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## DNA Fingerprinting: Dick Tracy of the '90s

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## CURRENT ISSUES

### DNA FINGERPRINTING: DICK TRACY OF THE '90s

The use of scientific evidence at criminal trials can be a very potent weapon for both the prosecution and the defense.<sup>1</sup> One of

<sup>1</sup> See *United States v. Williams*, 583 F.2d 1194, 1196 (2d Cir. 1978) (use of spectrographic voiceprints), *cert. denied*, 439 U.S. 1117 (1979); *United States v. Bruno*, 333 F. Supp. 570 (E.D. Pa. 1971) (use of chromatographic analysis of ink); *State v. Nicholas*, 34 Wash. App. 775, 779-80, 663 P.2d 1356, 1358, (test results showing defendant's blood type very incriminating), *review denied*, 100 Wash. 2d 1006 (1983); *State v. Chavez*, 100 N.M. 730, 733, 676 P.2d 257, 260 (Ct. App. 1983) (defendant's blood type and percentage in population admissible); *State v. Temple*, 302 N.C. 1, 10, 273 S.E.2d 273, 280 (1981) (admission of testimony by dentist that defendant's teeth impression matched bite marks on victim's body); *State v. Powell*, 264 N.C. 73, 74, 140 S.E.2d 705, 706 (1965) (breathalyzer results admissible to show defendant's blood-alcohol level).

"As the Utah Supreme Court suggested in 1980, this is 'an age when one scientific advancement tumbles in rapid succession upon another' . . . ." Inwinkelreid, *The Standard for Admitting Scientific Evidence: A Critique from the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 555 (1983) (quoting Phillips v. Jackson, 615 P.2d 1228, 1234 (Utah 1980)). This increase is attributable, in part, to the fact that "scientists are more focused on the forensic application of their research than ever before." *Id.* at 556. Tests which have passed the experimental stage may be admitted if their reliability can be reasonably demonstrated. 3 JONES ON EVIDENCE § 15.9 (6th ed. 1972).

Courts have also relaxed the standards for the admission of scientific evidence. See Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, A Half-Century Later*, 80 COLUM. L. REV. 1197, 1219-21 (1980) (discussion of admission of scientific evidence in various cases). See also Lewis, *DNA Fingerprints-Witness for the Prosecution*, DISCOVER, June, 1988, at 44 (conviction of rapist based on DNA fingerprinting). *But see* *United States v. Brown*, 557 F.2d 541, 559 (6th Cir. 1977) (rejected ion microprobe analysis of hair as unreliable); *United States v. Hearst*, 412 F. Supp. 893, 895 (N.D. Cal. 1976) (psycholinguistics testimony held inadmissible), *aff'd*, 563 F.2d 1331 (9th Cir. 1977), *cert. denied*, 435 U.S. 1000 (1978); *People v. Kelly*, 17 Cal. 3d 24, 41, 549 P.2d 1240, 1251, 129 Cal. Rptr. 144, 155 (1976) (rejecting voiceprint evidence); *Smith v. State*, 31 Md. App. 106, 119-20, 355

the most effective newcomers to this area is that of deoxyribonucleic acid (DNA) Fingerprinting.<sup>2</sup> The overwhelming precision of DNA analysis,<sup>3</sup> if proven acceptable in court, gives it the potential to revolutionize the administration of criminal justice.<sup>4</sup>

A.2d 527, 535 (1976) (court rejected admissibility of psychological stress evaluation due to unreliability); *Clarke v. State*, 218 Tenn. 259, 270, 402 S.W.2d 863, 868-69 (court denied admission of paraffin test), *cert. denied*, 385 U.S. 942 (1966). *See also* *Brooke v. People*, 139 Colo. 388, 339 P.2d 993 (1959). The Colorado court held the trial court's admission of a paraffin test to be error. *Id.* The paraffin test, designed to reveal whether the person tested has within recent hours fired a gun, had "not gained that standing and scientific recognition or demonstrated that degree of reliability to justify courts in approving its use in criminal cases." *Id.* at 393, 339 P.2d at 996; Moenssens, *Admissibility of Scientific Evidence-An Alternative to the Frye Rule*, 25 WM. & MARY L. REV. 545 (1984) (discussion of problems arising under *Frye* test and recommendation of new standards). *See generally* Note, *The Syndrome Syndrome: Problems Concerning the Admissibility of Expert Testimony on Psychological Profiles*, 37 U. FLA. L. REV. 1035 (1985) (examination of nature and admissibility of syndrome evidence).

<sup>2</sup> *See* Note, *DNA Fingerprinting and the Law*, 51 MOD. L. REV. 145, 145 (1988):

In the last few years Dr. A.J. Jeffreys of Leicester University, with various colleagues, has invented a technique known as "DNA fingerprinting." It can give, to all intents and purposes, indisputably accurate evidence of identity by means of a comparison of samples of organic material taken from a person. It can also, by comparison of samples from putative parents and offspring, give equally indisputable evidence of parentage.

*Id.*; Kelly, Rankin & Wink, *Method and Applications of DNA Fingerprinting: A Guide for the Non-Scientist*, 1987 CRIM. L. REV. 105, 105. (1987) "The development of a new technique known as 'DNA Fingerprinting,' has enormous potential for use in medical science and forensic investigation." *Id.* *See* *People v. Wesley*, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (Albany County Ct. 1988) (DNA used in identifying two defendants). *See also* Michaud, *DNA Detectives*, N.Y. Times, Nov. 6, 1988, § 6 (Magazine) at 72. "The first murder suspect to be identified and charged solely as a result of DNA analysis was a 27-year-old Briton named Colin Pitchfork, who, in September 1987, was charged with two murder-rapes near Leicester, England." *Id.*

<sup>3</sup> *See* Moss, *DNA-The New Fingerprints*, 74 A.B.A. J. 66 (1988). Except for identical twins, estimates of the probability of duplicate DNA fingerprints have been as great as one in 30 billion. *Id.*

<sup>4</sup> *See* *Wesley*, 140 Misc. 2d at 308, 533 N.Y.S.2d at 644. "Where applicable, [DNA Fingerprinting will] reduce to insignificance the standard alibi defense . . . [and] tend to reduce the importance of eyewitness testimony." *Id.* The court accepted DNA evidence as reliable, and spoke of its advantages in "certainty of identification." *Id.*; *DNA Fingerprint Factor in Rape Trial*, N.Y.L.J. Sept. 21, 1988. The defendant was accused of raping at least 13 women in the Forest Hills area of Queens, N.Y. *Id.* The trial was the first in New York to allow introduction of evidence obtained by the DNA Fingerprinting technique. *Id.* *See also* *Admission of DNA Fingerprints Prompts Queries*, 10 Nat'l L.J., Jan. 18, 1988, at 42, col. 1. "The case of Tommie Lee Andrews, who was sentenced to twenty-two years in prison . . . was the first successful prosecution in history in which scientists identified a defendant from DNA molecules." *Id.*; Lewis, *supra* note 1, at 46-47 (discussing first jurisdiction in United States to convict defendant based on DNA Fingerprinting). *See also* Note, *supra* note 2, at 148-50 (discussing British courts which have applied DNA analysis). *But cf.* Note, *DNA Fingerprinting: Possibilities and Pitfalls of a New Technique*, 28 JURIMETRICS J. 455, 464-67 (1988) (discusses limits of DNA Fingerprinting).

## DNA Fingerprinting

Although evidence obtained from this technique has been admitted in only a minority of jurisdictions,<sup>6</sup> enthusiasm for DNA analysis continues to grow.<sup>6</sup> This Article will examine the development and usage of the technique, the standard used for its admission, and its application as a forensic tool.

### I. BACKGROUND: HOW DNA ANALYSIS WAS DEVELOPED AND HOW IT IS APPLIED TODAY

The technique of DNA Fingerprinting was invented by Dr. A. J. Jeffreys of Leicester University, Great Britain.<sup>7</sup> Although initially utilized in immigration cases,<sup>8</sup> it has now begun to gain acceptance in the field of criminal law.<sup>9</sup> The strength of the DNA technique lies in the fact that DNA can be found in almost any

Because of its precision, DNA evidence may also be used as a complete defense to prosecution. Thompson, *DNA's Troubled Debut*, CALIF. L., June, 1988 at 36 (prosecutor's dilemma when victim makes positive identification and DNA exonerates defendant).

<sup>6</sup> See Thompson, *supra* note 4, at 42. The following states have permitted DNA Fingerprints to be introduced as evidence in criminal cases: Florida, Oklahoma, Pennsylvania, Virginia, Washington and most recently New York. North Carolina has also accepted the technique. Comment, *DNA Identification Tests and the Courts*, 63 WASH. L. REV. 903, 906 n.7 (1988).

"Florida's 5th District Court of Appeal has upheld the admissibility of DNA typing in the first appellate decision concerning such evidence in a criminal case." Moss, *DNA Proof*, 75 A.B.A. J. 20, 20 (1989).

<sup>6</sup> See Moss, *supra* note 3, at 67. Lifecodes, the lab which performs a majority of the DNA prints, has done tests in approximately 400 criminal cases and 2,000 paternity cases. *Id.* "Legislators are working to establish computerized registries of DNA types of those convicted of sex crimes." *Id.* at 70. See also Michaud, *supra* note 2, at 72. "Virginia, California and Florida are starting up their own DNA labs." *Id.* "California, anticipating the technology's advent, in 1985 passed a law mandating that all convicted sex offenders provide blood and saliva specimens at the time of their release from prison." *Id.* at 73. The FBI is also planning to open its own DNA lab. *Id.*; Marx, *DNA Fingerprinting Takes the Witness Stand*, 240 SCIENCE 1616 (1988) (DNA is "greatest boon to forensic medicine and law since fingerprinting"). See generally *DNA Testing on the Increase*, 131 SOLICS. J. 1596 (1987) (discussing use in civil and immigration cases). Some commentators have warned of the possible problems which may arise from the use of DNA evidence. Comment, *supra* note 5, at 906 n.6 (urging caution in proceeding with test); Note, *Possibilities and Pitfalls*, *supra* note 4, at 467-71 (discussing legal limits of technique).

<sup>7</sup> Gill, Jeffreys & Warrett, *Forensic Application of DNA "Fingerprints"*, 318 NATURE, Dec. 12, 1985 at 577 (briefly discussing legal implications of the test).

<sup>8</sup> See Jeffreys, Brookfield & Semeonoff, *Positive Identification of an Immigration Test-Case Using Human DNA Fingerprints*, 317 NATURE, Oct. 31, 1985 at 818 (British immigration officials relied on test to determine Ghanaian's identity). See also Kelly, *supra* note 2, at 108-09 (discussing United Kingdom case); Note, *supra* note 2, at 151-55 (importance of DNA test in expeditious resolution of immigration dispute).

<sup>9</sup> See *supra* notes 2-4 (discusses increased use of DNA analysis).

tissue sample taken from the human body.<sup>10</sup> Often tissues recovered at the scene of a crime such as blood, semen, hair and saliva<sup>11</sup> contain DNA.<sup>12</sup> If a successful match is made between a defendant's sample and that found at a crime scene, a positive identification can be established.<sup>13</sup>

Before engaging in a general discussion of DNA's application, it is helpful to examine how a DNA print is formed. Each cell in the human body contains 23 pairs of chromosomes containing DNA.<sup>14</sup> The structure of a DNA molecule within a chromosome looks like a twisted rope ladder or a spiral staircase.<sup>15</sup> Inside each rung of the ladder is a different sequence of four chemical compounds known as the bases A, C, G and T.<sup>16</sup> Scientists have compared the structure of DNA to that of a zipper, with A, C, G and T acting as

<sup>10</sup> See *People v. Wesley*, 140 Misc. 2d 306, 308, 533 N.Y.S.2d 643, 644 (Albany County Ct. 1988). In its order granting admission of DNA evidence the court stated:

[I]n each individual the configuration of DNA contained in one cell is the same for every cell in the body of that individual. Thus, for the purpose of DNA Fingerprinting, DNA for comparative purposes can be obtained from blood, semen, hair roots, skin, and indeed from over 99% of the cells of the human body.

*Id.* at 308, 533 N.Y.S.2d at 644. See also *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County, filed Dec. 7, 1988). Dr. Roberts, an expert in molecular biology, testified at the *Frye* hearing. *Id.* at 5. His testimony established that "DNA is found in every cell" and "may be extracted from white blood cells, hair, semen, etc." *Id.* at 6. See also Mair, *DNA Identifiers*, 2 WASH. CRIM. DEF. 4, 4 (1988) (molecules from any living cell can be examined).

<sup>11</sup> See, e.g., *People v. Hamlin*, 71 N.Y.2d 750, 757, 525 N.E.2d 719, 722, 530 N.Y.S.2d 74, 76 (1988) (blood and hair similar to that of decedent found on defendant's clothing); *People v. Mountain*, 66 N.Y.2d 197, 203, 486 N.E.2d 802, 806, 495 N.Y.S.2d 944, 948 (1985) (defendant had same common blood type as victim, therefore court could not use blood found at crime scene); *People v. Owens*, 63 N.Y.2d 824, 825, 472 N.E.2d 26, 27, 482 N.Y.S.2d 250, 250 (1984) (evidence of sperm on victim's underwear). See generally Note, *The Use of Scientific Evidence in Rape Prosecutions*, 18 U. RICH. L. REV. 851 (1984) (increased use of scientific evidence in rape prosecutions); Comment, *Splitting Hairs in Criminal Trials: Admissibility of Hair Comparison Probability Estimates*, 1984 ARIZ. ST. L.J. 521.

<sup>12</sup> Mair, *supra* note 10, at 4 (DNA can be extracted from any living cell in body).

<sup>13</sup> Jeffreys, *supra* note 8, at 18 (discusses DNA technique).

<sup>14</sup> Kelly, *supra* note 2, at 106 (there are 46 chromosome packets within each cell).

<sup>15</sup> See Letter from Robert Arena, Assistant District Attorney, Queens County, N.Y. to John J. Santucci, D.A. Queens County, N.Y. (Oct. 27, 1988) (discussing DNA Fingerprinting) [hereinafter Letter from Robert Arena]; Note, *Possibilities and Pitfalls*, *supra* note 4, at 457 (shape of DNA molecule is "'double helix'"). See also *People v. Wesley*, 140 Misc. 2d 306, 309-13, 533 N.Y.S.2d 643, 645-49 (Albany County Ct. 1988) (background of DNA structure).

<sup>16</sup> See Kelly, *supra* note 2, at 106 (DNA is made up of four chemical building blocks). See also Letter from Robert Arena, *supra* note 15. "The bases are known as 'A', 'C', 'G', and 'T' . . . [which] are actually abbreviations for chemicals: A = adenine, C = cytosine, G = guanine and T = thymine." *Id.*

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the teeth.<sup>17</sup> The DNA “zipper,” however, can only close when A pairs with T and G with C.<sup>18</sup>

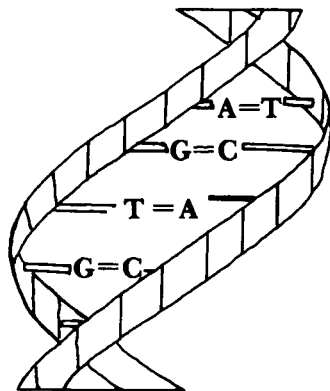


Fig. 1. Part of a fragment of the DNA ladder.<sup>19</sup>

It is this sequence of the bases on certain parts of the DNA molecule which is different within each individual (except identical twins).<sup>20</sup> Because A can only pair with T and C with G, the sites are “palindromic”; the complementary strands are the inverse of each other.<sup>21</sup>

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A A A T T C G G T
T T T A A G C C A
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Fig. 2. Fragment of DNA showing double strand and complemen-

<sup>17</sup> See *People v. Lopez*, No. 5048-87 at 8 (Sup. Ct. Queens County filed Dec. 7, 1988) (during print formation, two strands are “unzippered” from each other); Kelly, *supra* note 2, at 106 (DNA “can be thought of as resembling a zip fastener”).

<sup>18</sup> Kelly, *supra* note 2, at 106.

<sup>19</sup> *Wesley*, 140 Misc. 2d at 312, 533 N.Y.S.2d at 647. Diagram used with permission of Lifecodes Co.

<sup>20</sup> See Gill, *supra* note 7, at 577. “[DNA] Fingerprints produced by . . . hybridization . . . are completely specific to an individual.” *Id.*; Jeffreys, *supra* note 8, at 818 (DNA prints can provide positive identification in forensic science and paternity testing). See generally Note, *supra* note 2, at 145-46 (each person is genetically unique); Kelly, *supra* note 2, at 108 (DNA analysis is only duplicative in cases involving identical twins).

<sup>21</sup> Kelly, *supra* note 2, at 107.

tary base pairing.<sup>22</sup>

In order to create a DNA print, DNA must be extracted from tissue and enzymatically cut up into different size fragments.<sup>23</sup> These fragments are placed in a slot cut in one end of a gel and charged with an electric current.<sup>24</sup> This current propels the DNA through the gel field at various distances which are dependent on the size of the fragments. Subsequently, through a process known as "Southern blotting," the DNA fragments are split and transferred onto a nylon nitrocellulose membrane.<sup>25</sup> This procedure, which is similar to ink blotting, causes the fragments to appear in the same distinct pattern as they did in the gel.<sup>26</sup>

Hybridization of the extracted fragments with a radioactively labelled strand of DNA is then attempted through the use of a DNA probe.<sup>27</sup> To perform this process, the labelled strand is ex-

<sup>22</sup> *Id.* at 106.

<sup>23</sup> See Kelly, *supra* note 2, at 107. "[E]nzymes can be . . . used to break human DNA into fragments of different sizes which are separated from each other by a technique known as gel electrophoresis." *Id.* See also Note, *supra* note 2, at 146 (to take print, treat DNA sample with enzymes that "chop it all up"); Note, *supra* note 4, at 459 (same). See generally Balazs, Baird, Clyne & Meade, *Human Population Genetic Studies of Five Hypervariable DNA Loci*, 44 AM. J. HUM. GENETICS 182 (1989).

<sup>24</sup> See *People v. Wesley*, 140 Misc. 2d 306, 315, 533 N.Y.S.2d 643, 649 (Albany County Ct. 1988). The DNA fragments are subjected to the widely accepted technique of "gel electrophoresis". *Id.* The process commences by placing the DNA on an "electrically charged flat gelatin surface." *Id.* See also Balazs, *supra* note 23, at 183 (electrophoresis performed for approximately 64 hours); Moss, *supra* note 3, at 69 (fragments exposed to electric field which causes their movement); Thompson, *supra* note 4, at 41 (DNA propelled by electric current).

"[T]he distance the fragments travel depends on their length - the larger fragments, being bulkier than the shorter fragments, find it more difficult to worm their way through the holes in the agarose gel, and will not travel as fast or as far . . ." *Wesley*, 140 Misc. 2d at 316, 533 N.Y.S.2d at 649. See Kelly, *supra* note 2, at 107 (distance fragments travel varies with size).

<sup>25</sup> See Jeffreys, *supra* note 8, at 818, fig. 1 (describing Southern blot technique used in immigration cases). See also *Wesley*, 140 Misc. 2d at 316, 533 N.Y.S.2d at 649-50 (fragments chemically split, leaving A, C, T and G "separated like open zipper teeth"); *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County filed Dec. 7, 1988). "The process is known as Southern blotting, named for Dr. E.H. Southern, who developed the procedure in 1975." *Id.* at 8. "It is a procedure that all experts stated was integral to genetic fingerprinting and accepted as reliable by all scientists in the field of genetic and molecular biology." *Id.*

<sup>26</sup> See Note, *supra* note 4, at 460 (transferred fragments occupy same positions as in gel). "This transfer fixed the results of the size separation and leaves each fragment single stranded . . ." Mair, *supra* note 10, at 4; Lewis, *supra* note 1, at 49 (upon separation, strands are transferred to a nylon sheet). See generally Balazs, *supra* note 23, at 182 (after electrophoresis, DNA transferred using "capillary transfer method").

<sup>27</sup> See Gill, *supra* note 7, at 577 (discussing use of probes; Dr. Jeffreys was the first to use them); Mair, *supra* note 10, at 5 (probes radioactively "tagged"); Marx, *supra* note 6, at

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posed to the first strand; if the two complement each other, they will hybridize.<sup>28</sup> This affinity property of the DNA strands is the crucial element to successful identification.<sup>29</sup>

Because of its radioactivity, the pattern from the membrane can then be reproduced on x-ray film.<sup>30</sup> The resulting picture shows parallel bands, quite similar to bar codes found on supermarket goods.<sup>31</sup> Once this print is obtained, it is compared with a second print. If the patterns match, it is almost certain that the two samples came from the same person; if they do not match, the samples did not come from the same person.<sup>32</sup>

1616 (probes are short pieces of radioactive DNA); Letter from Robert Arena, *supra* note 15 (identification done through “ ‘probe’ ” which is charged with radioactivity). *See generally* Note, *supra* note 2, at 146 (probe pretreated to make it radioactive).

<sup>28</sup> *See* Kelly, *supra* note 2, at 108 (when properly exposed, complementary strands of chromosomes find each other); Mair, *supra* note 10, at 5 (probe binds to matching counterpart). *See generally* *People v. Wesley*, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (Albany County Ct. 1988).

<sup>29</sup> Jeffreys, *supra* note 8, at 818:

The human genome contains a set of minisatellites, each of which consists of tandem repeats of a DNA segment containing the ‘core’ sequence, putative recombination signal in human DNA. Multiallelic variation in the number of tandem repeats occurs at many of these minisatellite loci. Hybridization probes consisting of tandem repeats of the core sequence detect many hypervariable minisatellites simultaneously in human DNA, to produce a DNA fingerprint that is completely individual-specific.

*Id.* (quoting Jeffreys, Wilson & Thein, *Individual-Specific ‘Fingerprints’ of Human DNA*, 316 NATURE, July 4, 1985, at 76 and Jeffreys, Wilson & Thein, *Hypervariable “Minisatellite” Regions in Human DNA*, 314 NATURE 67, Mar. 7, 1985). *See also* Lewis, *supra* note 1, at 49 (fragment patterns are as individual as fingerprints); Mair, *supra* note 10, at 5 (“combination of . . . probe patterns appearing in . . . individual sample heightens . . . uniqueness of the identification”); Marx, *supra* note 6, at 1616 (print enables differentiation of one person and rest of world).









<sup>30</sup> *See* Balazs, *supra* note 23, at 183 (“Radioactive bands . . . visualized by autoradiography”); Comment, *supra* note 5, at 914 (radioactivity allows pattern to be captured on film). *See also* Moss, *supra* note 3, at 69 (when membrane placed on x-ray film, image of DNA picked up).

<sup>31</sup> *See* Note, *supra* note 2, at 147.

<sup>32</sup> *See* Gill, *supra* note 7, at 577. DNA Fingerprints are “completely specific to an individual.” *Id.* *See generally* Kelly, *supra* note 2, at 110. “The distinguishing feature of DNA fingerprinting compared with traditional tests is that positive identification [sic] is virtually certain.” *Id.*



Fig. 3. Forensic Case Example

Recovered DNA	Suspect 1	Suspect 2	Victim
			
			
			

DNA recovered from a crime scene. Note the print exonerates suspect 1 and positively identifies suspect 2.

DNA Fingerprinting has been reported as more accurate than the HLA (human leukocyte antigen) blood test.<sup>33</sup> Moreover, DNA can be obtained from almost any tissue sample, whereas the HLA test can only be obtained from blood.<sup>34</sup> The size of the DNA sample need not be great. It is estimated that a blood sample that is the size of a quarter contains enough material to produce a DNA

<sup>33</sup> See Moss, *supra* note 3, at 66. Reports have shown that the likelihood of two persons having the same DNA pattern are one in 30 billion. *Id.*

Cellmark Diagnostics . . . claims its 'DNA fingerprint' test can identify a suspect with 'virtual certainty,' and that the chances that any two people having the same DNA fingerprint are one in 30 billion. Lifecodes Corp. . . . says that when its DNA-PRINT test produces a match between specimens, there is at least a 99 percent certainty that the specimens are from the same person.

*Id.* The traditional HLA blood test has an exclusion rating of anywhere from 50-95%. *Id.* at 66-67. See also Note, *supra* note 2, at 146 (traditional blood tests only eliminate possibilities; DNA provides identification); 10 Nat'l L.J., Jan. 18, 1988, at 42, col. 1 (blood test proved defendant had same blood type as a third of the population). Cf. Michaud, *supra* note 2, at 70. "The potential for 100 percent certainty makes this a singular forensic tool." *Id.* at 72. "The best that other techniques, such as serology and hair-analysis, can hope to establish is a 90 to 95 percent level of certainty, leaving room for reasonable doubt, and acquittal." *Id.*

<sup>34</sup> See Michaud, *supra* note 2, at 72.

Bone, blood, semen, skin and hair (if it contains the root) all contain DNA . . . . Noncellular body fluids such as saliva, urine and sweat can also carry testable quantities of DNA. This means that a discarded cigarette butt, shoes, a handkerchief, a wad of gum, or even the inner part of a hat or watchband could yield DNA evidence to solve a crime.

*Id.*

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print.<sup>35</sup> Additionally, the sample does not have to be fresh; sperm and blood samples of up to four years old have been reported to have testable quantities of DNA.<sup>36</sup>

DNA Fingerprinting does have some drawbacks. To date, only three commercial laboratories in the United States are able to perform the test.<sup>37</sup> The analysis must be done precisely and a good deal of expertise is needed to perform it.<sup>38</sup> If the sample is too small or contaminated, no print will be produced.<sup>39</sup> This, however, can also be advantageous; since no "false positives" are produced, an innocent person cannot be wrongly identified.<sup>40</sup>

### II. STANDARD FOR ADMISSION

In order for DNA Fingerprinting to be admitted at trial it must first undergo a pretrial screening, known as a "*Frye* hearing."<sup>41</sup>

<sup>35</sup> Cf. Comment, *supra* note 5, at 918. There are times, however, when a bloodstain of this size is not recovered. *Id.* An alternative to DNA tests which use RFLP (restriction fragment length polymorphisms) analysis is a technique known as PCR (polymerase reaction). *Id.* at 918 n.70. PCR analysis can reproduce portions of insufficient DNA, amplifying them up to one million times their original size. *Id.* PCR can analyze a sample that is one thousand times smaller than that required for RFLP analysis. *Id.*

<sup>36</sup> See Gill, *supra* note 7, at 577. "DNA of high relative molecular mass . . . can be isolated from 4-yr-old bloodstains and semen stains made on cotton cloth . . . to produce DNA fingerprints suitable for individual identification." *Id.*

<sup>37</sup> Cellmark Diagnostics, Germantown, Md; Cetus Corp., Emeryville, Calif.; Lifecodes Corp., Valhalla, N.Y.. Cellmark and Lifecodes both perform the RFLP analysis; Cetus utilizes the new PCR technique.

<sup>38</sup> See Dodd, *DNA Fingerprinting in Matters of Family and Crime*, 318 NATURE, Dec. 12, 1985, at 507. The process of performing the test "is very labour intensive and needs both meticulous expertise and much experience in the reading and interpretation of the bands." *Id.* See also Thompson, *supra* note 4, at 43 (discussing botched blood test which erroneously resulted in conviction for rape).

<sup>39</sup> See generally Comment, *supra* note 5, at 919. "The need for sufficient amounts of DNA is crucial." *Id.* "In rape cases, where a semen stain is the only biological evidence, approximately half of all the samples given to one laboratory were untestable." *Id.*

<sup>40</sup> See N.Y.L.J., July 27, 1988, at 1, col. 6, at 3, col. 4 (if DNA insufficient or test improperly performed, no result recorded). See also Thompson, *supra* note 4, at 36 (victim made positive identification but DNA print did not match); Interview with Robert Arena, Assistant District Attorney Queens County, N.Y., in Queens, N.Y. (Dec. 5, 1988) (since no false positives, wrong individual cannot be improperly identified).

<sup>41</sup> *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923). The purpose of the hearing is to determine the reliability of novel scientific evidence. See generally Inwinkelreid, *supra* note 1, at 557.

It should be noted that not all courts follow the *Frye* standard of admissibility. Some jurisdictions follow the relevancy approach formulated by Professor McCormick. See *Copolino v. State*, 223 So. 2d 68 (Fla. Dist. Ct. App. 1968), *cert. denied*, 399 U.S. 927 (1970). Others utilize a hybridized *Frye* test. See Thompson, *supra* note 4, at 42 (California follows

The case of *Frye v. United States*<sup>42</sup> set the standard used by courts in determining the admissibility of scientific evidence.<sup>43</sup> The *Frye* test shifts the responsibility of analyzing the validity of a new principle "from the judge to the relevant scientific community."<sup>44</sup> According to the *Frye* court, a deduction must be "sufficiently established to have gained general acceptance in the particular field in which it belongs."<sup>45</sup>

*Kelly-Frye* standard).

<sup>42</sup> 293 F. 1013 (D.C. Cir. 1923). In *Frye* the court considered the admissibility of polygraph evidence. In an oft-cited passage, the court stated:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while the courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

*Id.* at 1014.

<sup>43</sup> *Id.* Since its acceptance in 1923, *Frye's* standard of 'general acceptance' in the scientific community has come to be the standard in almost all of the courts which have considered the admissibility of scientific evidence. *Reed v. State*, 283 Md. 374, 382, 391 A.2d 364, 368 (1978). Although *Frye* involved the admissibility of a polygraph test, its standard has been applied to numerous forensic techniques. *See, e.g.*, *United States v. Brady*, 595 F.2d 359, 362-63 (6th Cir.) (microscopic hair analysis inadmissible because no general acceptance in scientific community), *cert. denied*, 444 U.S. 862 (1979); *People v. Slone*, 76 Cal. App. 3d 611, 623, 143 Cal. Rptr. 61, 68-69 (1978) (admissibility of bitemark comparisons); *State v. Sinnott*, 24 N.J. 408, 423, 132 A.2d 298, 306 (1957) (admissibility of truth serum).

*Frye* has not been without its critics. *See Giannelli, supra* note 1, at 1208-10 (difficulties in applying the *Frye* test outweigh its advantages). *See generally Moenssens, supra* note 1, at 547 (*Frye* rule does not adequately screen novel scientific techniques).

<sup>44</sup> Note, *supra* note 1, at 1041-42 (burden of reliability of theory should be on scientific community). *See Mair, supra* note 10, at 7 (*Frye* requires general acceptance in scientific field); *People v. Middleton*, 54 N.Y.2d 42, 429 N.E.2d 100, 444 N.Y.S.2d 581 (1981). In explaining the *Frye* standard the court stated: The "test is not whether a particular procedure is unanimously endorsed by the scientific community, but whether it is generally acceptable as reliable." *Id.* at 49, 429 N.E.2d at 103, 444 N.Y.S.2d at 584. *See also United States v. Addison*, 498 F.2d 741, 743-44 (D.C. Cir. 1974) (those most qualified to assess should be the ones to testify). *Cf. Coppolino v. State*, 223 So. 2d 68, 75 (Fla. Dist. Ct. App. 1968) (Mann, J., concurring) (novel tests devised specifically for particular case do not render evidence inadmissible), *cert. denied*, 399 U.S. 927 (1970).

"Occasionally, new techniques compound the problem [of determining what field the technique belongs in] by combining elements of several disciplines, with no discipline claiming the novel process as its own." Moenssens, *supra* note 1, at 548. *See Mair, supra* note 10, at 7 (*Frye* requires court to identify particular scientific field). *See also People v. Collins*, 94 Misc. 2d 704, 708, 405 N.Y.S.2d 365, 368 (Sup. Ct. Kings County 1978) (before determining acceptance, must define relevant scientific community). *See generally Giannelli, supra* note 1, at 1208 n.68.

<sup>45</sup> *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

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The first part of this test requiring that the deduction be “sufficiently established” calls for proof of: 1) the validity of the principle;<sup>46</sup> and 2) the validity of the methods employed in applying the technique.<sup>47</sup> The second part of the test requiring “acceptance in the particular field” demands proof of reliability of the technique on a particular occasion.<sup>48</sup>

Courts throughout the United States have applied the *Frye* standard to examine the admissibility of DNA Fingerprinting.<sup>49</sup> Scientists group the analysis of DNA Fingerprinting into three fields of study: molecular biology, genetics and population genetics.<sup>50</sup> Be-

<sup>46</sup> See Giannelli, *supra* note 1, at 1201 (reliability of evidence derived from three factors).

<sup>47</sup> *Id.* See generally Latin, Tannehill & White, *Remote Sensing Evidence and Environmental Law*, 64 CALIF. L. REV. 309 (1978).

<sup>48</sup> Giannelli, *supra* note 1, at 1201. This last factor requires “adherence to proper procedures. . . .” *Id.* at 1202. See also *People v. Kelly*, 17 Cal. 3d 24, 30, 549 P.2d 1240, 1244, 130 Cal. Rptr. 144, 148 (1976) (“[T]he proponent of the evidence must demonstrate that correct scientific procedures were used in the particular case.”). In addition, the qualifications of the person conducting the procedure must be examined. See Giannelli, *supra* note 1, at 1202. See also *United States v. Dreos*, 156 F. Supp. 200, 208 (D. Md. 1957) (radar equipment “manned by a competent operator”); *State v. Crowder*, 285 N.C. 42, 50, 203 S.E.2d 38, 44 (1974) (police officer who collected evidence for atomic absorption analysis “qualified by training and experience to perform that simple task”).

<sup>49</sup> See *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County filed Dec. 7, 1988) (first New York case to obtain conviction using DNA); *People v. Wesley*, 140 Misc. 2d 306, 309, 533 N.Y.S.2d 643, 645 (Albany County Ct. 1988) (under *Frye* test, DNA evidence found admissible); *Andrews v. State*, 533 So. 2d 841 (first United States conviction using DNA print; held *Frye* hearing), *aff'd*, 533 So. 2d 851 (Fla. Dist. Ct. App. 1988). Cf. Thompson, *supra* note 4, at 36. California Attorney General, John Van de Kamp is opposed to immediate admission of the technique. *Id.*

<sup>50</sup> *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County filed Dec. 7, 1988) (testimony of molecular biologist, geneticist and population geneticist necessary); *Wesley*, 140 Misc. 2d at 319, 533 N.Y.S.2d at 651. Dr. Richard J. Roberts, molecular biologist, testified for the prosecution at the *Frye* hearing as an expert witness. *Id.* Dr. Roberts has published 98 articles in peer review journals, all of which deal with DNA and or molecular biology. *Id.* Dr. Kenneth K. Kidd, Professor of Human Genetics, Psychiatry, and Biology at the Yale University School of Medicine also testified. *Id.* at 321, 533 N.Y.S.2d at 653. He is the author or co-author of 184 articles, many of which are in the field of molecular biology and population genetics, and is the Chairman of the DNA Committee for the next scheduled meeting of the Human Gene Mapping Conference. *Id.* Another expert witness for the prosecution was Dr. Michael L. Baird, one of the founders of Lifecodes, and director of Paternity and Forensic Evaluation. *Id.* at 323, 533 N.Y.S.2d at 654. He is the author or co-author of 25 articles and 25 abstracts dealing primarily with molecular biology and various phases of genetics, including population genetics. *Id.* Cf. Note, *supra* note 4, at 468 (questions which scientific community court should rely upon).

In addition, “the extensive use of the tests in other well respected scientific disciplines may enhance the judicial acceptance of forensic DNA tests.” Comment, *supra* note 5, at 908. “These sciences also provide a ready pool of qualified, yet disinterested experts to testify about the DNA tests’ reliability and general acceptance in the scientific community.” *Id.*

cause of the crossover between the three areas, general acceptance in each is a prerequisite to admission.<sup>51</sup>

In resolving the general acceptance issue, expert testimony must be utilized.<sup>52</sup> The testimony of the molecular biologist and geneticist should establish that the principles and techniques employed in producing the print are accepted in the scientific community.<sup>53</sup> It is undisputed that the DNA structure is unique to each individual, with the caveat that identical twins carry the same DNA makeup.<sup>54</sup> Further, the methods engaged have been utilized by the scientific community for many years and are both well recognized and accepted.<sup>55</sup> Thus, the validity of both the principle and the technique are issues which are not difficult to favorably resolve.

The controversy surrounding the use of DNA Fingerprinting revolves around its reliability and accuracy on a particular occasion.<sup>56</sup> It is therefore essential to elicit the testimony of a population geneticist.<sup>57</sup> The testimony of this expert should show the

<sup>51</sup> See Lewis, *supra* note 1, at 50 (judge at *Frye* hearing must be convinced of technique's general acceptance); Interview with Robert Arena, *supra* note 40 (at trial, after *Frye* hearing, have several experts testify as to different areas).

<sup>52</sup> See *United States v. Wilson*, 361 F. Supp. 510, 513 (D. Md. 1973) (court recognized need for expert testimony, but also cautioned about experts misleading juries).

<sup>53</sup> See *Wesley*, 140 Misc. 2d 306, 319, 533 N.Y.S.2d 643, 651 (1988). Dr. Richard J. Roberts, a molecular biologist, testified that Lifecodes' (the commercial lab which produced the print) "laboratory protocols contained the same quality controls . . . that he would have established if he had been setting up Lifecodes. . . ." and that all the procedures used by them in their DNA Fingerprinting were procedures generally recognized by the scientific community as being "accurate, reliable and appropriate." *Id.* He further stated that "DNA Fingerprinting entailed no new scientific principles, only scientific principles that had long been established in and accepted by the scientific community." *Id.*

Dr. Kenneth Kidd, a molecular biologist and geneticist testified that he visited Lifecodes' Lab and was extremely impressed with the "detailed and specific laboratory protocols." *Id.* at 321-22, 533 N.Y.S.2d at 653. His testimony, which corroborated Dr. Roberts', also established the scientific acceptance of the Lifecode probes. *Id.* at 321, 533 N.Y.S.2d at 653.

<sup>54</sup> *Id.* at 307-08, 533 N.Y.S.2d at 644 (each individual has his own genetic "signature").

<sup>55</sup> *Id.* "This fact is not only generally accepted by the scientific community to which it is related, but is uniformly accepted therein." *Id.*

<sup>56</sup> *Id.* at 317, 533 N.Y.S.2d at 650 (defense attacked Lifecodes' laboratory procedures). See generally Comment, *supra* note 5, at 918-30 (discussing potential problems with forensic use of DNA tests).

<sup>57</sup> See *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County filed Dec. 7, 1988). Dr. Pablo Rubenstein, who was qualified as an expert in population genetics, testified as to the frequencies of the specific probes. *Id.* at 17. He concluded that the patterns identified by the probes in this case would "randomly appear in only one out of fifty four million, five

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frequency allocated to each probe; how often the regions detected by each probe randomly appear in the general population and the reliability of the population sample utilized for the probes.<sup>58</sup> Through the testimony of the population geneticist it should be established that the methods utilized in this particular probe were both accurate and reliable.<sup>59</sup> Once this expert testifies to these facts, the *Frye* standard has been fulfilled.

### III. DNA DEFENDANTS: PRISONERS OF THEIR OWN CELLS

Although DNA Fingerprinting is still a relatively new scientific tool,<sup>60</sup> it is increasingly attributed to a growing number of confessions and convictions.<sup>61</sup> Its capacity for close to one-hundred percent accuracy in identification has placed it on the cusp of forensic science.<sup>62</sup>

The first case to result in a conviction based exclusively on DNA analysis took place in Leicestershire, England.<sup>63</sup> During a

hundred thousand whites and sixty-two million, two hundred forty thousand blacks." *Id.*

<sup>58</sup> *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County filed Dec. 7, 1988). Dr. Kevin McElfresh, a population geneticist, testified as to the reliability of the samples used for the probes. *See id.* at 14-15. He stated that a data base of 1000 individuals was utilized: 200 samples were from New York, 200 from California and 600 from various areas across the country. *Id.* at 15. For these numbers to be acceptable they must fall within a statistical formula known as the Hardy-Weinberg equilibrium. *Id.* at 14. McElfresh concluded that they did so and that the sample was therefore reliable. *Id.*

<sup>59</sup> *See Wesley*, 140 Misc. 2d at 319, 533 N.Y.S.2d at 652 (experts testified to reliability of methodology used and results obtained).

<sup>60</sup> *See Jeffreys*, *supra* note 29, at 76. The technique of DNA Fingerprinting was introduced by British scientists in 1985. *Id.* Its first forensic application was in 1987: Lohr, *For Crime Detection, 'Genetic Fingerprinting'*, N.Y. Times, Nov. 30, 1987, at A9, col. 1. "The conviction of Robert Nelias on a rape charge in a Bristol court . . . appeared routine, except that vital evidence came from a technique called 'genetic fingerprinting' . . ." *Id.*; Note, *supra* note 2, at 148 (defendant convicted in rape case).

At least one New York court has applied DNA Fingerprinting to paternity cases; N.Y.L.J., Aug. 11, 1988, at 1, col. 6 (Manhattan surrogate allowed DNA evidence to establish paternity). *See also Jeffreys*, *supra* note 8, at 818. It is interesting to note that paternity may be accurately established through DNA fingerprinting even if a sample has not been obtained from the alleged father through comparison to a DNA sample obtained from a child of undisputed like parentage. *Id.* at 818-19. *See generally* Note, *supra* note 2, at 151.

<sup>61</sup> *See Toufexis, Convicted by Their Genes*, TIME, Oct. 31, 1988, at 74, col. 1 (DNA has "figured prominently" in over 150 cases). *See also* Michaud, *supra* note 2, at 70-71 (violent criminals handed grave sentences due to DNA).

<sup>62</sup> *See generally* *People v. Wesley*, 140 Misc. 2d 306, 307, 533 N.Y.S.2d 643, 644 (Albany County Ct. 1988).

<sup>63</sup> *See* Michaud, *supra* note 2, at 72-73 (murder suspect's arrest culminated four-year investigation). There were, however, other previous convictions in which DNA testing played

police investigation of two murder/rapes, all male inhabitants of Leicestershire between the ages of thirteen and thirty were asked to give a blood sample for DNA analysis.<sup>64</sup> The authorities became aware that the defendant, Colin Pitchfork, had persuaded a coworker to submit his own blood sample under the defendant's name.<sup>65</sup> When a proper sample was finally obtained from the defendant it matched the samples taken from the crime scenes and led to his conviction.<sup>66</sup>

In November, 1987, the Florida Court of Appeals became the first court in the United States to use DNA evidence for a conviction.<sup>67</sup> The defendant had allegedly committed a series of related rapes and assaults in Orlando, Florida, but only one of the victims had seen his face.<sup>68</sup> A DNA print containing the rapist's semen was produced from a vaginal swab.<sup>69</sup> Months later when the defendant was apprehended, his DNA prints matched those of the rapist and he was ultimately convicted.<sup>70</sup> Without the DNA Fingerprint, it is quite likely that the ensuing conviction would not

a part: Note, *supra* note 2, at 148-49.

<sup>64</sup> See Note, *supra* note 2, at 149 (action taken after two murder/rapes occurred within three years).

<sup>65</sup> *Id.* at 150. Pitchfork convinced his co-worker to partake in the deception by telling him he had convictions for "indecent exposure and was worried that he would be 'fitted up.'" *Id.*

<sup>66</sup> *Id.*

<sup>67</sup> *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App.), *aff'd*, 533 So. 2d 851 (1988). See Johnson, *DNA 'Fingerprinting' Tests Becoming a Factor in Courts*, N.Y. Times, Feb. 7, 1988, at A1, col. 2 (burglary suspect convicted of rape and assault based on DNA); N.Y. Times, Feb. 6, 1988, at A6, col. 5. An expert in genetics analysis testified that the DNA "fingerprint" of Andrews' blood matched that of the rapist's semen. *Id.* See also 10 Nat'l L. J., Jan. 18, 1988, at 42, col. 1. Lawyers, biologists and researchers have described the DNA technique as a "devastating" truth-finding tool. *Id.*

<sup>68</sup> See *Lewis*, *supra* note 1, at 45-46. The attacks always occurred late at night; the defendant would cover his victims' heads with a sheet and flick the light switch on and off during the attack. *Id.* The first victim, saw the perpetrator for six seconds. *Id.*

<sup>69</sup> See *Andrews v. State*, 533 So. 2d 841, 843 (Fla. Dist. Ct. App.), *aff'd*, 533 So. 2d 851 (1988). Because the rapist secreted his blood type in his semen it was ascertainable that the rapist's blood type was the same as that of the victim (also same as defendant's). *Id.* Since there was no actual blood sample, the rapist's blood type was only ascertainable because he was a secretor, a characteristic of only about half of the population. *Id.* Thus there was ample opportunity for DNA sampling, but only a 50% chance that his blood type would have been learned. *Id.* Moreover, DNA Fingerprinting is much more accurate than matching blood types. *Id.*

<sup>70</sup> *Lewis*, *supra* note 1, at 50. The prints showed a one in 10 billion chance that the semen found was not that of the defendant. *Id.* The defendant was sentenced to one hundred years in prison for sexual battery, armed burglary and aggravated battery. *Id.* at 52.

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have occurred.<sup>71</sup>

Since the Florida conviction, many jurisdictions have sought to apply the DNA technique to a variety of crimes.<sup>72</sup> Recently, an Assistant District Attorney in Queens County, New York obtained a sexual assault conviction based on successful application of the analysis.<sup>73</sup> Visual identification of the defendant was inconclusive in this case because all of the victims had told the police that their assailant was black, but the charged defendant was a light-skinned Hispanic.<sup>74</sup> Upon comparing sperm cells taken from one of the rape victims with a blood sample taken from the defendant, a positive match was reported.<sup>75</sup> The jury, which was troubled by the discrepancies in the defendant's description, used the match as the basis of their conviction.<sup>76</sup>

Although DNA Fingerprinting has been a prosecutor's tool, it may also be utilized by criminal defense attorneys.<sup>77</sup> In addition to

<sup>71</sup> *Id.* (no physical evidence obtained besides the semen).

<sup>72</sup> See *infra* notes 72-79 and accompanying text.

<sup>73</sup> See *People v. Lopez*, No. 5048-87 (Sup. Ct. Queens County filed Dec. 7, 1988) (defendant positively identified by DNA Fingerprint). See also Fried, *Prosecutors Move to Give DNA Evidence in Rape*, N.Y. Times, Sept. 30, 1988, at B3, col. 1 (defendant assaulted three women; he was driven off by screams of fourth); Anderson, *DNA 'Fingerprint' Factor in Rape Trial*, N.Y.L.J., Sept. 21, 1988, at 1, col. 3 (defendant faced twenty six counts of rape, sodomy and burglary).

<sup>74</sup> See James, *Man Convicted of Rape on DNA Evidence*, N.Y. Times, Oct. 20, 1988, at B1, col. 1. The defendant's attorney argued a case of mistaken identity. *Id.* at B16, col. 1. Prosecutors argued that defendant's skin may have been darker in the summer. *Id.*

<sup>75</sup> See Fried, *supra* note 73, at B3, col. 1 (analysis showed match between semen found at crime scene and blood sample).

<sup>76</sup> See James, *supra* note 74, at B16, col. 2 (DNA "was kind of a sealer on the thing"). See also Michaud, *supra* note 2, at 73. Although the Assistant District Attorney put four of Lopez's alleged victims on the stand to identify him as their attacker, it was his presentation of the DNA evidence that ultimately swayed the jury. "That was the only thing that opened my eyes. That was the whole case, in my opinion," the jury forewoman . . . told a . . . reporter.

*Id.*

A case in Pierce County, Washington, in which a bus driver was accused of sexually assaulting one of his passengers illustrates DNA Fingerprinting's use as a catalyst in inducing just pleas. See *State v. Haynes*, No. 87-1-02309-7 (Pierce County Sup. Ct., Wash., Mar. 28, 1988): Comment, *supra* note 5, at 904 (bus driver was only person who had access to victim). The victim, who was afflicted with Alzheimer's disease was incapable of identifying her attacker, or testifying against him in court. *Id.* There were no witnesses and the only physical evidence obtained was a semen sample recovered from the victim. *Id.* Based exclusively on this evidence, the defendant pleaded guilty and is now serving time in prison. *Id.*

<sup>77</sup> Marx, *supra* note 6, at 1618. "DNA typing can exonerate a suspect as well as incriminate him." *Id.* "This kind of evidence is a defendant's best friend if falsely accused." *Id.* Confident defense attorneys can have their own tests administered disclosing the results to



the obvious exculpatory use by a criminal defendant, DNA Fingerprinting may be essential in determining alternative defenses. On January 7, 1989, Dr. Kathryn Hinnant, a Bellevue pathologist, was robbed, raped and killed in her office.<sup>78</sup> The defendant, Steven Smith, who admitted to the robbery of Dr. Hinnant but claimed an accomplice raped and helped strangle her, consented to DNA analysis.<sup>79</sup> The results of the DNA print conclusively established that Mr. Smith was the only person involved in the commission of the crime.<sup>80</sup> As a result, he utilized an insanity defense.<sup>81</sup>

#### IV. LIMITATIONS AND WEAKNESSES OF THE TECHNIQUE

##### A. *Size limitation*

In order for a DNA Fingerprint to be produced it is necessary that a sample of sufficient size be obtained.<sup>82</sup> Under the current method of testing, a bloodstain the size of a quarter should be recovered in order to guarantee production of the print.<sup>83</sup> Other biological samples such as hair<sup>84</sup> and semen<sup>85</sup> have their own individual thresholds.

the prosecutors if positive. Mair, *supra* note 16, at 8. Moreover, this is useful for the defense even if the offense occurred in a jurisdiction where the DNA test is not yet admissible. See Thompson, *supra* note 4, at 40. The prosecution's desire to generally have this type of evidence admitted can be advantageous to the defense. *Id.*

<sup>78</sup> See Sullivan, *Slaying Suspect to Get Gene Test*, N.Y. Times, Feb. 7, 1989, at B2, col. 5 (victim strangled in her office).

<sup>79</sup> *Id.*

<sup>80</sup> See Sullivan, *Bellevue Jury Rejects Plea of Insanity*, N.Y. Times, Oct. 31, 1989, at B3, col. 2 (DNA test confirmed that Smith raped victim).

<sup>81</sup> See generally, Arce & Collins, *Trial in Doc's Slaying Begins*, Newsday, Oct. 17, 1989, at 7 (defense attorney stated Smith is insane and can't be blamed for his actions).

<sup>82</sup> See Gill, *supra* note 7, at 577 (discussion of sample size required).

<sup>83</sup> See Sensabaugh, *Forensic Biology - Is Recombining DNA Technology in its Future?*, 31 J. FORENSIC SCI. 393, 395 (approximately fifty microlitres are required). The sample size problem has been addressed by a complementary new technology called polymerase chain reaction (P.C.R.): Michaud, *supra* note 2, at 88. "P.C.R. solves the problem of what to do when there isn't enough tissue sample to run a DNA analysis." *Id.* "P.C.R. induces the material to replicate itself." *Id.*

"The use of DNA tests in paternity cases should not be affected by the sample size and environmental factors because an ample supply of high quality DNA material is available from all the parties." See Comment, *supra* note 5, at 918 n.71.

<sup>84</sup> See Von Beroldingen & Sensabaugh, *Forensic DNA Analysis*, 12 TIELINE 27, 37 (at least fifteen hairs are needed).

<sup>85</sup> See Sensabaugh, *supra* note 83, at 395 (approximately ten microlitres are needed).

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It is important to note however that inadequate sample size does not affect the reliability of the DNA Fingerprint. If too small a sample is obtained, no print will be produced.<sup>86</sup>

### *B. Possibility of Contamination*

DNA Fingerprints may be ineffective in situations where the sample used has been contaminated.<sup>87</sup> If the sample is exposed to excessive light,<sup>88</sup> heat<sup>89</sup> or moisture<sup>90</sup> it may be rendered unsuitable for print production. Although this limits DNA's investigatory capabilities, contaminated samples yield no results rather than false results.<sup>91</sup>

### *C. Meeting the Frye Standard*

In order for DNA evidence to be admitted at trial, it must first meet the requirements imposed by the *Frye* court.<sup>92</sup> These requirements can be fulfilled through the testimony of molecular and genetic experts.<sup>93</sup> A problem which may arise, however, is conflict of interest.<sup>94</sup> Many of the experts called upon to testify are closely affiliated with the labs conducting the tests.<sup>95</sup> These labs, which are proprietary in nature, do not satisfy the validity check mandated by *Frye*.<sup>96</sup>

<sup>86</sup> See *People v. Wesley*, 140 Misc. 2d 306, 317, 533 N.Y.S.2d 643, 655 (Albany County Ct. 1988). The DNA test cannot give a false result; only a correct result or no result at all. *Id.* See also Letter from Robert Arena, *supra* note 15 (there are no false positives).

<sup>87</sup> See Comment *supra* note 5, at 919 (environmental factors may make sample unsuitable for testing).

<sup>88</sup> See Sensabaugh, *supra* note 83, at 395-96 (mutations caused by overexposure to light).

<sup>89</sup> *Id.* (structure of DNA affected by heat).

<sup>90</sup> See Gill, Lyso, Fowler & Werrett, *An Evaluation of DNA Fingerprinting for Forensic Purposes*, 8 ELECTROPHORESIS 38, 42 (moisture breaks down cellular structure of DNA).

<sup>91</sup> See Comment, *supra* note 5, at 921 (results unreadable but not unreliable); see also *supra* note 86 (insufficient size sample yields no result).

<sup>92</sup> See *supra* notes 42-48 and accompanying text (describes *Frye* standard).

<sup>93</sup> See *supra* notes 50-53 (describes how testimony satisfied *Frye* standard).

<sup>94</sup> See Moss, *supra* note 3, at 69. Professor George Sensabaugh of the Berkeley School of Public Health is calling for additional study. *Id.* "He says the forensic science community is concerned because the research validating DNA typing has come primarily from the private sector companies." *Id.*

<sup>95</sup> See Mair, *supra* note 16, at 8. The expert testifying in favor of the admission of the evidence may have a financial interest in its admissibility and is likely to come from the company which conducted the tests. *Id.*

<sup>96</sup> See Michaud, *supra* note 2, at 89 (technology "not really typical and open to all"). *But see* Moss, *supra* note 3, at 69 (procedure is generally accepted by unbiased molecular biol-

Until recently the accuracy of the DNA technique had not been successfully challenged.<sup>97</sup> On August 14, 1989, however, Acting Justice Gerald Sheindlin of the New York State Supreme Court in the Bronx ruled that the genetic tests which linked a murder suspect to a victim were not scientifically reliable.<sup>98</sup> Reaction to this ruling has been mixed.<sup>99</sup> Judge Sheindlin did not question the general acceptance of the DNA technique in the scientific community. His criticism was limited to "unresolved ambiguities" based on testing done of the victim's blood.<sup>100</sup>

The prosecution, calling the ruling a victory, stated that Judge Sheindlin, on the whole, had upheld the validity and admissibility of the test.<sup>101</sup> The defense, also claiming victory, echoed Judge Sheindlin in calling for the possible reopening of similarly ambiguous DNA test results.<sup>102</sup> Although the impact of this ruling is unclear, the issues it raises will certainly reappear in future cases.

#### D. *Mixing of Samples*

DNA Fingerprinting may be impossible in cases where samples are mixed. In the recent case of the multiple rape of a Central Park jogger, multiple samples of blood and semen were recovered from both the victim and the suspects. Due to the mixing of samples, however, only one blood sample obtained has established a positive match with that of a defendant.<sup>103</sup> Further, experts have

ogy scientists).

<sup>97</sup> See Kinoshita, *Misprints: Seeking New Standards for Forensic DNA Typing*, SCIENTIFIC AMERICAN, Aug. 1989, p. 12 (scientists in unusual move agreed Lifecodes' data was scientifically unreliable).

<sup>98</sup> See Mcfadden, *Reliability of DNA Testing Challenged by Judges's Ruling*, N.Y. Times, Aug. 15, 1989, at B1, col. 4. The judge held that the blood found on the suspect's wristwatch was not his. *Id.* DNA tests were allowed to show this. *Id.* The tests were not allowed to show that the blood found was that of the victim. *Id.*

<sup>99</sup> *Id.* (both sides hail decision as a victory).

<sup>100</sup> *Id.* (additional experiments and controls may be necessary). *Id.* A spokesman for Lifecodes stated that a possible reason for the ambiguity was a mixing of several of the victim's blood. *Id.*

<sup>101</sup> *Id.*, col. 5. The prosecution called the ruling a "victory of national importance for the criminal justice system and the prosecutor." *Id.*

<sup>102</sup> See Mcfadden, *Reliability of DNA Testing Challenged by Judges's Ruling*, N.Y. Times, Aug. 15, 1989, at B1, col. 4. (case has set "unique precedent" in being first to rule DNA unreliable).

<sup>103</sup> Stone, *What Really Happened in Central Park*, N.Y. Times Aug. 14, 1989 §6 (Magazine), at 43.

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stated that it is unlikely that a clear match based on semen can be established when several samples are mixed, as they may be in the case of a multiple rape.<sup>104</sup>

### E. *Cost of Producing a Print*

Currently, there are three labs in the United States which are capable of performing DNA analysis.<sup>105</sup> These labs charge \$300 for every sample submitted.<sup>106</sup> As the technique becomes more widely used, and demand for its application increases, additional labs will spring forth. If the FBI and other law enforcement agencies commence utilization of DNA fingerprinting on a widespread level, costs will most certainly escalate.<sup>107</sup>

### F. *Religious Exclusions*

A final criticism of the DNA technique is the potential violation of religious freedom.<sup>108</sup> If a person's religion prohibits the taking of blood, a constitutional objection could be validly raised.<sup>109</sup> Although a meaningful argument, it is submitted that the chances of success are doubtful. Courts have held that an intrusive governmental procedure may be sustained against claims of infringement upon personal religious beliefs when the state has a compelling and paramount interest.<sup>110</sup> It is suggested that when a state's in-

<sup>104</sup> *Id.*

<sup>105</sup> *See supra* note 37.

<sup>106</sup> *See* Michaud, *supra* note 2, at 77 (regional forensic labs must pay fees to Lifecodes and Cellmarks).

<sup>107</sup> *Id.* at 88 (with only two companies as suppliers, costs will certainly rise). *See generally* R. POSNER, *ECONOMIC ANALYSIS OF THE LAW* § 1.1, at 8 (2d ed. 1977) (if supply remains constant, increase in demand will increase price).

<sup>108</sup> *See* *State v. Biddings*, No. 88AP-910 (Ohio Ct. App. filed Oct. 14, 1988) (defendant claimed religion prohibited taking of his blood). *See generally* L. TRIBE, *AMERICAN CONSTITUTIONAL LAW* 1242 (2d ed. 1987) (person may seek exemption under free exercise clause).

<sup>109</sup> *Id.* The defendant objected to the trial court's order requiring the taking of his blood to have it tested for DNA and compared to samples taken from rape victims. *Id.* He contended that the order deprived him of his "individual freedom to practice his religion as guaranteed by the first and fourteenth amendments of the United States Constitution . . ." *Id.*

<sup>110</sup> *See* *United States v. Lee*, 455 U.S. 252 (1982). The United States Supreme Court sustained a social security regulation which infringed upon the Amish religion. *Id.* at 259. This seems to lower the burden placed on the state for justifying state intrusion into a person's religious practice. L. TRIBE, *supra* note 100, at 1261. The United States Supreme Court has been especially "sympathetic to the states' interest in looking after minor chil-

terest in obtaining blood is to prove involvement in a violent crime, a person's religious interest should be overridden.<sup>111</sup>

#### CONCLUSION

Since its advent in 1985, DNA analysis has rapidly evolved into a powerful forensic tool. Its ability to identify with great specificity can both aid the prosecution and exonerate the innocent. Its future use may possibly change the way criminologists investigate murderers, rapists and muggers. Where applicable, it could reduce to insignificance the standard alibi defense.<sup>112</sup> Faced with such overwhelming evidence, a guilty defendant may decide to plea bargain instead of risking trial.

Because DNA can be obtained from almost any tissue sample, the chances of recovering a testable amount are much greater than recovery from traditional forensic tests. Noncellular body fluids such as saliva and sweat carry testable quantities of DNA. Hence, a discarded cigarette butt, a handkerchief or even a wad of gum could yield enough DNA to produce a print.

Although DNA Fingerprinting has been used as evidence in only a minority of jurisdictions, its ability to pass the *Frye* test has never been successfully rebutted. Indeed, the lack of credible experts willing to challenge its basic scientific premises seems indicative that its acceptance will only escalate.

Nevertheless, DNA does have its limitations. Adequate sample size, contamination and lack of objectivity are all legitimate concerns which must be considered by the courts. Yet, the implications of DNA analysis for our legal system are still quite signifi-

dren." *Id.* at 1267.

This leniency has been applied in state courts with respect to blood-testing. *See State v. Meacham*, 93 Wash. 2d 735, 612 P.2d 795 (1980). In this case, an action was brought by the state to establish that the defendants were the fathers of two children born out of wedlock. *Id.* at 736, 612 P.2d at 797. Noting that the defendants objected that a compulsory blood test violated constitutional rights to freedom of religion, the court stated that it is permissible to order an alleged father to submit to blood tests since the interests of the state and the welfare of its minor children were a compelling and paramount concern, and the intrusion by the state minimal. *Id.* at 736, 612 P.2d at 797.

<sup>111</sup> *See State v. Biddings*, No. 88AP-910 (Ohio Ct. App. filed Oct. 14, 1988) (court held state interest more compelling than defendant's objections).

<sup>112</sup> *See People v. Wesley*, 140 Misc. 2d 306, 308, 533 N.Y.S.2d 643, 645 (Albany County Ct. 1988).

## DNA Fingerprinting

cant. DNA's ability to implicate the guilty and exculpate the innocent are just two of the reasons why application of the technique should be both applauded and encouraged.

*Nancy Slater*

