calendar and judicial resources, where DNA fingerprinting will "revolutionize the disposition of criminal cases."[170] Regarding this benefit, the *Wesley* court explicitly recognized the need for a data base of DNA prints and advocated its use: "the compilation of a DNA fingerprint data base, such as that in existence for ordinary fingerprints, will enormously enhance the ability of law enforcement to reduce the number of unsolved crimes that currently occur daily."[171]

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165. 140 Misc. 2d 306, 533 N.Y.S.2d 643 (County Ct., Albany County 1988).
166. *Id.* at 308, 533 N.Y.S.2d at 644.
167. *Id.*
168. *Id.*
169. *Id.*
170. *Id.*
171. *Id.* For example, on January 7, 1989, Dr. Kathryn Hinnant was raped and murdered in her office at Bellevue Hospital in New York. The suspect, Steven Smith, originally pleaded not guilty to charges of raping, sodomizing, robbing and murdering Dr. Hinnant. However, DNA prints of the semen recovered from the doctor's body and

B. Current Implementation of DNA Testing

Not only will criminal cases be resolved more easily with the use of DNA prints, but paternity trials may be virtually doomed by the increasing use of DNA tests. One lawyer in a paternity suit predicted that if the trend of using DNA tests continues, "paternity lawyers would soon do little but negotiate settlements and argue over whether the DNA tests were performed correctly."[172] The Federal Bureau of Investigation (FBI) enthusiastically advocates the use of the DNA test and print,[173] and has proposed a computerized forensic data base.[174] Furthermore, the FBI has opened its laboratory in Washington, D.C. to police departments throughout the United States for the identification of suspects in criminal investigations.[175] Several states such as California, Washington and New York, are presently preparing their own data bases.[176] Furthermore, California passed a law in 1985 mandating that all convicted sex offenders provide blood and saliva samples at the time of their release from prison.[177]

Similarly, in Washington State's King County, an ordinance has been passed, effective January 1989, for the collection of DNA samples from all convicted sex offenders for the compilation of a DNA library for use in future crime investigations.[178] The likely motivation for this legislation was the conviction of Alan J. Haynes for the rape of a fifty-seven year old woman with Alzheimer's disease, who did not remember the crime.[179] DNA fingerprinting was performed on the semen sample recovered from the victim's undergarments and com-

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dress matched the prints produced from Smith's blood sample; additionally, tests performed on Dr. Hinnant's blood matched stains found on Smith's hospital pants, shirt and jeans. The suspect subsequently changed his plea to not guilty by reason of insanity. N.Y. Newsday, May 20, 1989, at 7, col. 1. The jury rejected Smith's insanity defense and convicted him of robbery, rape and murder. N.Y. Times, Oct. 31, 1989, at B1, col. 6.

172. N.Y. Times, Jul. 21, 1989, at B9, col. 3.

173. N.Y. Times, Nov. 6, 1988, § 6 (Magazine), at 72. John W. Hicks, a deputy assistant director of the FBI, views DNA testing as "the most significant thing for the century." *Id.* The FBI plans to open its own DNA identification laboratory. *Id.*

174. *Id.* at 73.

175. N.Y. Times, Jun. 12, 1989, at B1, col. 1. The F.B.I. noted that in one serial rape case in Florida, the police asked the F.B.I. to perform DNA analysis on vaginal swabs from seven women. The results revealed that one suspect was responsible for five of the rapes, but that two "copycats" were involved in the other rapes. *Id.* at B8, col. 2.

176. *See infra* notes 178-83 and accompanying text.

177. N.Y. Times, Nov. 6, 1988, § 6 (Magazine), at 73. Steve Helsley, chief of the California Attorney General's Bureau of Forensic Services, confirmed that the more than 4200 samples already collected will be submitted for DNA testing and will provide the basis for a computerized data bank. *Id.*

178. Toufexis, *Convicted by Their Genes*, TIME, Oct. 31, 1988 at 74.

179. N.Y. Times, Nov. 6, 1988, § 6 (Magazine), at 70.

pared with samples obtained from Haynes.[180] When faced with the statistical evidence that the semen sample recovered from the victim's undergarments could have come from only one in 3.5 million people, and finding no expert to dispute that statistic, Haynes pleaded guilty as charged.[181]

Furthermore, the bar-coded autoradiograph is eminently conducive to digitalized computer storage; the print displays the bands of DNA sequences marked according to their size,[182] and is easier to store on a computer than the swirls and whirls of a traditional fingerprint.

C. Potential Problems with a National DNA Data Base

Two issues arise regarding a national data base and its relationship to privacy rights. The first is obtaining the physical material to produce the print for inclusion in the proposed data base. The second is the use—and possible abuse—of the stored information.

As far as obtaining the samples for inclusion in a data base, at least two methods are possible: (1) mandatory or routine collection from convicted violent felons (as used in California, New York, and Washington); and (2) voluntary contribution by individuals. As previously discussed,[183] taking blood from a suspect pursuant to a search warrant after arrest would be an effective source of samples for a data base. The earliest "traditional" fingerprint files were also compiled from prisoners,[184] and arguably, society has a substantial interest in

180. In a telephone interview on April 14, 1989, Karen Wexler, Public Relations Associate of Lifecodes Corporation, confirmed that a comparison between the forensic evidence recovered from the crime and a blood sample from the suspect is necessary in order to identify the one with the other. This comparison was performed in Haynes' case.

181. N.Y. Times, Nov. 6, 1988, § 6 (Magazine), at 70. New York City will also begin routine DNA testing in virtually all homicide investigations early in 1989. N.Y. Newsday, Nov. 25, 1988, at 9, col. 1.

182. The DNA is measured in kilobases (kB) or thousands of base pairs. *See supra* note 57.

183. *See supra* notes 128-31 and accompanying text.

184. E. BLOCK, SCIENCE VS. CRIME: THE EVOLUTION OF THE POLICE LAB 41-53 (1979) [hereinafter BLOCK]. Block states that the New York Police Department began fingerprinting all arrested persons in 1903. *Id.* at 46; *see also* A.A. MOENSSENS, FINGERPRINTS AND THE LAW (1969): "[o]fficially, fingerprint science was adopted in the United States in 1902, when Dr. Henry P. DeForest, Chief Medical Examiner of the New York Civil Service Commission, started fingerprinting all civil service applicants." *Id.* at 7-9. As various law enforcement agencies began to take fingerprints, central organizing body became necessary to maintain and correlate the records for use by authorities throughout the country. BLOCK, *supra*, at 48. Originally, convicts were to maintain the files, but this arrangement led to altered and inaccurate records. *Id.* at 48-49. Finally, when J. Edgar Hoover was appointed head of the FBI in May, 1924, he decided that all criminal records were to be in his care and he quickly started to assemble the massive collection of records presently filed in Washington. *Id.* at 49.

protecting its citizens by utilizing a procedure which can accurately identify criminals.

As previously noted,[185] the information contained on a DNA print consists only of the presence and length of certain nucleotide sequences found in an individual's DNA, as compared to a sample of known size. Substantive information, such as genetically linked diseases, cannot be obtained from the resulting print, unless the technician originally sought to look for that information by choosing certain probes and enzymes.[186] The presence and size of nucleotide sequences on the DNA print reveal no substantive information,[187] but merely form a series of lines with their corresponding sizes indicated; thus, the DNA print should be characterized and treated more as a traditional fingerprint. Arguably, the potential privacy problem is less in the DNA print than in the results of urinalysis, which is often used to determine alcohol or drug use.[188] Any potential privacy problem could be diminished by selecting probes which, instead of binding to "invasive" base sequences (i.e. those that are coded for genetic disorders), bind to those sequences of DNA which are considered more "benign."[189] Also, because different combinations of restriction enzymes and probes would produce very different patterns on an autoradiograph,[190] a successful national data base would have to declare a particular set of probes used in connection with a specific set of enzymes as the standard for all prints used and collected; those prints produced which did not conform with the declared standards would be deemed unacceptable for inclusion in the data base.

Several cases involving the use or disclosure of personal or medical records provide useful analogies concerning the issue of privacy in a DNA data base. In *Whalen v. Roe,*[191] the United States Supreme Court discussed the question of whether New York State could keep computer files of the names and addresses of all person who have obtained, pursuant to a doctor's prescription, certain drugs classified as

185. *See supra* notes 67-70 and accompanying text.

186. *Id.*

187. *See supra* note 70 and accompanying text.

188. *See supra* note 117 and accompanying text.

189. James Watson, co-discoverer of the double helix, is directing a new research project: to map all of the genes in the human genome, an endeavor which is expected to take 10 to 15 years. N.Y. Newsday, Jan. 24, 1989, Part III (Discovery), at 5.

190. In a telephone conversation on Feb. 23, 1989, Karen Wexler, Public Relations Associate of Lifecodes Corporation stated that probes must be used in connection with certain enzymes in order to obtain a correct print. She confirmed that by varying the probes and the enzymes used, a large, but not infinite, number of different prints would result.

191. 429 U.S. 589 (1977).

potentially harmful.[192] The Court held that "neither the immediate nor the threatened impact" of the statute was "sufficient to constitute an invasion of any right or liberty protected by the [f]ourteenth [a]mendment."[193] In so holding, the Court noted three factors: first, the statutory prohibition of publicly disclosing this information; second, the stringent safeguards to which the Department of Health adhered in retaining the forms;[194] and third, the possibility of voluntary disclosure by the patient, physician or pharmacist.[195] Clearly, the state's interest in the information contained in the files, plus the numerous safeguards imposed, outweighed the perceived privacy violation.

In *United States v. Westinghouse*,[196] the court considered the privacy interest of employees over information in their medical records, and the significant public interest in research designed to improve occupational safety and health.[197] The court admitted that an em-

192. *Id.* at 591-92. The state was concerned that certain drugs, such as opium and its derivatives, cocaine, methadone, and amphetamines, which have both legitimate and illegitimate uses, were being diverted into "unlawful channels." *Id.* at 591. The state enacted the New York State Controlled Substances Act of 1972, which required that prescriptions for these drugs be prepared in triplicate on an official form, containing the name of the prescribing physician, the pharmacy, the drug, the dosage, and the patient's name, address, and age. *Id.* at 593. One copy would be kept by the physician, another by the pharmacist, and the third had to be filed with the State Department of Health, where the information was coded and recorded on magnetic tapes for computer storage. *Id.* The forms were returned to a "receiving room," protected by an alarm system and a locked wire fence, and were destroyed after five years as required by the statute. *Id.* at 594. Further, Pub. Health Law § 3371 (codified as amended at 10 N.Y.C.R.R. § 80.107 (1973)), expressly prohibited public disclosure of the identity of patients whose records were thus retained. *Id.* at 594 n.12.

193. *Id.* at 603-04. The Court's discussion of fourteenth amendment rights or liberties was based on its reading of Roe v. Wade, 410 U.S. 113 (1973), where the Court "expressed its opinion that the 'right of privacy' is founded on the [f]ourteenth [a]mendment's concept of personal liberty." 429 U.S. at 598 n.23 (quoting Roe v. Wade, 410 U.S. at 152-53). The Court added a "final word" about related issues: "the enforcement of the criminal laws . . . require[s] the orderly preservation of great quantities of information, much of which is personal in character and potentially embarassing or harmful if disclosed. The right to collect and use such data for public purposes is typically accompanied by a concomitant statutory or regulatory duty to avoid unwarranted disclosures." Whalen v. Roe, 429 U.S. 589, 605 (1977).

194. *See supra* note 193.

195. *See Whalen*, 429 U.S. at 600.

196. 638 F.2d 570 (3rd Cir. 1980).

197. The National Institute for Occupational Safety and Health (NIOSH) was asked by an officer of the International Union of Electrical Workers at Westinghouse Electric Corporation's plant in Trafford, Pennsylvania, to conduct a health hazard evaluation at that facility. *Westinghouse*, 638 F.2d at 572. NIOSH requested access to the company's medical records of employees suspected of having been affected by a chemical used in the plant, but Westinghouse found the request too difficult, claiming that the records were considered confidential. *Id.* NIOSH issued a subpoena duces tecum to Westinghouse

ployee's medical records are "well within the ambit of materials entitled to privacy protection."[198] This privacy right, however, is not absolute.[199] Some intrusion into the privacy rights associated with medical records has been allowed, usually after finding that "the societal interest in disclosure outweighs the privacy interest on the specific facts of the case."[200] The *Westinghouse* court enumerated a list of factors to consider in deciding whether an intrusion into an individual's privacy is justified: "the type of record requested, the information it does or might contain, the potential for harm in any subsequent nonconsensual disclosure, . . . the degree of need for access, and whether there is an express statutory mandate, articulated public policy, or other recognizable public interest militating toward access."[201] The *Westinghouse* court, like the *Whalen* Court, recognized that in order to allow access to private information, the perceived or unlikely privacy invasion must be balanced against legitimate societal interests in the information.

One final case to consider is *In re Warrant (Sealed)*,[202] which involved the medical records of a physician being investigated for insurance fraud.[203] The court, while acknowledging that the patients' rights to privacy "[are] applicable to the compelled disclosure of medical records,"[204] also recognized that "[t]he protection afforded by the right to privacy is not absolute. The individual privacy interests in the patients' medical records must be balanced against the legitimate interest of the state in securing the information contained therein."[205]

These cases aptly demonstrate judicial recognition that in certain

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requiring the production of the medical files, which request was also refused. *Id.* at 572-73.

198. *Id.* at 577 (footnote omitted).

199. *See infra* notes 201-02 and accompanying text.

200. *Westinghouse*, 638 F.2d at 578.

201. *Id.* The court held that strong public interest in facilitaing research and investigation of NIOSH justified minimal intrusion into the employees' medical records. *Id.* at 580.

202. 810 F.2d 67 (3rd Cir.), *cert. denied*, 481 U.S. 1030 (1987).

203. A special agent of the FBI was issued a warrant, authorizing him to search the offices of the physician, and to seize specified property, including all medical records, account ledger cards, medical insurance claim forms, and explanations of Blue Shield and Medicare Benefits forms for 210 named patients. *Id.* at 68-69. The physician, claiming standing for his patients, alleged that the warrant violated his patients' right to privacy because of the disclosure of confidential information. *Id.* The district court denied his motion to enjoin the search, but directed the FBI and United States Attorney to treat the records as confidential and not to disclose the information, except as reasonably required by the investigation. *Id.*

204. *Id.* at 71.

205. *Id.* at 71-72. The court affirmed the district court's denial of the physician's motion to suppress the medical records, and held that the seizure of such medical records in

situations, society's interest in personal information outweighs the individual's objection to its disclosure. Where the alleged privacy violation is more potential or perceived than actual,[206] limited disclosure is properly granted. Additionally, when adequate safeguards, statutory or otherwise, are promulgated and enforced to ensure the continued confidentiality of this important information, the privacy problems are substantially diminished.

Likewise, DNA prints and their uses in criminal and civil cases offer a societal benefit which, when combined with the lack of invasive information contained therein,[207] point to the establishment of a national data base, similar to the one already compiled for traditional fingerprints. Regarding its use in criminal cases, society's legitimate interest in apprehending and convicting criminals is undeniably substantial, and is certainly the primary justification for using this technology. Similarly, civil cases, notably paternity and child support suits, will benefit from the accuracy in identification which is possible through DNA fingerprinting.[208]

In addition to the procedural safeguards, such as search warrants and probable cause involved in obtaining the blood samples from unwilling donors (i.e., convicted or suspected felons), certain restrictions could be implemented on the actual retention of the print and their uses. For example, the files could be kept under the exclusive control of one centralized body, such as the FBI, to be used only in forensic

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connection with the investigation for insurance fraud did not deny the patients their right to privacy. *Id.* at 73.

206. *See, e.g.*, Whalen v. Roe, 429 U.S. 589 (1977); *supra* notes 192-96 and accompanying text.

207. *See supra* notes 67-70 and accompanying text.

208. With paternity and child support suits, the operative standard should be concern for the best interests of the child. For example, a Pennsylvania couple, Regina and Ernest Twigg, discovered that their daughter, Arlena, who died in August 1988, was not their biological child. They claimed that the hospital where Arlena was born switched babies, and that Kimberly Mays, the daughter of Robert W. Mays and Barbara Mays, who was the only other white child in the hospital at the time, was really their child. The Twiggs wanted to compel genetic testing of Kimberly, and sought custody as her "real" parents. Understandably, Mays has refused to allow his daughter to be tested saying that "even if tests eventually proved Kimberly was not his biological daughter, he wanted to retain custody. To disrupt her life, he said, would only make her unhappy. . . . whoever her biological parents were, he would always be her father, the man who had raised her from a baby." N.Y. Times, Oct. 27, 1988, at A16, col. 4. Kimberly's reaction to the dispute was, "Daddy, I don't want to move." *Id.* at col. 5. Clearly, this is a case where the best interest of the child would be *not* to perform the test. Mr. Mays agreed to the genetic testing only after the Twiggses promised not to seek custody of Kimberly, even if she turned out to be their biological daughter. N.Y. Times, Nov. 20, 1989, A21, col. 1. The test established a 99.9% certainty that Kimberly is the biological daughter of the Twiggses, who now intend to seek visitation rights. *Id.*

investigations.[209] No third parties, such as employers, would be permitted access to the information—it would strictly be a tool of the legal system.[210] In regard to the prints themselves,[211] the probes and enzymes selected as standards for use in obtaining the DNA fingerprint would be those which bind to "less invasive" base sequences, thus revealing no invasive information. Furthermore, in order to assure compliance, each print could be required to follow the standards already used in tests involving DNA polymorphisms which were approved by the Parentage Testing Committee of the American Association of Blood Banks.[212]

V. Conclusion

The DNA test is a sensitive and accurate way to identify individuals by their unique molecular makeup. Its potential to revolutionize criminal investigations has been well recognized. Furthermore, the various scientific fields which contributed to its development accept the current technology both in theory and in application. Society recognizes the need to protect its citizens from unwarranted invasions of privacy, but only to the extent that it not jeopardize society's duty to protect its citizens from crime and violence. The time is now to begin the creation of a DNA data base for future criminal investigations.

JoAnn Marie Longobardi

209. "Forensic investigations" are criminal, paternity, and other legal proceedings. Note, *DNA Identification Tests*, *supra* note 7, at 908 n.21. Obviously, prosecutors or defense attorneys could request comparisons between DNA prints on file with those obtained in a given investigation for identification purposes. Similarly, civil court judges could order the test performed in paternity cases, and presumably could also run similar checks on existing files.

210. This is not to say that an individual could not request a physician to perform a genetic-screening test for the types of genetic disorders which can be detected. As suggested *supra* note 191 and accompanying text, any DNA test performed which does not utilize the specified standards of probes and enzymes simply would not be accepted in the data base.

211. *See supra* notes 192-93 and accompanying text.

212. *See supra* notes 91-92 and accompanying text.