DNA Fingerprinting: Evidence of the Future

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DNA Fingerprinting: Evidence of the Future

INTRODUCTION

Over the past several years a scientific technique has been developed and introduced that many believe will revolutionize the criminal justice system.¹ This procedure, commonly referred to as “DNA Fingerprinting,” has been used in hundreds of criminal cases and admitted into evidence in several criminal trials,² although the procedure has been sanctioned at the appellate level only once to date.³ Since it offers significant advantages over traditional genetic tests, DNA typing will be used with increasing frequency in forensic testing.⁴ One commentator referred to DNA testing as “... the most significant thing of the century”⁵ It represents the first major breakthrough in forensic detection since Sir Edward Richard Henry determined how to use human fingerprints to identify criminals at the turn of the century.⁶

Where admitted, DNA testing could reduce the importance of eyewitness testimony. With today’s clogged judicial calendars, DNA fingerprinting can be a boon for the criminal justice system. As with any new technique, it is important to look at all the elements involved in the procedure to determine its reliability. Currently,
standard procedures for the use of DNA in the courts are undeveloped.7 As a result of prematurely admitting into evidence other scientific procedures,8 significant problems were encountered. To prevent the same problems with DNA fingerprinting, it is important to proceed cautiously. Part I of this Comment explains the process of DNA fingerprinting. Part II discusses the companies who perform the procedures, and Part III suggests steps courts should take to assure the reliability of the procedure.

I. WHAT IS DNA FINGERPRINTING?

It has long been the ambition of forensic scientists to be able to identify the origin of blood and body-fluid stains with the same degree of certainty as fingerprints. DNA fingerprinting, which was developed by Dr. Alec Jeffreys at Leicester University, makes a big step towards this goal.9 Dr. Jeffreys' approach for visualizing differences among individuals has been used for approximately twelve years and currently is used in laboratories around the world. Scientists deem the test both accurate and reliable.10 With the rapid advancement of technology, this is an area of forensic science that should continue to develop. Based on the accuracy of the current tests and new tests being developed, which determine with unprecedented specificity whether a given individual was the source of a biological specimen,11 DNA testing promises to be extremely useful in criminal investigations. The new tests can identify samples too small or too old to be analyzed by any other means.12 DNA also can be retrieved from non-cellular body fluids such as saliva, urine, and sweat. Discarded cigarette butts, shoes, a handkerchief, a wad of gum,
an inner part of a hat, or even a watchband might produce enough DNA evidence to solve a crime.\(^\text{13}\) The amount of DNA required depends upon the type of test used.

When investigators search a crime scene, they often find blood or semen stains of unknown origin.\(^\text{14}\) In order to use this material to identify a perpetrator, the investigators must establish a connection between the stain and the offender.\(^\text{15}\) DNA fingerprinting, also called genetic fingerprinting, allows police to compare the unknown stain with a blood sample from a suspect in order to determine whether the suspect was the source of the stain found at the crime scene.\(^\text{16}\) Thus, like a fingerprint left at the scene of the crime, DNA can be used to link organic evidence found at the crime scene with the one person whose DNA it matches.\(^\text{17}\)

The DNA fingerprinting procedure is an advancement in criminal investigations that allows "greater specificity in identifying the unknown donor."\(^\text{18}\) To convince a judge that the DNA evidence should be admissible into a court of law, it is important that the judge have a general understanding of what "DNA Fingerprinting" encompasses. "[A]n understanding of the process already has become a prerequisite for effective criminal practice on either side of the counsel table and undoubtedly in civil cases too."\(^\text{19}\) DNA fingerprinting can give "indisputably accurate evidence of identity by means of comparison of samples of organic materials taken from a person."\(^\text{20}\) DNA fingerprinting takes its theoretical foundation from "molecular biology, genetics, and a special branch of genetics known as population genetics."\(^\text{21}\) This Comment first outlines essential background information about DNA and the testing procedure.

A. What is DNA?

A cell is the basic unit of all living organisms. The human body has more than ten trillion cells.\(^\text{22}\) A cell has two main parts—

\(^{13}\) Michaud, supra note 5.


\(^{15}\) Id.

\(^{16}\) Id.

\(^{17}\) Id.

\(^{18}\) Id.

\(^{19}\) Taylor, From One Speck a Case is Made, NAT'L L.J., Jan. 16, 1989, at 3, col. 2.


\(^{22}\) MOSBY'S MEDICAL & NURSING DICTIONARY 129 (1983).
the nucleus and the cytoplasm. The nucleus contains two important structures, chromosomes and nucleoli.\textsuperscript{23} An individual inherits half of his or her chromosomes from each parent.\textsuperscript{24} The chromosomes combine to form a genome, which determines one's physical characteristics.\textsuperscript{25} DNA, or deoxyribonucleic acid, is the material that makes up the genomes and carries the body's genetic information. DNA allows the cells to operate and construct the body.\textsuperscript{26} Every cell carries a complete DNA "blueprint" of the unique characteristics of each person.\textsuperscript{27} The same DNA blueprint will be produced from any body cell—DNA from any part of the body still allows a conclusive match.\textsuperscript{28} This explains why DNA can be tested from forensic samples such as hair, blood stains, and semen.

In 1953, James Watson and Francis Crick, "working together at Cambridge University in England, discovered the chemical and spatial structure of the DNA molecule."\textsuperscript{29} The physical shape of the DNA molecule is a "Double Helix" structure. It consists of two parallel chains of "nucleotide bases."\textsuperscript{30} The DNA carries the information in a coded form for the cell to read. The code is dependent upon the sequence of the bases in the DNA chain. The structure has been compared to a ladder, with the bases combining to form the rungs of the ladder.\textsuperscript{31} Throughout the DNA chain are "core" sequences of approximately thirty identical bases called "repetitive DNA,"\textsuperscript{32} which are always paired in the same order.\textsuperscript{33} The length and number of repetitive DNA differ in each individual,

\textsuperscript{23} The nucleus contains the cell's genetic program. It sends instructions to the cytoplasm, which in turn builds the whole human body. A chromosome is composed mainly of DNA and associated proteins and stores and transmits genetic information. DNA is an abbreviation for deoxyribonucleic acid, its chemical structure. In each human cell there are forty-six chromosomes, arranged in pairs of 22, plus two sex chromosomes. \textit{Id.} at 315.

\textsuperscript{24} Burk, \textit{DNA Fingerprinting: Possibilities and Pitfalls of a New Technique}, 28 \textit{JUR-METRICS J. OF L., SCI., & TECH.} 455, 457 (Summer 1988) [hereinafter Burk].

\textsuperscript{25} \textit{Id.}

\textsuperscript{26} \textit{Id.}

\textsuperscript{27} \textit{Id.} Cells in different parts of the body read only specific sections of DNA that they need to perform their functions.

\textsuperscript{28} White & Greenwood, \textit{supra} note 20, at 147.

\textsuperscript{29} Wesley, 533 N.Y.S.2d at 645.

\textsuperscript{30} Burk, \textit{supra} note 24, at 457.

\textsuperscript{31} The four bases are Adenine (A), Thymine (T), Guanine (G), and Cytosine (C). They are specific in that A will pair only with T and C only with G. Burk, \textit{supra} note 25, at 457, citing Kelly, Rankin & Wink, \textit{Method and Applications of DNA Fingerprinting: A Guide for the Non-Scientist}, \textit{Crim. L. Rev} 105, 106 (Feb. 1987).

\textsuperscript{32} \textit{The Ultimate Identification Test}, 1 (Cellmark Diagnostics 1988).

\textsuperscript{33} \textit{Id.}
as evidenced by each person's unique physical characteristics. The sequences, scattered throughout the DNA chain, can be four to eight bases long. DNA fingerprinting focuses on these differences by utilizing the length and number of repetitive DNA sequences to distinguish the one individual who has that exact sequence.

B. The DNA Testing Process

DNA fingerprinting allows one to see and compare the fragments of two samples of organic material to determine whether they are from the same person. This test allows positive identification, whereas other tests only eliminate a person as a suspect. The laboratory process distinguishes the behavioral and physical characteristics of each DNA molecule by analyzing the placement, size, and type of the repetitive DNA sequences produced.

In a laboratory, DNA is examined by taking the DNA from the cell, isolating the DNA, and then analyzing the DNA to see what particular size fragments are present in that strand of DNA. The standard method for this procedure is called restriction fragment length polymorphism, or RFLP, analysis. This procedure requires several steps. First the DNA is extracted from the cell and purified. Next, the long strands of DNA are cut into fragments by mixing them with "restrictive enzymes." These enzymes cut

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34 Id.
35 Id.
36 White & Greenwood, supra note 20, at 147.
37 Burk, supra note 24, at 459.
39 This is the approach used by the two main laboratories doing this testing. The methods for RFLP analysis used by Lifecodes and Cellmark are based closely on standard techniques used in molecular biology laboratories for identifying DNA fragments. Most of these techniques can be found in T. Maniatis, E. Frith & J. Sambrook, MOLECULAR CLONING, A LABORATORY MANuRAL (1982) [hereinafter T. MANiATIS].
40 DNA extraction procedures are well accepted among molecular and cellular biologists. Standard methods for extracting DNA from mammalian cells and tissues are described in T. MANiATIS, supra note 39, at 280; Herrmann & Frschauf, Isolation of Genomic DNA, METHODS IN ENZYMOLOGY 152-180 (1987). Methods of extracting DNA from forensic samples are enumerated in a number of papers. For the extraction of DNA from blood stains, see Kanter, Bard, Shater & Balaz, Analysis of Restriction Fragment Length Polymorphisms in Deoxyribonucleic Acid (DNA) Recovered from Died Bloodstains, 31 J. FORENSIC Sci. 403, 405 (1986) [hereinafter Kanter].
41 Restrictive enzymes are like biological scissors, which cut the DNA chains at specific sites. They are specific in the points at which they cut DNA. For a description of restrictive enzymes, see T. MANiATIS, supra note 39, at 98-106.
the DNA chains at specific sites, but do not break up the repetitive DNA sequences. Finally, the fragmented DNA is placed into one end of a slab of gel.\textsuperscript{42} An electric current is applied to the gel, causing the negatively charged DNA to move to the opposite end of the gel, which has a positive electrode. Since the shorter fragments move faster, when the current is shut off\textsuperscript{43} the fragments are positioned according to size; thus, the process separates the DNA according to length.\textsuperscript{44} The DNA is invisible during this stage, so they are transferred to a thin filter \textsuperscript{45} This enables the scientists to begin the process of visualizing the DNA fragments by using DNA probes.\textsuperscript{46} The probes are radioactive. After the film is developed one can see the positions of the specific DNA fragments.\textsuperscript{47} Black bands appear where the radioactive probes attach to the repetitive fragments. The RFLP process illustrates the presence of the bands at different positions due to the differences in each of the fragments' lengths.\textsuperscript{48} The pattern of black bands in a white column constitute the DNA fingerprint.\textsuperscript{49} Based on the location of the segment, the length of the repetitive DNA can be determined and compared. Since everyone has different repetitive DNA, each RFLP shows an identifiable, inherited characteristic, which is useful to determine identity or relationship. DNA fingerprinting examines many repetitive fragments to obtain a pattern from the bands, which is compared with other DNA fingerprint patterns.\textsuperscript{50}

\textsuperscript{42} For an excellent explanation of DNA electrophoresis, see Burk, \textit{supra} note 24, at 459-60.

\textsuperscript{43} \textit{Id.}

\textsuperscript{44} \textit{Id.}


\textsuperscript{46} The probe was developed by Dr. Jeffrey. \textit{See supra} notes 9 and 10 and accompanying text. The probe consists of lab-made DNA that stick wherever they find a matching repetitive DNA sequence on the fragments. When a probe finds its matching piece of DNA, the two pieces "zip" together. Since A pairs only with T and C only with G, \textit{see supra} note 31, repetitive sequence TAGCTA would "zip" only with a DNA probe labeled ATCGAT. For a more detailed discussion of genetic probes, \textit{see} B. Lewin, \textit{GENEs II} 287-89 (1985).

\textsuperscript{47} Burk, \textit{supra} note 24, at 460.


\textsuperscript{49} Lewin, \textit{supra} note 1, at 49.

\textsuperscript{50} \textit{See} Jeffreys, Wilson & Then, \textit{Hypervariable Minsatellite Regions in Human DNA}, 314 \textit{NATURE} 72 (1985).
The end result of a DNA fingerprint test is a piece of X-ray film with dark bands showing the positions of certain fragments. The final step in RFLP analysis is to compare the print from the crime scene with the print from the suspect. In most cases, this is done by the human eye alone. The comparison can be done by machines,\(^{51}\) which read prints and convert each print into a numerical code.\(^{52}\) DNA fingerprints resemble ordinary fingerprints in that they are highly individualized patterns that can be compared with other highly individualized patterns.\(^{53}\)

II. Who Performs This Procedure

Currently, three different tests for typing DNA are offered by commercial laboratories. Probably the best known is the "DNA-Print" identification test offered by Lifecodes Corporation.\(^{54}\) "The information obtained from this one test can identify an assailant with a specificity equal to, if not greater than, that achieved with an entire battery of modern-day forensic tools."\(^{55}\) To verify the accuracy of this test, scientists analyzed thousands of DNA specimens from people of various racial and ethnic backgrounds. If two patterns match, investigators can conclude with a 99.9% certainty that they are from the same individual. If they do not match, then the suspect is not the source of the biological specimen.\(^{56}\) This test relies on the RFLP analysis\(^{57}\) and produces a "print" that consists of a pattern of bands.\(^{58}\) Lifecodes generally uses four probes, which produce one or two bands each.\(^{59}\) Lifecodes has done prints in over four hundred criminal cases, approximately 2,000 paternity cases in the United States\(^{60}\) and given testimony in sixty-three criminal

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\(^{51}\) Thompson & Ford, supra note 4, at 45, 47-75.
\(^{52}\) Numerical codes are then compared with one another to determine the degree to which the two prints match. Id.
\(^{53}\) Burk, supra note 24, at 463.
\(^{54}\) 4 Westchester Plaza, Elmsford, NY 10523.
\(^{55}\) This test relies not on the presence of specific proteins as other genetic tests do, but instead on the integrity of the DNA molecule—a molecule that is highly resistant to forces of nature and particularly stable in dried specimens. M. Terry, DNA-Print Identification Test, in BACKGROUND INFORMATION PACKET 6 (Lifecodes Corp. 1986).
\(^{56}\) Id.
\(^{57}\) For a detailed discussion of RFLP analysis, see T. Maniatis, supra note 39.
\(^{58}\) Thompson & Ford, supra note 4, at 82.
\(^{59}\) The two specimens are then compared to see if they match. While there is significant probability that different individuals will match on one or two bands, the likelihood of a coincidental match on all of the bands is low. See Baird, supra note 48, at 489, 492.
\(^{60}\) Moss, supra note 1, at 67.
cases, including convictions in which the defendant received the death sentence based on DNA evidence.

A second test for typing DNA, known as "DNA Fingerprinting," is offered by Cellmark Diagnostics Corporation. Like the Lifecodes test, Cellmark uses RFLP analysis, although there are important distinctions. When Cellmark first opened in 1987 the company relied exclusively on "multi-locus" probes, which produce a "fingerprint" that looks similar to a supermarket bar code with approximately fifteen bands. The DNA fingerprint takes only a week or two to develop, while other tests can take up to six months. In early 1988, the company abandoned the use of the multi-locus probes in favor of single-locus probes similar to those used by Lifecodes. Cellmark's test was first used in an immigration case in 1983. According to Jeffreys, "the chance that two unrelated individuals will have the same DNA fingerprint is 1 in 1,000,000,000,000,000. Even among siblings (except identical twins) the chance is 1 in 10,000,000,000,000."

The Jeffreys single locus probes can be used in the analysis of as little as 20 nanograms of sample DNA, which allows testing to be done on a hair root recovered from a crime scene. Cellmark is unique in that it can cross reference bands present in the DNA fingerprint patterns of suspects prepared using the multi-locus probes against patterns prepared using the single locus probes. As of April 1989, Cellmark's single-locus procedure had been admitted into evidence in twenty-seven criminal cases.

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61 M. Terry, supra note 55. The sixty-three criminal cases in which Lifecodes has given testimony resulted in forty-five convictions. Of these cases, three persons pled guilty prior to trial, three were acquitted or the case was dismissed and four cases are still pending.


63 20271 Goldenrod Lane, Germantown, MD 20874.

64 Developed by British Geneticist Alec Jeffreys, who also developed DNA Fingerprinting. See supra note 9 and accompanying text.

65 The bar code is unique to every individual, except for identical twins, as their DNA is the same. Jeffreys, Wilson & Them, Individual-Specific "Fingerprints" of Human DNA, 316 Nature 76 (1985).


67 See Thompson & Ford, supra note 4, at 49.


69 Jeffreys, Wilson & Them, supra note 65.

70 The Ultimate Identification Test, 6 (Cellmark Diagnostics 1988).

71 Id.
A third test for typing DNA was developed by Cetus Corporation. The procedures used in the Cetus test are vastly different from those in the Lifecodes and Cellmark tests. The Cetus test employs a technique called polymerase chain reaction ("PCR"), which is sometimes known as "DNA Amplification." One advantage of this technique is that it requires less biological material than the other two tests. This test can go so far as to "type" the DNA from a single cell. The test is especially useful when the amount of genetic material left at the crime scene yields too little DNA for conventional analysis. To produce interpretable results, the Cellmarks and Lifecodes tests require the amount of DNA found in "several hundred thousand sperm heads or a well-soaked bloodstain the size of a quarter." According to Cecil Hider, director of the California Criminalistics Institute, a sample this size is larger than can be found at many crime scenes. However, "the Cetus test can produce results with only one ten-thousandth of this amount of DNA." The disadvantages of the Cetus test are that it is less specific than the other tests, and it relies on new, less widely accepted technology. It does not guarantee the identity of a suspect with "virtual certainty" like the other two companies, but it still boasts better statistics than traditional methods of semen and hair testing.

The Supreme Court of Virginia recently affirmed the admissibility of "PCR" DNA amplification by upholding a death sentence which was based on the DNA amplification evidence. The test also was used and caused the release of a non-English speaking man, Roberto Chavez. Chavez was identified by a crime victim, had no alibi, and was otherwise unable to show his innocence.

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72 1400 53d Street, Emeryville, CA 94608.
73 Thompson & Ford, supra note 4, at 50.
74 Higuchi, Von Beroldingen, Sensabaugh & Erlich, DNA Typing From Single Hairs, 332 Nature 543 (1988) [hereinafter Higuchi].
75 The procedure involves taking an enzyme, called polymerase, to amplify target DNA sequences by creating a million or more copies of them. A machine called a thermal cycler amplifies the DNA, which is then spotted on a filter to be tested with gene probes. If a particular genetic variant is present the probe produces a blue dot that is compared with the sample that was given by the suspect. Moss, supra note 1, at 69. See also Spencer, 384 S.E.2d at 781-82.
76 Thompson, DNA's Troubled Debut, CAL. L. W., June 1, 1988, at 36, 41.
77 Id., Higuchi, supra note 74, at 543.
78 Id., supra note 4, at 50.
79 Moss, supra note 1, at 67.
80 Moss, supra note 1, at 69. See also Spencer, 393 S.E.2d 609 (Va. 1990).
After spending seven months in jail awaiting trial in Minlow Park, California, his attorney sought this test to prove his client's innocence, and Chavez was released based on the results of the test.82

These three procedures from the three private laboratories have been shown to be reliable, but they are expensive tests that have yet to be accepted throughout the nation. This cost has caused concern, but many believe that "once the FBI gets its laboratory into operation DNA will become the routine identification buzzword of the 1990's."83 The FBI initiated widespread use of the technique after concluding a year of practical tests in December, 1988.84

The FBI developed their own typing procedure and selected four states to participate in validating their procedure. Kentucky was one of the states selected.85 To develop this procedure, the FBI worked closely with Cellmark and Lifecodes. According to John Hicks, an FBI Laboratory Official, Bureau scientists spent much of 1986 studying the commercial methods and experimenting with some of their own.86 Cellmark personnel helped train FBI lab technicians and traveled to the Bureau's DNA Analysis Unit in Quantico, Virginia, to evaluate its procedure.87 Through FBI laboratories, the testing will be readily available to the local police departments.88 By initiating this procedure, the FBI assured many skeptics that DNA testing is reliable.89 Over the past two years, DNA testing has had two significant events that helped to establish its reliability in the legal community 90 First, the FBI implemented its program, and second, the use of DNA evidence in the courtroom was sanctioned by an appellate court for the first time.

83 Taylor, supra note 19, at 3, col. 1.
84 Nalcolm, DNA Profiling Allows Precise Identification in Crime Cases, St. Peters-
85 State Police to Use DNA to Identify Suspects, Lexington Herald Leader, June 11, 1989, § A, at 1, col. 4.
87 The probe the FBI ended up with is a blend of four different probes, drawing on technology from Cellmark and Lifecodes, as well as two smaller biotechnology companies. This enables the FBI to use the probes without having to pay Cellmark, which has a patent on its technology. Id. at 12, col. 4.
88 Nalcolm, supra note 84.
89 Watson, supra note 86, at 1, col. 3. According to John Huss, Vice President of Marketing for Cellmark, "It was like Cardinal Spellman saying, "This catechism is OK.""
III. ADMISSIBILITY IN A COURT OF LAW

Acceptance or rejection of scientific tests by a court is a complex process, particularly in criminal cases. To determine the admissibility of a new scientific technique, the majority of jurisdictions rely on the rule developed in United States v Frye. Under the Frye rule, for a new scientific technique to be deemed admissible, it "must be sufficiently established to have gained general acceptance in the particular field in which it belongs." The Court of Appeals of the District of Columbia stated,

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

The underlying assumption "is that general acceptance is an indication of reliability."

"Once a procedure is sufficiently established to have gained general acceptance in the particular field in which it belongs, it presumably has gone through an extended period of use and testing within the scientific community and is reliable." The goal of the Frye test, then, is to assure that only reliable evidence is admitted.

Along with reliability, there are other justifications for the Frye rule. First, "[t]he requirement of general acceptance in the scientific community assures that those most qualified to assess the general validity of a scientific method will have the determinative voice." Using Frye, judges need only assess whether experts in the field where the technique belongs consider it reliable. Second, the Frye rule assures at least a small reserve of experts. It prevents situations

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* United States v. Frye, 293 F 1013, 1014 (D.C. Cir. 1923).
* Id.
* Id. at 1014.
* Thompson & Ford, supra note 4, at 53.
* Some commentators have questioned whether general acceptance always indicates reliability. Id. at 846-57.
where litigants find it difficult or impossible to obtain experts who critically examine the validity of an opponent's scientific evidence. Third, *Frye* promotes uniformity "Individual judges whose particular conclusions may differ regarding the reliability of particular scientific evidence, may discover substantial agreement in the scientific community". Finally, the *Frye* rule eliminates the need to reopen the issue of admissibility in each case.

The theory underlying DNA is not controversial. The theory on which the DNA typing tests are based is called the "DNA paradigm." There are many publications that have relied on the DNA paradigm and conflicting authorities are virtually nonexistent. *People v. Wesley* was the first case that indicated how a court would respond on the issue of reliability of a particular DNA test. The trial court opinion, issued after an extensive hearing on the admissibility of DNA typing, stated that the Lifecodes test met the standard for admissibility under the *Frye* rule. As of the date of the *Wesley* decision, no court had ruled the DNA typing test inadmissible under the *Frye* rule.

There are a number of criticisms of the *Frye* rule. In *U.S. v. Downing*, the Third Circuit rejected *Frye* and instead utilized the reliability approach. This test focuses on the following three factors when considering the admissibility of new scientific evidence: "the soundness and reliability of the process or technique used in generating the evidence, the possibility that admitting the

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100 See id.
104 See *State v. Castro*, 545 N.Y.S.2d 985, 987 (N.Y. Sup. Ct. 1989); see also M. Terry, supra note 55, stating that as of May, 1989, Lifecodes had given testimony in twenty-six evidentiary hearings, in at least eight different states, and it was ruled admissible in every situation.
106 753 F.2d 1224 (3d Cir. 1985).
evidence could overwhelm, confuse, or mislead the jury, and the proffered connection between the scientific research or test result to be presented and particular disputed factual issues in the case.  

This test was used in *State v. Andrews.* The appellate court upheld the admission of the DNA typing evidence, stating, "evidence derived from DNA print identification appears based on proven scientific principles." The court noted that "DNA testing has been used for about ten years for the diagnosis, treatment, and study of genetically inherited diseases." The extensive non-judicial use tends to show the reliability of the technique.

On July 6, 1989, the West Virginia Supreme Court set a precedent by ruling that DNA tests are admissible because scientists generally agree they are reliable. According to Justice Richard Neely, who wrote for the court, "[t]he reliability of DNA typing analysis is now generally accepted in this jurisdiction when such a test is conducted by qualified personnel." This decision and the Florida appellate court decision signify that DNA testing is deemed reliable and, thus, admissible in a court of law regardless of the evidentiary test that is used.

Since the majority of jurisdictions use the *Frye* rule today, one must question what is implied when a court determines DNA to be admissible. This question demands an answer, as the criminal justice system has yet to develop a standard procedure for every criminal case involving DNA. There are various labs and procedures currently being used to test the evidence. When a court holds that the DNA procedure is admissible, what does this mean? To answer this question this Comment compares the acceptance of DNA evidence with that of hypnotic testimony.

Due to reliability concerns about hypnotic testimony, the courts developed four different approaches to its admissibility. They are per se inadmissibility, a balancing approach in accordance with Rule 403 of the Federal Rules of Evidence, per se admissibility,

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109 Id. at 1237.
112 Id. at 849.
113 Id. at 849.
115 Id.
116 See supra notes 65-105 and accompanying text.
and conditional admissibility, providing safeguards are fulfilled. Hypnotic testimony differs from DNA evidence as some courts hold that it is too unreliable for use in the courtroom. Hypnotic testimony failed the Frye test because the scientific community was divided on the acceptability of the technique. This division led the courts to use the per se inadmissible approach in hypnotic testimony cases. Since the scientific community is not divided on the subject of DNA, and it has passed the Frye test in every case, the inadmissibility approach is not relevant to DNA fingerprinting.

Rule 403 of the Federal Rules of Evidence provides a new approach to the admissibility of hypnotic testimony, although Frye is still favored by the courts in cases involving scientific evidence. For the most part, Rule 403 has been disregarded with respect to hypnotic testimony. Since DNA evidence already had been held admissible under the conservative Frye standard, this Comment focuses on the remaining two approaches to hypnotic testimony. The two solutions this Comment focuses on are per se admissibility and conditional admissibility.

A. Per Se Admissibility

The per se admissibility approach to post-hypnotic testimony was adopted by the Maryland Court of Special Appeals in Harding v. State. In Harding, the court held that all hypnotically refreshed testimony was to be admissible in the same manner as other testimony. They held that the facts of a particular case should go to the weight of the evidence rather than the admissibility.

118 Id.
120 Shirley, 723 P.2d at 1383-84.
121 Castro, 545 N.Y.S.2d at 987.
122 Fed. R. Evid. 403 provides, “Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence.”
In *People v Wesley*, a New York court applied a similar approach to DNA fingerprinting. The defense focused on two areas of the Lifecodes tests: the adequacy of Lifecodes' labor procedures, methodology, and quality control, and the adequacy of Lifecodes' population studies used to support the statistics on the probability of a coincidental match. The court noted that these challenges may well go "not to the question of admissibility but to the weight of the evidence, a matter for resolution by the trier of facts." The court found it unnecessary to resolve this issue, as neither of the challenges were supported with adequate evidence.

Several decisions over the past months indicate that some courts are looking at DNA evidence as per se admissible. In *Martinez v Florida* the court held DNA evidence admissible, as "[t]he testing method and process are substantially identical to those described in *Andrews v State.*" It did not delve into the particular facts of the case. In another decision, a Maryland appellate court held DNA admissible but commented, "we are not holding that DNA fingerprinting is now admissible willy-nilly in all criminal trials conducted between this date and January 1, 1990," when a Maryland statute takes effect making DNA evidence admissible at criminal trials within the state. This statute, as well as West Virginia's Supreme Court ruling, indicate that DNA fingerprinting will be admissible in these two states.

A final factor strengthening the case for per se admissibility in DNA fingerprinting is the testimony in both *Andrews* and *Wesley* that "it is impossible under the scientific principles, technology, and procedures of DNA Fingerprinting (outside of an identical twin), to get a 'false positive'—i.e. to identify the wrong individual as a contributor of the DNA being tested." The court

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126 533 N.Y.S.2d at 650-51.
127 Id. at 650.
128 Id. at 650-51.
129 Id. at 651.
133 Id. at 398.
137 Wesley, 533 N.Y.S.2d at 652.
has called this "a matter of extreme significance." However, this issue has been disputed.

Once post-hypnotic testimony was allowed, some abuse necessarily followed. This led many courts to establish several procedural safeguards. Many argue that DNA evidence has the same potential for abuse. Since there are no set standards for the procedure, credibility could be compromised through mishandling, mismanagement, and improper analysis. This concern leads one to examine the possibility of allowing only conditional admissibility of DNA fingerprinting evidence.

B. Conditional Admissibility

In New Jersey v. Hurd, the court determined that although testimony enhanced through hypnosis is admissible, the opponent may challenge the reliability of the particular procedures followed in each individual case. However, the general reliability of hypnosis cannot be proven during the case. The evidence is subject to strict safeguards to ensure reliability in the particular procedure. If the procedure is not capable of giving reasonably reliable results, then its probative value may be outweighed by risks such as prejudice, jury confusion, and waste of time and trial resources. The object of the pretrial review is not to determine whether proffered hypnotic testimony is accurate, but to determine whether the procedure followed in the particular case was reliable.

This procedure could be beneficial in determining the admissibility of DNA evidence. DNA evidence has been admitted under the Frye standard, but is that enough? The court, in considering

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138 Id.
139 See Castro, 545 N.Y.S.2d at 985.
140 The original jurisdictions embracing the per se admissible approach to hypnotically refreshed testimony, Maryland and North Carolina, have subsequently rejected the approach, specifically overruling earlier cases. Harding, 5 Md. App. 230, 246 A.2d 302, overruled, Collins v. State, 52 Md. App. 1986, 447 A.2d 1272 (Md. Ct. Spec. App. 1982); State v. McQueen, 295 N.C. 96, 244 S.E.2d 414 (N.C. 1978), overruled, State v. Peoples, 311 N.C. 515, 319 S.E.2d 177 (N.C. 1984). Procedural safeguards were not intended to ensure the reliability of the hypnotically refreshed testimony, but merely to curb the potential for abuse that had arisen under the per se admissible approach. Stokes, 548 So. 2d at 192 n.2.
141 See Anderson, supra note 7.
143 See Fed. R. Evid. 403.
145 Id. at 585-86.
the admissibility of scientific evidence, has an important decision to make, as the evidence has vast potential to influence a jury. The media's portrayal of DNA fingerprinting as magically foolproof may make the admission of the testimony seriously misleading and prejudicial. Because of this portrayal, the importance of making certain that the evidence that is presented to the jury is reliable and accurate is paramount. The first case to deal precisely with this concern was *State v Castro.*

*State v Castro* involved a pretrial hearing some have referred to as the most comprehensive and extensive legal examination of DNA forensic identification tests held to date in the United States. The hearing, which was ordered because no appellate court in New York had decided this issue, took twelve weeks and the transcript consisted of approximately 5,000 pages. To assist in evaluating and resolving the issue of admissibility of DNA evidence, the court developed a three prong test. The first two prongs of the test deal exclusively with the *Frye* issue. The first prong confronting the court asked, "[i]s there a theory, which is generally accepted in the scientific community, which supports the conclusion that DNA forensic testing can produce reliable results?" In response, the court found unanimity among all scientists that DNA typing is capable of producing reliable results. "There is nothing controversial about the theory underlying DNA typing. Indeed, this theory is so well accepted that its accuracy is unlikely even to be raised as an issue in hearings on the admissibility of the new tests. The theory has been repeatedly put to the test and has successfully predicted subsequent observations."

The second prong of the court's analysis asked, "[a]re there techniques and experiments that currently exist that are capable of producing reliable results in DNA identification and which are generally accepted in the scientific community?" The techniques

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147 U.S. v. Williams, 583 F.2d 1194 (2d Cir. 1978).
148 *Castro,* 545 N.Y.S.2d at 985.
149 *Id.* at 986.
150 Id. at 987.
151 Id. at 988.
152 Id. at 987.
153 Id. at 987.
154 Id. at 988.
156 *Castro,* 545 N.Y.S.2d at 987.
and experiments performed "in this case have been used in laboratories conducting DNA analysis in diagnostics, clinical and experimental settings for years."

This demonstrates the importance of knowing the different procedures used by the various labs.

All of the procedures used in this case were found to have gained general scientific acceptance.

The conclusion of the Castro court is consistent with the findings of other courts; DNA identification tests are admissible under the Frye standard. "It has been [noted] that, 'Perhaps the most important flaw in the Frye test is that by focusing attention on the general acceptance issue, the test obscures critical problems in the use of a particular technique.'" Therefore, the court created a third prong for the pre-trial hearing on the question of the admissibility of the particular DNA evidence presented in the specific case. Given the complexity of the procedures and the vast impact that findings may have on a jury, it is important to look at more than the general approach. Courts need to focus on the specifics of each case.

The third prong of this analysis asked, "[d]id the testing laboratory perform the accepted scientific techniques in analyzing the forensic samples in this particular case?" Other courts have held that this question goes to the weight of the evidence and not to the question of admissibility under Frye. In response to this notion, the Castro court determined that "passing muster under Frye alone is insufficient to place this type of evidence before a jury without a preliminary critical examination of the actual testing procedures performed in a particular case." "[A] scientist may

157 Id. at 990.
158 See supra notes 54-89 and accompanying text.
160 Castro, 545 N.Y.S.2d at 988.
162 Castro, 545 N.Y.S.2d at 987.
163 Id.
164 See Wesley, 533 N.Y.S.2d at 650-656; Gianelli, supra note 161, at 1201.
165 Castro, 545 N.Y.S.2d at 987; see also Beeler and Wiebe, DNA Identification Tests and the Courts, 63 WASH. L. REV. 903, n.172-75 (1988).
have no trouble accepting the general proposition that DNA typing can be done reliably, yet still have doubts about the reliability of the test as performed by a particular laboratory.166

The Castro court noted authorities that discuss improper procedures and experiments, and they advised caution in reviewing the procedures.167 By attacking each piece of evidence presented, the defense in Castro successfully showed that the testing laboratory failed to perform the accepted scientific techniques and experiments in several major respects. One of the tests utilized a contaminated probe, and upon discovery its use should have been discontinued. This was not done. Another problem involved the degraded DNA. Because bacteria had been eating it, questions were raised as to whether there was a true homozygous band or a heterozygous band that appeared to be homozygous.168 The court found that the laboratory should have used a non-polymorphic probe to answer this question.169 The court concluded that "[t]he testing laboratory failed in several major respects to use the generally accepted scientific techniques and experiments for obtaining reliable results, within a reasonable degree of certainty."170 This led to the exclusion of DNA identification evidence as a matter of law.171

The court suggested procedures that should be applied to the use of DNA identification evidence in a criminal courtroom. The first procedure requires that notice be given as soon as practicable when one intends to offer DNA evidence.172 Secondly, one must give his adversary the following items:

(1) copies of autorads, along 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 the standard deviation used; (6) a statement by the testing lab, setting

166 Thompson & Ford, supra note 4, at 57-58.
167 Castro, 545 N.Y.S.2d at 996, citing Wesley, 140 Misc. at 320; Andrews v. State, 533 So.2d at 850.
168 Castro, 545 N.Y.S.2d at 996.
169 Id., other problems that existed with this specific test are found in the case at 996-98.
170 Castro, 545 N.Y.S.2d at 994.
171 Id. at 999.
172 Id.
forth the method used to calculate the allele frequency 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 the tests performed to determine the origin and 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; and (12) chain of custody documents. 173

The third requirement places on the proponent the burden of establishing that the tests and calculations were properly conducted. 174 Once this has been done the burden then shifts to the adversary to prove, by a preponderance of the evidence, that the tests and calculations should be suppressed or modified. 175 Any issues of fact that arise during the hearing concerning the reliability of a particular test, or the size or ratio of the population frequency, relates to the weight of the evidence and not its admissibility. 176 When the results are unreliable, they are inadmissible as a matter of law. 177 These steps were followed in the Castro case, leading to the exclusion of information that could have been misinterpreted by the jury, increasing the likelihood of an erroneous verdict.

C. Problems and Precautions

Every jurisdiction in the United States should narrowly focus on the acceptability of the implementation of DNA typing rather than its general reliability. Even with comments stating that the test will not give a false positive, one needs to remember what was said by Dr. Alec Jeffreys: "I would, however, like to point out that, contrary to statements in the popular press, this test is not foolproof. It cannot necessarily detect blood sample substitutions, whether accidental or deliberate." 178 This controversy further emphasizes the need for a pretrial hearing to examine the test that was performed in a particular case.

173 Id.
174 Id.
176 Castro, 545 N.Y.S.2d at 999.
177 Id.
The practical problems of doing the test should not be underestimated. The process "is very labor intensive and needs both meticulous expertise and much experience in the reading and interpretation of the bands." A high degree of technical expertise is needed to perform and interpret the tests, as all conditions of the test must be uniform before the results can be compared. There are a number of steps in the procedure that can affect the reliability of the test. Courts need to inquire into which lab performed the test, the laboratory personnel's expertise level, the testing procedure used, the knowledge of the scientist with respect to the particular facts of the case, and environmental conditions with regard to the evidence that is sampled.

It is important to focus on which lab performed the test as there are not uniform standards and each laboratory's test is different. There should be a showing that the specific protocol that the lab used is accepted as reliable. Once this is determined, one should show that the protocols were accurately followed. Most problems that occur at this stage produce noninterpretable results, but a study has shown that false results may be produced. A number of common errors and problems are known to arise in research labs that employ the techniques used in RFLP analysis. The forensic scientist must take special care to make certain that proper controls are used in performing the experiment correctly. The pretrial hearing can be used to ensure this.

This procedure requires a high level of expertise. The expertise level will differ among the labs offering the test. It is important that the scientists who are doing the procedures be familiar with the tests and the procedures that are needed for a particular sample. A degree of human judgment enters when autoradiographs are

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180 Id. at 506.
181 Burk, *supra* note 24, at 469.
182 In response to this specific problem, the New York legislature "passed the nation's first bill that would license and regulate forensic laboratories." At the time of publication Governor Cuomo had yet to sign the bill. See *Setting DNA Standards*, Nat'l. L.J., July 16, 1990, at 6, col. 3.
183 See DNA Committee, Cal. Assoc. of Criminalistics, Report No. 6, at 5 (1988). The Crime Laboratory Directors in California submitted various samples to match the sample with the same individual. Cellmark incorrectly matched one pair of samples.
interpreted. This creates the possibility of an erroneous reading since no formal standards for determining what constitutes a match between two DNA prints exist. It is the subjective judgment of the forensic scientist. It has been shown that priorities of a decision-maker can affect the subject threshold decision. This makes it essential that the scientist lack knowledge of the particular facts of the case and who has hired the lab to do the testing. Until objective standards are developed to determine what constitutes a match, this should be an important factor that the court considers during the pretrial hearing.

Another problem area involves the environmental effects on evidence that is submitted for testing. Contamination can occur when blood mixes with bacteria that grows in material at the scene of the crime or by bacteria growing in the sample. If the contaminants have DNA, that DNA will show on the autoradiograph along with the human DNA. Potentially, this is a serious problem if bands of foreign DNA cannot be distinguished from human bands. Chemicals also can contaminate a sample causing the DNA to be only partially digested during the restrictive digestion phase. This may cause some of the resulting fragments to be longer than normal, thus affecting the outcome of the sample. If a scientist uses the wrong enzyme or a contaminated enzyme, this also could cause the DNA to be cut at the wrong place. Contamination can be controlled through the use of careful laboratory examinations and testing standards. Once again, this is where the importance of a pretrial hearing is vital to determine that the procedures were in fact carefully followed.

When a court is looking at the admissibility of DNA evidence, it is important to remember that the development of standards to be used in the testing procedure and the development of objective standards to interpret the results are necessary before a court can say that the evidence is per se admissible.

185 Burk, supra note 24.
186 Brand, Perceptual Readiness, 64 PSYCH. REV. 123 (1951).
187 Castro, 545 N.Y.S.2d at 988.
188 Gills, Jeffreys & Werrett, supra note 159, at 577.
189 Fuchs & Blakesley, supra note 184, at 32.
190 "Commercial Restriction Enzymes are usually sold in high commercial solutions. Thus, a small amount of enzymes might be enough to contaminate a sample." Thompson & Ford, supra note 4, at 94 n.217.
191 See Lander, supra note 90 for discussion of cases that stress the importance of objective criteria.
To once again parallel DNA evidence with the procedures used in the admissibility of post-hypnotic testimony, the problems that occurred with post-hypnotic testimony should be used as a guide in helping a court realize the importance of taking the precautionary steps for admitting intricate and possibly prejudicial evidence to a jury. A criminal trial is a serious undertaking, where one hopes that justice will be served. In order to reach this goal, it is important to take the steps outlined above before admitting DNA evidence into the court of law. A jurisdiction should look to the guidelines given in the Castro case as well as the precautions discussed above before deciding that the evidence is admissible. Passing the Frye test is not enough. Until standards are developed to prevent the mishandling, mismanagement, and improper analysis, the pre-trial hearing is vital to the furtherance of this important new area. Standards need to be established in order for a judge to know which procedures will automatically be followed when confronted with this evidence. Simply put, a standardized procedure that ensures the reliability of the particular test in a case is of great importance.

CONCLUSION

When FBI reports announce that there is a violent crime committed every twenty-one seconds, a new scientific technique such as DNA fingerprinting will create vast excitement in law enforcement circles. Many forensic experts say that the chief use of DNA fingerprinting will involve sex crimes, but it is available in any crime where a suspect leaves behind his or her DNA. This is a great advantage since not only can it test a smaller amount of evidence, but it also offers a precise identification.

DNA fingerprinting is a scientific test that is reliable and has gained general acceptance in the scientific community. In order to gain acceptance in a court of law, it is vital to proceed cautiously to assure the procedure's reliability. Until procedures are developed that standardize the use of DNA evidence, courts should carefully examine the procedures involved in each case. Once DNA testing becomes routine, it will save considerable money and shorten police

192 CNN, supra note 82.
193 Michaud, supra note 5.
195 Id.
investigations. Furthermore, its precision shall increase conviction rates.

In a relatively short period of time there has been an incredible explosion of knowledge that will lead this technology to progress at a fantastic rate. According to Dr. Baird of Lifecodes, "[i]f you are a criminal, it's like leaving your name, address, and social security number at the scene of the crime. It's that precise." With crime increasing, a procedure that can match criminals with evidence that previously would have been discarded just might be the answer for which law enforcement has been waiting. However, the courts must proceed cautiously to assure its continued use and reliability.

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197 Lewis, *supra* note 1, at 52.