Statutory Control of DNA Fingerprinting in Indiana

Introduction

In 1986, a woman was raped in a small town in Leicestershire, England. The only evidence of the perpetrator was a semen sample recovered from the victim. The police were aware that a local scientist, Alec Jeffreys,[1] was developing a technique for comparing deoxyribonucleic acid (DNA) samples that might be used for identification purposes. The police asked Dr. Jeffreys to test DNA samples from each of the four thousand men in the town. One of the persons to be tested, Colin Pitchfork, engaged a substitute to take the test for him. The police discovered this attempted subterfuge and arrested Pitchfork. Pitchfork later confessed to the rape, thereby earning the dubious distinction of being the first person to be convicted by DNA fingerprinting evidence.[2]

DNA fingerprinting has been described as the most important advance in criminology since the advent of cross-examination.[3] In common with traditional genetic analyses such as ABO typing, human leucocyte antigen typing, and typing of red cell enzymes and serum proteins,[4] DNA fingerprinting serves to indicate whether two samples of human tissue, one recovered from the scene of the crime and the other from a suspect, share common characteristics. DNA fingerprinting, however, differs from traditional techniques in that it requires a smaller sample size and it gives rise to a much higher exclusion frequency.[5]

DNA fingerprinting was first used in the United States in 1987, one year after Pitchfork's conviction.[6] As of October 1990, it has been used in 2000 criminal investigations and 200 trials in thirty-eight states.[7] It has also been used in thousands of civil cases, principally paternity

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1. Alec Jeffreys is a professor of biochemistry at Leicester University, England.
2. *See* Moss, *DNA—The New Fingerprints*, 74 A.B.A. J. 66 (1988).
3. People v. Wesley, 140 Misc. 2d 306, 308, 533 N.Y.S.2d 643, 644 (1988).
4. For a discussion of these analyses, see P. Giannelli & E. Imwinkelried, Scientific Evidence 565-632 (1986).
5. Exclusion frequency, as used herein, is the frequency with which characteristics shared by the two samples under test occur in the population at random. Exclusion frequencies as high as one in 30 billion have been claimed for DNA fingerprinting. Dodd, *DNA Fingerprinting in Matters of Family and Crime*, 318 Nature 506, 506 (1985). Exclusion frequencies of about one in 10 to one in 100 are more typical for traditional genetic analyses. *Id.* at 507.
6. Slackman, *Genetic Finger-Pointing; Prosecutors Fear Impact of Surprise Bill Regulating DNA Evidence*, Newsday, July 7, 1990, at 3.
7. Marcotte, *Report: DNA Tests Valid*, 76 A.B.A. J. 26, 26 (1990).

disputes.[8] Most of these DNA tests were performed by two commercial laboratories, Cellmark and Lifecodes. Lifecodes now earns $40 million each year from the process.[9]

In the initial case, Pitchfork's confession spared the court from having to assess the reliability of DNA fingerprinting evidence. Reliability has, however, been closely scrutinized in later cases. Such scrutiny is inevitable in light of the complexity of the DNA fingerprinting process and the possibility of conviction solely on the basis of DNA fingerprinting evidence.[10] In 1989, two courts refused to admit DNA fingerprinting into evidence.[11] These courts accepted that the principles underlying DNA fingerprinting are sound, but found that the particular procedures of the laboratories conducting the test were unreliable.[12] More recent appellate decisions have generally affirmed trial court decisions to admit DNA fingerprinting into evidence and have sustained both the fundamental principles and the particular procedures of the laboratories conducting the tests.[13]

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8. *Id.* This Note principally addresses the use of DNA fingerprinting in criminal, rather than civil cases. Reliability concerns are not as great in civil cases because the comparison is made between DNA samples derived from two people (*e.g.*, alleged father and son in a paternity proceeding), rather than between one sample derived from the scene of a crime and another from a person, as in criminal applications. Unlike samples derived from the scene of the crime, samples derived from people are clean and can be as large as required. DNA fingerprinting can be performed with greater accuracy on large clean samples. A large sample also allows repetition of the test if the results are ambiguous. Paradoxically, the Indiana statute, which facilitates admission of DNA fingerprinting evidence, applies only to criminal trials in which reliability concerns are greatest.

9. Unger, *Court Challenge Casts Pall Over DNA Testing Industry*, NEWSDAY, July 30, 1989, at 47.

10. In Spencer v. Commonwealth, 240 Va. 78, 393 S.E.2d 609 (1990), the Virginia Supreme Court affirmed a capital conviction in which there was little evidence other than DNA fingerprints. A juror interviewed after an unpublished New York criminal trial commented, "DNA was kind of a sealer on the thing. You can't really argue with science . . . that was the whole case in my opinion." Note, *The Dark Side of DNA Profiling: Unreliable Scientific Evidence Meets the Criminal Defendant*, 42 STAN. L. REV. 465, 515 (1990) [hereinafter Note, *The Dark Side*].

11. State v. Schwartz, 447 N.W.2d 422 (Minn. 1989); People v. Castro, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (1989).

12. *Schwartz*, 447 N.W.2d at 427; *Castro*, 144 Misc. 2d at 978, 545 N.Y.S.2d at 999.

13. Martinez v. State, 549 So. 2d 694 (Fla. Dist. Ct. App. 1989); Andrews v. State, 533 So. 2d 841 (Fla. Dist. Ct. App. 1989); Caldwell v. State, 260 Ga. 278, 393 S.E.2d 436 (1990) (approving the trial court's decision to admit DNA fingerprinting evidence, but remanding for retrial on the grounds that the testing laboratory overestimated the exclusion frequency); Cobey v. State, 73 Md. App. 233, 533 A.2d 944 (1989); State v. Pennington, 327 N.C. 89, 393 S.E.2d 847 (1990); State v. Ford, 301 S.C. 485, 392 S.E.2d 781 (1990); Glover v. State, 787 S.W.2d 544 (Tex. Ct. App. 1990); Kelly v. State, 792 S.W.2d 579 (Tex. Ct. App. 1990).

Indiana Code section 35-37-4-10 follows the trend of recent appellate court decisions toward increasing acceptance of DNA fingerprinting evidence. The statute provides: "In a criminal trial or hearing, the results of forensic DNA analysis are admissible in evidence without antecedent expert testimony that forensic DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material."[14] It is obvious that the statute is intended to make DNA fingerprinting evidence more easily admissible into Indiana courts by reducing the expert testimony that is required to establish a foundation of reliability. It is less clear, however, whether the statute is intended merely to recognize that reliable techniques for performing DNA fingerprinting can be devised, whether it is intended to endorse the particular procedures of currently recognized testing laboratories, or whether it is intended as a per se rule of admissibility.

This Note shows how these three interpretations arise when the statute is viewed in light of Indiana's common-law approach to admissibility of scientific evidence. This Note attempts to discern which interpretation was intended by the Indiana legislature by referring to case law in other jurisdictions, by analogizing to other statutes, and by tracing the policy consequences of each interpretation. This Note also considers possible constitutional challenges to the statute.

I. Principles of DNA Fingerprinting

DNA fingerprinting (otherwise known as DNA profiling, DNA typing, or forensic DNA analysis) is an analytical technique for detecting differences between DNA molecules. This technique is based on the fundamental principle that, between different people, there are differences between their respective DNA molecules that give individuals their unique character.[15] A DNA molecule comprises millions of copies of four different units known as bases.[16] The sequence of bases along the molecule forms a code that is different for each individual.[17] Perhaps surprisingly, differences between the DNA sequences of different individuals amount to less than one percent of their total DNA codes.[18] However, these differences are not distributed at random throughout the code, but are concentrated at several specific locations known as "polymorphic regions."[19] At polymorphic regions, there is a high probability of finding

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14. Ind. Code Ann. § 35-37-4-10(b) (Burns Supp. 1990) (effective July, 1990).
15. *See generally* J. Watson, The Molecular Biology of the Gene (1987).
16. *See* L. Stryer, Biochemistry 71-76 (3rd ed. 1988).
17. *Id.*
18. *See* Note, *The Dark Side*, *supra* note 10, at 470-71.
19. Polymorphic sites are also referred to as "minisatellites." *See* Jeffreys, *Highly Variable Minisatellites and DNA Fingerprints*, 15 Biochemical Soc'y Transactions 309 (1987).

different sequences in different individuals. In DNA fingerprinting, a DNA sample from the scene of the crime is compared with a sample from a suspect at several polymorphic regions. If the two DNA samples are different at any of the polymorphic regions tested, the two samples are from different people. If the two DNA samples are identical at all polymorphic regions tested, the two samples are likely derived from the same person.[20]

II. Procedures For Performing DNA Fingerprinting and Sources of Error

The original method for performing DNA fingerprinting, and one that has been the subject of the most litigation to date, is known generically as restriction fragment length polymorphism (RFLP) analysis. RFLP analysis is practiced by three laboratories: Lifecodes, Cellmark (both commercial), and the FBI. A third commercial laboratory, Cetus, uses a different method based on the polymerase chain reaction.[21] A further method based on DNA sequencing is under development.[22]

A. RFLP Analysis

1. Procedure.—RFLP analysis is a complex procedure that can be subdivided into eight individual steps.[23]

a. DNA extraction

DNA is extracted from two samples. One sample is from human cells (*e.g.*, semen, blood, or hair) found at the scene of the crime. The

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20. *But see infra* note 29 and accompanying text.

21. The polymerase chain reaction is a recently discovered procedure for artificial reproduction of DNA. *See* Mullis, Erlich, Arnheim, Horn, Saiki, & Scharf, *Process for Amplifying, Detecting and/or Cloning Nucleic Acid Sequences*, U.S. Patent 4,683,195 (1987).

22. DNA sequencing is a technique for determining the sequence of bases comprising the DNA code. *See* L. Stryer, *supra* note 16, at 120-23.

23. The FBI, Lifecodes, and Cellmark procedures for performing RFLP analysis are respectively described in: Jakobetz v. United States, 747 F. Supp. 250, 251-54 (D. Vt. 1990); Baird, Balazs, Guisti, Miyazaki, Nicholas, Wexler, Kanter, Glassberg, Allen, Rubinstein, & Sussman, *Allele Frequency Distribution of Two Highly Polymorphic DNA Sequences in Three Ethnic Groups and Its Application to the Determination of Paternity*, 39 Am. J. Hum. Genetics 489 (1986) [hereinafter Baird]; Jeffreys, Willson, & Thein, *Individual-Specific "Fingerprints" of Human DNA*, 316 Nature 76 (1985) [hereinafter Jeffreys]. The description of the RFLP procedure given in this Note is schematic only and is based in part on these sources and in part on T. Maniatis, E. Fritsch, & J. Sambrook, Molecular Cloning: A Laboratory Manual (1982) [hereinafter T. Maniatis]. A more detailed account is given by Thompson & Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Tests*, 75 Va. L. Rev. 45 (1989).

other sample is taken directly from the suspect (*e.g.*, a blood sample). Subsequent steps are performed on the two samples in parallel.

b. DNA cleavage

The DNA is cleaved by use of enzymes known as restriction endonucleases that recognize and cut specific sequences of the DNA. This cleavage converts single molecules of DNA, each comprising millions of bases, to thousands of smaller fragments.[24] The vast majority of fragments generated from an individual's DNA will be identical to fragments derived from corresponding regions of another individual's DNA. However, a small proportion of fragments derived from polymorphic regions will differ in size from fragments derived from corresponding polymorphic regions in a different individual.[25] Subsequent steps in the procedure are designed to detect size differences between fragments derived from corresponding polymorphic regions in the two samples.

c. Electrophoresis

The DNA fragments are separated according to their size by a technique known as agarose gel electrophoresis. The procedure entails inserting DNA fragments into a gel and applying an electric field across the ends of the gel. DNA is negatively charged and hence, moves to the positive terminal. Small fragments are less impeded by the gel than large fragments and hence, move faster. Thus, after electrophoresis, the fragments are arranged in size from largest to smallest while immersed in the gel. Cleavage and separation of fragments allow analysis of polymorphic fragments free from the vast majority of fragments which exactly correspond in different individuals.

d. Southern transfer

The DNA fragments are transferred from the fragile gel to a more robust nylon membrane in a procedure known as Southern transfer.[26] The nylon membrane is layered directly over the gel and a stack of tissues is placed on top of the membrane. Fluid from the gel is drawn through the membrane into the tissues. DNA moves with the fluid from the gel, but comes to rest on the membrane to which it becomes permanently bound. Southern transfer preserves the separated array of fragments in the same relative positions as on the gel.[27]

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24. L. Stryer, *supra* note 16, at 130.

25. *See* Thompson & Ford, *supra* note 23, at 67-68.

26. Southern, *Detection of Specific Sequences Among DNA Fragments Seperated by Gel Electrophoresis*, 98 J. Molecular Biology 503 (1973).

27. *Id.*

e. Hybridization

The nylon membrane containing the array of DNA fragments is immersed in a hybridization fluid containing a radioactive probe specific for a polymorphic region. The probe binds to the fragments containing this polymorphic region which are themselves immobilized to the nylon membrane.

f. X-ray photography[28]

The nylon membrane is overlaid with film. The radioactive probe bound to polymorphic fragments exposes the film specifically at the positions where the polymorphic fragments have located. The polymorphic fragments derived from the two samples are compared to determine whether there is a match as judged by coincidence of band positions.

g. Rehybridization

The probe is washed off the nylon membrane and hybridization and X-ray photography (steps e and f) are successively repeated for two or three other probes. As an alternative to rehybridization, when sufficient DNA is available, the pair of samples under test may be split into fractions after DNA extraction (step a). Steps b - f are then performed separately for paired fractions and each pair is hybridized with a different probe at step e.

h. Statistical analysis

If a difference in polymorphic fragments is identified for any of the probes used, the two DNA samples are not identical and therefore, derive from different people. If the polymorphic fragments match for all of the probes used, an exclusion frequency is calculated. The exclusion frequency, as used herein, is the frequency with which the characteristics shared by the two DNA samples under test occur in the general population. If there is no independent incriminating evidence, the exclusion frequency is the relative probability that the defendant committed the crime compared with a person selected at random from the general population. The exclusion frequency is not, however, the same as the probability that the defendant committed the crime.[29]

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28. Technically known as "autoradiography."

29. If independent incriminating evidence exists that can be translated into a probability that the defendant committed the crime, this probability can be combined with the exclusion frequency to generate an overall probability of guilt using Bayesian analysis. *See* Finkelstein & Fairley, *A Bayesian Approach to Identification Evidence*, 83 HARV. L. REV. 489 (1970).

2. Possible Sources of Error.—The procedure outlined in the preceding section comprises many successive steps each of which is subject to a multitude of errors which can be subdivided into three categories.

a. Anomalous fragments

A match is declared by comparing the size of polymorphic fragments between two samples. Theoretically, the polymorphic fragments from each sample should be the only fragments visible on the photograph from which the comparison is made. Yet, a variety of errors can result in the appearance of extra spurious fragments or the disappearance of genuine polymorphic fragments. Either occurrence may make the comparison erroneous.

Spurious extra fragments can result from the addition of either too much enzyme (resulting in star activity and extra small fragments) or too little enzyme (resulting in partial digestion and extra large fragments).[30] Determining how much enzyme to add is difficult because the activity of the enzyme may decay with storage[31] and because it is not known precisely how much DNA there is in the sample to be digested.[32] Spurious fragments may also result from the contamination of a sample with bacterial DNA (this is particularly likely for DNA recovered from the scene of the crime)[33] or by cross-contamination between the two samples (which could arise from operator error).[34] Spurious bands can also result from nonspecific binding of the radioactive probe to fragments other than those from the polymorphic region under test.[35] The extent to which nonspecific binding causes problems depends on the hybridization conditions and the length of time the film is exposed.

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30. Restriction endonucleases recognize and cut at specific sequences of the DNA code. If the right amount of enzyme is added, the enzyme cuts at each occurrence of its recognition sequence and at no other sequences. If too much enzyme is added, the enzyme may cut at sequences resembling its recognition sequence (referred to as "star activity"). If too little enzyme is added, the enzyme will not cut all of its recognition sequences present on the DNA. *See* Fuchs & Blakesley, *Guide to the Use of Type II Restriction Endonucleases*, 100 METHODS IN ENZYMOLOGY 3, 33-38 (1983).

31. The FBI claims to check the activity of each batch of enzyme before performing a test. *See* United States v. Jakobetz, 747 F. Supp. 250, 257 (D. Vt. 1990).

32. DNA concentration is easily measured provided that a sufficiently large sample of DNA is available. *See, e.g.*, J. ZYSKIND & L. BERNSTEIN, RECOMBINANT DNA LABORATORY MANUAL 17-19 (1989). A possible difficulty with measuring DNA concentration in the course of performing DNA fingerprinting is that the available sample of DNA may be so small that to use up some of it in determining its concentration risks not having a sufficient remaining sample to perform the fingerprinting analysis.

33. People v. Castro, 144 Misc. 2d 956, 969, 545 N.Y.S.2d 985, 993 (1989); Lander, *DNA Fingerprinting on Trial*, 339 NATURE 501, 503 (1989).

34. Thompson & Ford, *supra* note 23, at 95.

35. *See* Jeffreys, *supra* note 23, at 77 (legend to Fig. 1).

Not only can spurious extra fragments appear, but genuine polymorphic fragments can also disappear for a variety of reasons. One such reason is the possibility of exonuclease contamination.[36] All procedures involving DNA are performed by technicians wearing plastic gloves who use sterile apparatus in the cold to minimize the likelihood of exonucleases present on human skin or in airborne bacteria from contaminating the samples and degrading them.[37] No precautions, however, can be taken to prevent degradation of the DNA sample recovered from the scene of the crime before it gets to the laboratory. If pronounced, degradation results in loss of all fragments. If less severe, selective loss of particular bands may occur.[38] Although it is relatively easy to test for DNA degradation, such a test may not be performed because of the risk that after using up some of the DNA sample in performing the test, an insufficient sample to perform the fingerprinting analysis will remain.

b. Subjective nature of declaring a match

Theoretically, a match should be declared only when the polymorphic fragments in one sample exactly match those in the other. However, gel electrophoresis is insufficiently precise to create an exact match even when the same sample is run twice.[39] Furthermore, the bands that indicate the position of fragments are not sharp lines like the bar codes on supermarket items, but are somewhat blurred and curved.[40] In a research environment, matches are declared by eye. That is, if it appears to the investigator that bands in one track occur in roughly corresponding positions to those in another track, there is a match. Initially, forensic laboratories performing DNA fingerprinting also adopted the eyeball method. This approach was criticized in *People v. Castro*,[41] and more recently, testing laboratories have declared matches by computer analyses of band patterns.[42] Although the use of computers removes the case-by-case variability of subjective human judgment, matches are still declared on the basis of arbitrary margins of errors defined by the computer's human operators and not on the basis of perfect alignment of bands.

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36. *See Castro*, 144 Misc. 2d at 969, 545 N.Y.S.2d at 996. Exonucleases are enzymes that progressively digest the ends of DNA molecules to generate free bases. Exonucleases are found in all living organisms.
37. *See generally* T. MANIATIS, *supra* note 23.
38. *See* Lander, *supra* note 33, at 503.
39. Thompson & Ford, *supra* note 23, at 87.
40. *Id.* at 87 n.188.
41. 144 Misc. 2d 956, 967, 545 N.Y.S.2d 985, 995 (1989).
42. *See* United States v. Jakobetz, 747 F. Supp. 250, 259 (D. Vt. 1990).

c. Statistical analysis

The overall exclusion frequency is the product of the individual frequencies of occurrence of each matching polymorphic fragment. Application of the product rule assumes, *inter alia*, that the individual frequencies are independent, an assumption that may be invalid. Although individuals do not knowingly choose their marital partners because of their possession of specific polymorphic fragments, humans do not necessarily mate at random with respect to polymorphic fragments.[43] The DNA code, of which polymorphic fragments are a part, determines characteristics such as intelligence and race which may have a profound effect on choice of marital partner. Geographic and religious factors can also contribute to a nonrandom assortment of polymorphic fragments. For example, if people from one small town continually intermarry, their descendants will retain distributions of polymorphic fragments similar to the founders of the town, rather than the more random distribution of the total population.[44] If the assumption of independent distribution of polymorphic fragments is invalid, the statistical calculation will overestimate the exclusion frequency. Such may well have happened in *Texas v. Hicks*[45] in which the defendant came from a small, inbred Texas town founded by a handful of families.

Even if the statistical calculation of exclusion frequency is reasonably accurate, it may be presented to the jury in a misleading fashion. Astronomical exclusion frequencies, such as one in thirty billion, purportedly derived from DNA fingerprinting, seem extraordinarily high for a complex process in which each step affords a multitude of opportunities for human error.[46] This is because exclusion frequencies are calculated on the assumption that a match has been correctly declared and do not take into account the possibility of previous human error in declaring the match.[47] Of course, this can be explained to a jury, but it is a subtle point that might nevertheless be overlooked. There is an additional danger that, as with other forms of statistical evidence, juries will confuse exclusion frequencies with probabilities of guilt, a confusion that may be encouraged by the prosecutor.

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43. *Id.* at 260.

44. Thompson & Ford, *supra* note 23, at 86-87.

45. Unpublished case discussed in Lander, *supra* note 33, at 505.

46. *See* Dodd, *supra* note 5.

47. If matches are declared by computer, the objective margins of error within which the computer is programmed to operate can and should be taken into account in calculating the exclusion frequency. *See infra* text accompanying note 53. However, random human errors (for example, adding the wrong amount of enzyme or cross-contaminating the samples) are not easily taken into account in calculating the exclusion frequency. In practice, the exclusion frequency is calculated on the assumption that such errors did not occur.

3. Significance of Errors.—The preceding section lists only a small fraction of the total number of errors that can occur. A more comprehensive account is given by Thompson and Ford.[48] In light of this vast assortment of potential errors, euphoric pronouncements of the infallibility of DNA fingerprinting are misplaced.[49] To suggest, however, that use of this technology in court is reminiscent of the Orwellian nightmare of 1984 is an exaggeration.[50]

Although numerous errors can give rise either to extra spurious bands or missing genuine bands, the fact that an unexpected number of bands appeared indicates that some error has likely occurred. Provided that no attempt is made to interpret band patterns containing an anomalous number of bands, errors of this nature can only benefit the defendant in that the evidence will not be used against him.[51] The difficulty arises when someone attempts to decide which bands are anomalous and which are not and attempts to interpret the pattern notwithstanding the obvious anomaly. For example, in *Castro*, the suspect's DNA sample showed two extra bands compared with the sample found at the scene of the crime. If genuine, these bands would have exonerated the suspect. However, the expert interpreting the gel somewhat arbitrarily concluded that these bands were artifacts and declared a match notwithstanding this anomaly. This was one of the reasons that the *Castro* court found the testing laboratory's procedure unacceptable.[52]

The subjective nature of declaring a match between samples by visual inspection can be reduced by declaring the match by computer scanning. Computers necessarily operate within margins of error programmed by their human operators, but these margins of error can be taken into account in the statistical calculation of the exclusion frequency.[53] Thus, looser criteria for declaring a match result in a lower exclusion frequency and less probative evidence.

Although the danger of a nonrandom distribution of polymorphic fragments cannot be ignored, it may not be as pronounced as was once thought.[54] The FBI, for example, tested subpopulations including Italians, Swedes, Irish, and Amish and found "very small differences" in distributions of polymorphic fragments between them.[55]

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48. *See* Thompson & Ford, *supra* note 23.
49. *See, e.g.*, Note, *Admit It! DNA Fingerprinting Is Reliable*, 26 HOUS. L. REV. 677 (1989).
50. *See* Note, *The Dark Side*, *supra* note 10, at 465.
51. United States v. Jakobetz, 747 F. Supp. 250, 262 (D. Vt. 1990).
52. People v. Castro, 144 Misc. 2d 956, 967, 545 N.Y.S.2d 985, 997 (1989).
53. *Jakobetz*, 747 F. Supp. at 259.
54. *See, e.g.*, Lander, *supra* note 33, at 504.
55. *Jakobetz*, 747 F. Supp. at 260.

Notwithstanding the above discussion of the reliability of DNA fingerprinting, the ultimate test of accuracy is to perform blind testing of samples of known origin. Surprisingly, only one such analysis has been published. In that test, Lifecodes correctly matched thirty-seven of fifty-one paired samples and called the remaining fourteen pairs inconclusive.[56] Cellmark correctly matched forty-four of forty-nine pairs, called four pairs inconclusive, and matched one pair erroneously.[57]

B. Techniques Other Than RFLP for Performing DNA Fingerprinting

Although most DNA fingerprinting evidence to date has derived from the RFLP method, a recent state supreme court decision affirmed the admission of such evidence derived from an entirely different technique based on the polymerase chain reaction.[58] This technique can yield results from smaller samples than can RFLP analysis.[59] The polymerase chain reaction method shares the same fundamental principle as the RFLP method (*i.e.*, identification is based on detecting differences in polymorphic regions between different individuals), but has little else in common. A further distinct method of performing DNA fingerprinting based on DNA sequencing is being developed.[60] Although this Note will not discuss these alternative methodologies in detail,[61] they are nevertheless relevant to the interpretation of the Indiana statute. It cannot be assumed that courts which have found RFLP analysis reliable will also find other methods of performing DNA fingerprinting equally reliable, much less that these courts will admit evidence derived from alternative methods without further inquiry.

III. Principles and Procedures for Determining Admissibility of Scientific Evidence

The substantive reliability of scientific evidence depends on four questions: (1) whether the fundamental principles from which the evidence derives are sound; (2) whether there are reliable procedures for generating

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56. Kinoshita, *Misprints: Seeking New Standards for Forensic DNA Typing*, 261 Sci. Am. 16 (Aug. 1989).

57. *Id.*

58. Spencer v. Commonwealth, 240 Va. 78, 89, 393 S.E.2d 609, 621, *cert. denied*, 111 S. Ct. 281 (1990).

59. Higuchi, von Beroldingen, Sensabaugh, & Erlich, *DNA Typing from Single Hairs*, 332 Nature 543 (1988).

60. *Id.*

61. These alternatives are discused at Thompson & Ford, *supra* note 23, at 76-81.

evidence based on those principles; (3) whether the procedure the testing laboratory purports to be following is reliable;[62] and (4) whether the testing laboratory actually followed the procedure it claims to be following.[63] There is a further procedural question as to whom should be entrusted with answering the four substantive questions above: the scientific community, the trial judge, or the jury. The two main tests for determining the admissibility of evidence, the *Frye* test and the relevancy test, take different approaches.

The *Frye* test places the initial responsibility for assessing reliability on the scientific community. Witnesses from the scientific community testify at a pretrial evidentiary hearing to determine admissibility of scientific evidence. The test under *Frye* is whether "the thing from which the deduction is made [has been] sufficiently established to have gained

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62. If it is generally accepted that reliable procedures for performing DNA fingerprinting exist, why would a testing laboratory adopt any procedure other than the generally accepted one? Most obviously, because no generally accepted procedure has been spelled out in detail by an authoritative body. When it is said that a generally accepted procedure exists, what is really meant is merely that the component methods of such a procedure, such as restriction digests, hybridization, and Southern blotting, exist and have proved reliable in nonforensic contexts such as research. The task of the testing laboratories is to assemble the component methods into a procedure appropriate to the particular difficulties encountered in forensic DNA analysis. The particular difficulties arise because the samples available for forensic DNA analysis are often small or contaminated. These difficulties are compounded by the need for accuracy in forensic testing, when a defendant's life may rest on the outcome, in contrast to the situation in a research environment, in which a reasonable rate of error is expected and is acceptable.

Some courts tend to merge the third and fourth criteria ((3) and (4) in the text). *See* People v. Castro, 144 Misc. 2d 956, 958-59, 545 N.Y.S.2d 985, 987-88 (1989). This is sensible if a generally accepted procedure is spelled out in detail by an authoritative body or is so obvious that it is self-defining. If this is so, the only remaining question is whether the testing laboratory complied with the generally accepted procedure. However, given the presently abstract nature of what constitutes a generally accepted procedure, the question of whether a laboratory complied with such a procedure is meaningless. It makes more sense to consider as separate questions whether the procedure the testing laboratory purports to be following is reliable and whether the testing laboratory actually followed this purported procedure. Once it is accepted that a particular laboratory's procedure is reliable, courts can focus on the simpler question of whether departures from this accepted procedure are material.

63. Why would a testing laboratory ever depart from the procedure it claims to be following in a particular application of DNA fingerprinting? First, there are many steps in the procedure that offer the opportunity for inadvertent departure from the purported procedure through human error. Second, the procedure involves use of unstable reagents such as enzymes which may not always behave in the expected manner. Third, the testing laboratory might deliberately depart from its usual procedure to attempt to encounter problems arising from an atypical sample, such as a sample that contains an unusual form of contamination.

general acceptance in the particular field in which it belongs."[64] The term "thing" is not self-defining; in practice courts have sought to determine whether there is general acceptance of the first, second, and sometimes the third substantive criteria for the evidence in question.[65] Even if scientific evidence satisfies the *Frye* test as determined by the scientific community, it may still be subject to the traditional evidentiary challenge of legal relevancy as determined by the court.[66] Evidence is legally relevant if its probative value outweighs its prejudice.[67] Probative value depends on reliability. Prejudice results when the jury does not attempt to make its own assessment of reliability, but unquestionably accepts scientific evidence because of the expert status of its proponent.[68] Questions of reliability not resolved by the *Frye* test (*i.e.*, the fourth and possibly the third of the above criteria) can, in principle, be raised to have scientific evidence held legally irrelevant by the court. In balancing probative value against prejudice, much depends on the seriousness of the alleged error and whether it is the kind of error that a jury could take into account in determining what weight to give the scientific evidence. If scientific evidence passes the *Frye* test and is not otherwise held legally irrelevant by the court, its reliability remains open to attack on cross-examination. Such attack goes to the weight of the evidence and the credibility placed on it by the jury.

Court rulings under *Frye* have the same precedential value as other case law. Thus, if a trial court's *Frye* ruling is affirmed by an appellate court, other trial courts in that jurisdiction are bound by the decision.[69] This would not, however, preclude trial courts from conducting a *Frye* hearing of more limited scope on different facts, as for example, if testing was performed by a different laboratory than that in the appellate decision. After further appellate decisions, the need for and scope of *Frye* hearings would diminish and eventually disappear.

The *Frye* test is the traditional means of assessing reliability and is said to have the following advantages.[70] First, it places the primary decision to admit scientific evidence in the hands of those most qualified to make it, that is, the scientific community rather than the court.

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64. Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923).

65. *See* People v. Castro, 144 Misc. 2d 956, 958, 545 N.Y.S.2d 985, 987 (1989); People v. Wesley, 140 Misc. 2d 306, 312, 533 N.Y.S.2d 643, 650 (1988).

66. Baker v. Wagers, 472 N.E.2d 218, 219 (Ind. Ct. App. 1984); E. CLEARY, MCCORMICK ON EVIDENCE § 203, at 605 (3d ed. 1984).

67. E. CLEARY. *supra* note 66, § 185, at 545.

68. *See* Note, *The Frye Doctrine and Relevancy Approach Controversy: An Empirical Evaluation*, 74 GEO. L.J. 1769, 1774 (1986) [hereinafter Note, *The Frye Doctrine*].

69. State v. Ford, 301 S.C. 485, 489, 392 S.E.2d 781, 784 (1990).

70. People v. Kelley, 17 Cal. 3d 24, 31, 549 P.2d 1240, 1248, 130 Cal. Rptr. 144, 151 (1976).

Second, application of the *Frye* test creates precedent ensuring uniformity of decisions. Third, it is a deliberately conservative test that results in a lag period between the invention of new techniques and the introduction of evidence derived from them into court. The lag period ensures appropriate refinement of new procedures before evidence derived from them becomes admissible.

Although *Frye* is the traditional standard, there is a trend in favor of the alternative relevancy standard.[71] In this approach, the court resolves all reliability questions according to the legal relevancy standard. This approach differs from *Frye* in that the court makes its own appraisal of reliability, rather than attempting to perceive general acceptance in the scientific community. It also differs from *Frye* in that the substantive criteria for determining reliability, which are answered sequentially under *Frye*, tend to merge under the relevancy approach. The court determines reliability by reference to somewhat arbitrary criteria established by prior case law such as the potential rate of errors, the existence and maintenance of standards, the care with which the technique was employed and whether it was susceptible to abuse, analogies with other admissible scientific procedures, and the existence of fail-safe characteristics.[72] If the court finds that evidence is legally relevant, it is admissible. Reliability can still, of course, be challenged during trial so as to reduce the weight given to the evidence.

The relevancy test results from some jurisdictions' frustration with the inherently conservative nature of the *Frye* test and the accompanying lag period between discovery of a new technique and admissibility of evidence derived from it. Courts applying the relevancy standard are more likely to admit novel scientific evidence than courts applying *Frye*.[73]

IV. Summary of Court Decisions on Admissibility of DNA Fingerprinting Evidence

Since 1989, DNA fingerprinting has been the subject of five state supreme court decisions,[74] five intermediate appellate decisions,[75] several

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71. E. Cleary, *supra* note 66, § 203, at 606.

72. United States v. Williams, 583 F.2d 1194, 1198 (2d. Cir. 1978), *cert. denied*, 439 U.S. 1117 (1979).

73. *See* Note, *The Frye Doctrine*, *supra* note 68, at 1771.

74. Caldwell v. State, 260 Ga. 278, 393 S.E.2d 436 (1990); State v. Schwartz, 447 N.W.2d 442 (Minn. 1989); State v. Pennington, 327 N.C. 89, 393 S.E.2d 847 (1990); State v. Ford, 301 S.C. 485, 392 S.E.2d 781 (1990); Spencer v. Commonwealth, 240 Va. 78, 393 S.E.2d 609, *cert. denied*, 111 S. Ct. 281 (1990).

75. Martinez v. State, 549 So. 2d 694 (Fla. Dist. Ct. App. 1990); Andrews v. State, 533 So. 2d 841 (Fla. Dist. Ct. App. 1989); Cobey v. State, 73 Md. App. 233, 533 A.2d 944 (1989); Glover v. State, 787 S.W.2d 544 (Tex. Ct. App. 1990); Kelly v. State, 792 S.W.2d 579 (Tex. Ct. App. 1990).

published New York trial court decisions,[76] and one published federal district court decision.[77]

The first appellate court to consider DNA fingerprinting held the evidence admissible under the relevancy test.[78] This decision, however, was somewhat less than satisfactory in that it was based on a trial court record containing testimony from three witnesses in favor of DNA fingerprinting and none opposing it. Furthermore, two of the three witnesses testifying in favor of DNA fingerprinting were employees of the company performing the test and could scarcely be considered disinterested.

The first exacting inquiry into DNA fingerprinting was by the court in *People v. Castro*,[79] which examined its reliability under *Frye*. After hearing extensive testimony from prosecution and defense expert witnesses, the court found that there was general acceptance in the scientific community of both the theory underlying DNA fingerprinting and the existence of techniques capable of generating reliable results from that theory (prongs one and two of *Frye*).[80] However, the court held DNA fingerprinting evidence inadmissible (at least for the prosecution, which was seeking to have it admitted) on the grounds that the testing laboratory, Lifecodes, had not properly complied with generally accepted scientific procedures.[81]

The Minnesota Supreme Court came to a similar conclusion in *State v. Schwartz*.[82] This decision was based on an exacting pretrial inquiry at which testimony was heard from twelve expert witnesses. The court found that there is general acceptance of the theory behind DNA fingerprinting and the existence of techniques capable of generating reliable results from that theory.[83] As in *Castro*, the *Schwartz* court held the evidence inadmissible because of deficiencies in the procedure of the particular testing laboratory, in this case Cellmark.[84] The Minnesota Supreme Court also held that statistical evidence from DNA fingerprinting was generally inadmissible, but this was more because of Minnesota's long-standing distrust of statistical evidence than because of specific deficiencies.[85]

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76. *E.g.*, People v. Castro, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (1989); People v. Wesley, 140 Misc. 2d 306, 533 N.Y.S.2d 643 (1988).

77. United States v. Jakobetz, 747 F. Supp. 250 (D. Vt. 1990).

78. Andrews v. State, 533 So. 2d 841, 850 (Fla. Dist. Ct. App. 1989).

79. 144 Misc. 2d 956, 545 N.Y.S.2d 985 (1989).

80. *Id.* at 979, 545 N.Y.S.2d at 999.

81. *Id.* at 980, 545 N.Y.S.2d at 999.

82. 447 N.W.2d 422 (Minn. 1989).

83. *Id.* at 426.

84. *Id.* at 427.

85. *Id.* at 429. After this decision, the Minnesota legislature made statistical evidence admissible by statute. *See* MINN. STAT. ANN. § 634.26 (Supp. 1991).

After *Schwartz*, there has been a succession of published opinions approving admission of DNA fingerprinting evidence.[86] This apparent uniformity following the initial doubts raised in *Castro* and *Schwartz* results from several factors. First, the testing laboratories have improved their procedures in response to the criticisms voiced in *Castro* and *Schwartz*. For example, the FBI has replaced subjective visual inspection with gel-scanning machines that operate according to objective margins of error, and these margins of error are taken into account in calculating the exclusion frequency.[87] Controls are now included to check for degradation of DNA.[88] Perhaps most importantly, the FBI now claims to discard all results when the controls indicate a problem, rather than attempting to interpret ambiguous fragment patterns as in *Castro*.[89]

Second, all but one of the recent decisions[90] have been based on the less-exacting relevance test, rather than the *Frye* test used in *Castro* and *Schwartz*.[91]

Third, some of these decisions have been based on trial court records containing testimony from only prosecution expert witnesses, some or all of whom were employees of the testing laboratories.[92] In other trials, the defendant's so-called experts were woefully inadequate. In *State v. Pennington*,[93] the defendant's lone "expert" conceded that he had little time to analyze the testing laboratory's procedure in detail.[94] In *Kelly v. State*,[95] the defendant attempted to combat five prosecution witness with a single "expert" whose credentials were confined to a bachelor's

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86. United States v. Jakobetz, 747 F. Supp. 250 (D.C. Vt. 1990); Martinez v. State, 549 So. 2d 694 (Fla. Dist. Ct. App. 1989); Andrews v. State, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988); Caldwell v. State, 260 Ga. 278, 393 S.E.2d 436 (1990); Cobey v. State, 73 Md. App. 944, 533 A.2d 944 (1987); State v. Pennington, 327 N.C. 89, 393 S.E.2d 847 (1990); State v. Ford, 301 S.C. 485, 392 S.E.2d 781 (1990); Glover v. State, 787 S.W.2d 544 (Tex. Ct. App. 1990); Kelly v. State, 792 S.W.2d 579 (Tex. Ct. App. 1990); Spencer v. Commonwealth, 240 Va. 78, 393 S.E.2d 609, *cert. denied*, 111 S. Ct. 281 (1990).

87. *Jakobetz*, 747 F. Supp. at 259.

88. *Id.* at 257.

89. *Id.*

90. *Ford*, 301 S.C. at 485, 392 S.E.2d at 781.

91. *See, e.g.*, United States v. Jakobetz, 747 F. Supp. 250 (D.C. Vt. 1990); Caldwell v. State, 260 Ga. 278, 393 S.E.2d 436 (1990); State v. Pennington, 327 N.C. 89, 393 S.E.2d 847 (1990); Kelly v. State, 792 S.W.2d 579 (Tex. Ct. App. 1990); Spencer v. Commonwealth, 240 Va. 78, 393 S.E.2d 609, *cert. denied*, 111 S. Ct. 281 (1990).

92. *See, e.g.*, Glover v. State, 787 S.W.2d 544, 548 (Tex. Ct. App. 1990); *Spencer*, 240 Va. at 90, 393 S.E.2d at 620.

93. 327 N.C. 89, 393 S.E.2d 947 (1990).

94. *Id.* at 97, 393 S.E.2d at 853.

95. 792 S.W.2d 579 (Tex. Ct. App. 1990).

degree and a public school teaching certificate.[96] The same court declined to consider an *amicus* brief challenging the reliability of DNA fingerprinting evidence on grounds that it could not consider error not asserted by the defendant.[97]

Based on *Castro*, *Schwartz*, and *Ford,* there is unanimous agreement that DNA fingerprinting satisfies the first two prongs of the *Frye* test.[98] The doubts raised by *Castro* and *Schwartz* over the particular procedures of individual testing laboratories have been diminished, but not altogether dispelled by the more recent cases. Although these cases have revealed some improvements in the reliability of testing procedures, the courts' acceptance of DNA fingerprinting evidence also results from inadequate presentation of the defense and the less stringent legal relevancy standard.

V. The New Indiana DNA Fingerprinting Statute

A. Admissibility of DNA Fingerprinting Evidence in Indiana Prior to the Statute

Indiana uses the *Frye* test for determining the admissibility of novel scientific evidence which means that the relevant scientific community makes the initial determination.[99] Indiana takes a broad view of what comprises the relevant scientific community.[100] To determine the admissibility of voice spectrograph analysis, the Indiana Supreme Court found that the relevant scientific community is comprised of linguists, psychologists, and engineers, rather than simply technicians who use voice spectrography for identification purposes.[101] The adoption of the *Frye* standard applied from the perspective of a broad scientific community results in a particularly conservative approach to the admissibility of novel scientific evidence. In keeping with this approach, the Indiana Supreme Court held that voice spectrographs are inadmissible in Indiana,[102] an issue on which courts in other jurisdictions are split.[103]

There are no appellate decisions on the admissibility of DNA fingerprinting evidence in Indiana. Indiana trial courts confronted with DNA fingerprinting evidence as a matter of first impression will, there-

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96. *Id.* at 583.
97. *Id.* at 588.
98. State v. Schwartz, 447 N.W.2d 422, 426 (Minn. 1989); People v. Castro, 144 Misc. 2d 956, 979, 545 N.Y.S.2d 985, 999 (1989); State v. Ford, 301 S.C. 485, 490, 392 S.E.2d 781, 784 (1990).
99. Cornett v. State, 450 N.E.2d 498, 503 (Ind. 1983).
100. *Id.*
101. *Id.*
102. *Id.*
103. *Id.* at 502.

fore, be expected to conduct a pretrial *Frye* hearing.[104] The trial court might reduce the scope of a *Frye* hearing by taking notice of nonbinding precedent from other Indiana trial courts or the appellate courts of other jurisdictions. Opinions from other jurisdictions, however, would only be relevant to the extent that they adopted the same criterion for assessing scientific evidence as Indiana, namely the *Frye* test incorporating a broad-based scientific community. This includes *Castro*, *Schwartz*, and possibly *Ford*.[105] The remaining appellate decisions, including those most receptive to DNA fingerprinting, would have little relevance. These decisions were neither based on the *Frye* standard nor on trial court records containing testimony from the broad-based scientific community. Given the criticism of DNA fingerprinting in the cases with strongest precedential value, a *Frye* hearing by an Indiana court would hardly be a formality.

Conducting a full-scale *Frye* hearing each time the admissibility of DNA fingerprinting evidence is sought would be an immense and futile undertaking. (The *Frye* hearing in *Castro* took twelve weeks to complete.) However, time could be saved if Indiana trial courts took notice of nonbinding precedent. Eventually, a decision on admissibility would be appealed to the Indiana Supreme Court. This would establish a uniform standard for the jurisdiction and make clear which, if any, remaining inquiries should be conducted on a case-by-case basis.

B. Enactment of the Statute

The Indiana statute became effective July 1, 1990. There is no published legislative history, nor are there court decisions interpreting the statute. Indiana is the third state to enact a statute governing DNA fingerprinting. The Indiana statute closely follows the wording of a Minnesota statute effective one year earlier.[106] Maryland also has a DNA fingerprinting statute of apparently unrelated genus.[107] New York has

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104. *See, e.g.*, State v. Hopkins, No. CCR86-428 (Allen County Ct. 1988) (unpublished opinion cited in Thompson & Ford, *supra* note 23, at 59).

105. State v. Schwartz, 447 N.W.2d 422 (Minn. 1989); People v. Castro, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (1989); State v. Ford, 301 S.C. 485, 392 S.E.2d 781 (1990). The *Ford* court applied the *Frye* test, but it is not clear who testified at the pretrial hearing.

106. In a civil or criminal trial or hearing, the results of DNA analysis, as defined in section 299C.155, are admissible in evidence without antecedent expert testimony that DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material upon a showing that the offered testimony meets the standards for admissibility set forth in the Rules of Evidence.

MINN. STAT. ANN. § 634.25 (Supp. 1991).

107. "In any criminal proceeding, the evidence of a DNA profile is admissible to prove or disprove the identity of any person." MD. CTS. & JUD. PROC. CODE ANN. § 10-915 (Supp. 1990).

an act pending, the effect of which will be to limit the admissibility of DNA fingerprinting to tests performed in state-certified laboratories.[108] Congress is also considering similar legislation for federal courts.[109]

C. Possible Interpretations of the Statute

It is obvious that the statute is intended to make DNA fingerprinting evidence more easily admissible in Indiana courts. It is less clear precisely to what extent the statute is intended to restrict the scope of pretrial evidentiary hearings or indeed, whether the statute is intended to eliminate such hearings entirely. The literal wording of the statute read in light of Indiana's common-law approach to admissibility of novel scientific evidence suggests three interpretations.

The statute provides that "the results of forensic DNA analysis [*i.e.*, DNA fingerprinting] are admissible in evidence without antecedent expert testimony that forensic DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material."[110] If expert testimony is not required to establish that DNA fingerprinting provides a reliable method, the statute at least reflects a legislative determination that reliable methods for performing DNA fingerprinting can be devised (*i.e.*, that the second prong of the *Frye* test is satisfied). If the legislature finds the second prong of *Frye* satisfied, it would seem that it must also accept the first prong of the *Frye* test (*i.e.*, the fundamental principles underlying DNA fingerprinting are sound). One interpretation of the statute, therefore, represents a legislative determination that DNA fingerprinting satisfies the first two prongs of the *Frye* test. Accordingly, expert testimony might still be required to show that the particular procedure of the testing laboratory is reliable under the third prong of *Frye* and that any departures from this procedure in a particular application are not material as judged by the legal relevancy standard.

There are, however, two other possible interpretations of the statute. The statute might reflect a legislative determination not only that reliable techniques for performing DNA fingerprinting can be devised, but also that the actual procedures of the recognized testing laboratories are reliable. This second interpretation of the statute represents a legislative determination that DNA fingerprinting satisfies all three prongs of the *Frye* test and effectively precludes any further inquiry under *Frye*. Accordingly, expert testimony would only be required to show that any departures from the purported procedure of the testing laboratory in a

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108. Slackman, *supra* note 6, at 3.
109. Marcotte, *supra* note 7, at 26.
110. IND. CODE ANN. § 35-37-4-10 (Burns Supp. 1990).

particular application were immaterial as judged by the legal relevancy standard.

A third possible interpretation of the statute is that it represents a legislative determination that antecedent expert testimony should never be required to show the reliability of DNA fingerprinting. Accordingly, DNA fingerprinting evidence would be virtually per se admissible.[111] The reliability of DNA fingerprinting evidence could only be challenged at trial so as to affect the weight given to the evidence, but not its admissibility.

D. Discerning the Intended Meaning of the Statute

1. As a Codification of What Has Been Decided in Other Jurisdictions.—The first interpretation of the Indiana statute, whereby expert testimony is not required to establish the soundness of fundamental principles or the feasibility of devising reliable methods, does no more than codify the unanimous decisions of the courts of other jurisdictions. The courts in *Castro*, *Schwartz*, and *Ford* all found that DNA fingerprinting satisfies the first two prongs of *Frye*.[112]

The second interpretation, whereby expert testimony is not required to establish the reliability of the actual procedures of particular testing laboratories, goes somewhat beyond the decisions of other jurisdictions. Courts applying the relevancy standard have held that the procedures of the currently recognized testing laboratories are reliable.[113] However, under the *Frye* test, which is the applicable standard in Indiana, both the Cellmark and Lifecodes procedures have been found unreliable[114] (at least where evidence derived from them is sought to be admitted by the prosecution).[115] It remains to be seen whether improvements incorporated by Cellmark and Lifecodes since these decisions will lead to acceptance by the same courts that rejected their original procedures.

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111. Presumably, admissibility could still be challenged on grounds that do not require refutation by expert testimony. Discrepancies alleged to exist in the chain of custody of DNA samples provide grounds for such a challenge.

112. State v. Schwartz, 447 N.W.2d 422, 426 (Minn. 1989); People v. Castro, 144 Misc. 2d 956, 979, 545 N.Y.S.2d 985, 999 (1989); State v. Ford, 301 S.C. 485, 490, 392 S.E.2d 781, 784 (1990).

113. *See, e.g.*, United States v. Jakobetz, 747 F. Supp. 250 (D. Vt. 1990) (FBI); Caldwell v. State, 260 Ga. 278, 393 S.E.2d 436 (1990) (Lifecodes); State v. Pennington, 327 N.C. 89, 393 S.E.2d 847 (1990) (Cellmark); Spencer v. Commonwealth, 240 Va. 78, 393 S.E.2d 609, *cert. denied*, 111 S. Ct. 281 (1990) (Cetus).

114. *Schwartz*, 447 N.W.2d at 427; *Castro*, 144 Misc. 2d at 980, 545 N.Y.S.2d at 999.

115. Although the *Castro* court denied admission of DNA fingerprinting evidence for the prosecution, it indicated that it would admit the same evidence for the defense. *Castro*, 144 Misc. 2d at 979, 545 N.Y.S.2d at 999.

The third interpretation of the statute, whereby DNA fingerprinting evidence is virtually per se admissible, finds no support in the opinions of courts of other jurisdictions. In *Ford*, the court found that DNA fingerprinting satisfies the *Frye* test, but stated that "[t]his, however, does not mean that DNA test results should always be admitted into evidence . . . [i]ssues pertaining to relevancy or prejudice may be raised."[116] The *Pennington* court, applying the relevancy test, stated, "While . . . evidence of DNA profile testing is generally admissible and was admissible in the present case, this should not be interpreted to mean that DNA test results should always be admitted into evidence."[117]

To summarize, the first interpretation is justified as a codification of case law in other jurisdictions, the second interpretation goes somewhat beyond case law at least where, as has usually been the case,[118] admissibility of DNA fingerprinting evidence is sought by the prosecution, and the third interpretation expressly contradicts case law.

2. By Analogy With Other Statutes.—A Minnesota statute on DNA fingerprinting,[119] enacted one year prior to the Indiana statute, may aid the interpretation of the Indiana statute. Like Indiana, Minnesota recognizes *Frye* as the standard for determining the admissibility of scientific evidence.[120] The Indiana statute so closely follows the wording of its Minnesota counterpart to suggest derivation. The Minnesota statute, however, contains two extra clauses that are of considerable assistance in discerning its meaning. First, the Minnesota statute contains a reference to a distinct section of the code which provides that "[t]he bureau shall adopt uniform procedures and protocols to maintain, preserve and analyze human biological specimens for DNA."[121] If the Minnesota legislature, via "the bureau," finds it necessary to define its own standards for performing DNA analysis, it can hardly be intending to confer statutory endorsement of the procedures used by the current testing laboratories. Second, the Minnesota statute provides that the "results of DNA analysis . . . are admissible in evidence without antecedent expert testimony that DNA analysis provides a trustworthy and reliable method of identifying characteristics . . . *upon a showing that the offered testimony meets the*

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116. State v. Ford, 301 S.C. 485, 490, 392 S.E.2d 781, 784 (1990).

117. State v. Pennington, 327 N.C. 89, 102, 393 S.E.2d 842, 854 (1990).

118. There has been only one appellate decision on the admissibility of DNA fingerprinting in which the defendant sought admission. The court refused admission, but this decision was inevitable in view of the testing laboratory's (Cellmark's) own report stating that no result could be obtained from its test. State v. Woodall, 385 S.E.2d 253 (W. Va. 1989).

119. MINN. STAT. ANN. § 634.25 (Supp. 1991). For the text of this statute, see *supra* note 106.

120. State v. Schwartz, 447 N.W.2d 422, 424 (Minn. 1989).

121. MINN. STAT. ANN. § 299C.155 subd. 3 (Supp. 1991).

standards of admissibility set forth in the Rules of Evidence."[122] The extra italicized clause, not present in the Indiana statute, makes it clear that the Minnesota statute is not intended to eliminate traditional evidentiary challenges to DNA fingerprinting.[123]

If the Minnesota statute is not intended to endorse particular procedures or preclude traditional evidentiary challenges to departures from particular procedures, then it only affects the first two prongs under *Frye*. The Minnesota statute simply represents a legislative determination that DNA fingerprinting meets the first two prongs of *Frye* and consequently, that expert testimony is not required to establish this at each trial.

The similarity in wording between the Indiana and Minnesota statutes suggests that the Indiana legislature may have derived the Indiana statute from the Minnesota version. However, if the Indiana legislature intended its statute to have the same meaning, it is not clear why it did not follow Minnesota in conditioning admissibility on compliance with procedures to be promulgated by an administrative agency (*i.e.*, the "bureau"). Conceivably, this omission might be an oversight. It might also reflect a legislative determination that the particular procedures of testing laboratories should continue to be judged on a common-law basis. In direct contrast to the Minnesota statute, it might reflect a legislative endorsement of the particular procedures of the current testing laboratories. Similarly, if the Indiana legislature intended the same meaning as its Minnesota counterpart, it is not clear why it omitted the clause conditioning admissibility on conformity to the general rules of evidence. This might have been either because the legislature thought it too obvious to mention or because the legislature did not want it to apply.

An earlier Indiana statute regulating the admissibility of evidence derived from blood-group marker tests[124] may also shed some light on the Indiana DNA fingerprinting statute. Blood-group marker tests yield similar information to DNA fingerprinting, albeit with less sensitivity. The reliability of this technique has also been questioned.[125] Indiana Code section 31-6-6.1-8 provides that the results of blood-group marker testing are admissible in "all paternity proceedings, *unless the court excludes the results . . . for good cause.*"[126] This statute has been interpreted to represent a legislative determination that evidence derived

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122. MINN. STAT. ANN. § 634.25 (Supp. 1991) (emphasis added).
123. *See supra* text accompanying note 66.
124. IND. CODE ANN. § 31-6-6.1-8 (Burns 1989).
125. *See* Thompson & Ford, *supra* note 23, at 47.
126. IND. CODE ANN. § 31-6-6.1-8 (Burns 1989) (emphasis added).

from blood-group marker testing satisfies the *Frye* test,[127] but that the reliability of the specific test in question must still be demonstrated before its results are admissible in evidence.[128] One might expect the legislature to treat the admissibility of similar technologies (*i.e.*, DNA fingerprinting and blood-group marker analysis) in the same manner. Accordingly, the DNA fingerprinting statute would reflect a legislative determination that DNA fingerprinting satisfies the *Frye* test (or at least the first two prongs thereof), but that it remains open to traditional evidentiary challenge. Yet, unlike the blood-marker statute, the DNA fingerprinting statute does not contain a clause conditioning admissibility on the discretion of the court. As in the discussion of the Minnesota statute, the question arises whether the legislature omitted such a clause because it was too obvious to mention or because it was not to apply.

3. On Policy Grounds.—It is obvious that the purpose of the statute is to facilitate the admission of DNA fingerprinting evidence into Indiana courts by reducing the expert testimony required to establish a foundation of reliability. Two policies might justify this purpose. One policy is to save the time and expense of pretrial evidentiary hearings to determine admissibility.[129] The pretrial hearing in *Castro*, for example, took twelve weeks to complete, and the hearing in *Schwartz* required testimony from twelve different expert witnesses.[130] A second policy is to ensure that DNA fingerprinting evidence actually gets before the court and is not waylaid by spurious arguments about reliability in a pretrial evidentiary hearing.

The first interpretation of the statute, whereby DNA fingerprinting satisfies the first two prongs of the *Frye* test, represents a codification of what has been unanimously decided by the courts of other jurisdictions. Accordingly, the statute might save some of the time and expense of the pretrial *Frye* hearings that would have to be held until such time as the Indiana Supreme Court announced its seemingly inevitable agreement with other jurisdictions. Yet, if the statute merely forecloses debate of the first two prongs of the *Frye* test, the time savings will not be great. In previous pretrial hearings on DNA fingerprinting, argument has centered on the particular procedure of the testing laboratory and

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127. The court did not explicitly state which prongs of the *Frye* test were satisfied. The distinction is more important for more complicated procedures (such as DNA fingerprinting) that are subject to many possible variations.

128. Baker v. Wagers, 472 N.E.2d 218, 219 n.1 (Ind. Ct. App. 1984).

129. The expense of a protracted pretrial hearing may be a more significant concern to a defendant than to the state. This may explain why, in the great majority of cases, DNA fingerprinting evidence has been offered by the state.

130. State v. Schwartz, 447 N.W.2d 422, 425 (Minn. 1989); People v. Castro, 144 Misc. 2d 956, 957, 545 N.Y.S.2d 845, 986 (1989).

not on underlying theory.[131] Furthermore, although expert witnesses may be able to testify about a particular testing procedure without mentioning general principles, a trial judge is in no position to understand such testimony without this background. Thus, in practice, a legislative determination that DNA fingerprinting satisfies the first two prongs of the *Frye* test will result in only limited savings of time. The issues on which argument is foreclosed are noncontentious and the information concerning these issues must still be presented to the court in some form for the court to understand argument on the contentious issues.

If the first interpretation of the statute will result in little saving of court time, it will have still less effect in reducing the opportunity for preventing admissibility on the basis of spurious challenges to reliability. Such challenges are likely to be directed at the contentious issues, on which, in this interpretation of the statute, argument is not foreclosed.

To save significant court time and to appreciably reduce the opportunity for spurious objections, argument on the reliability of particular procedures must be foreclosed. The second interpretation of the statute has precisely this effect. If it is accepted that the purported procedure of a testing laboratory is valid, the only remaining question is whether the testing laboratory actually performed the procedure as specified. For major departures from the purported procedure, the trial court could rule the evidence legally irrelevant at a pretrial hearing. Minor departures from purported procedure could be argued to the jury. In either event, the issue is not a *de novo* evaluation of the reliability of the entire procedure, but is the more limited question of whether a departure from that procedure was significant. The saving of time and reduction of spurious argument that will result from this interpretation will be significant, but not without cost.

The second interpretation of the statute will cause considerable confusion as to which laboratory procedures the legislature intended to endorse. The statute does not describe a mechanism for promulgating procedures (in contrast to the Minnesota statute), and it does not name authorized laboratories. At present, there are three laboratories performing DNA fingerprinting by the RFLP method and one by a totally different method. Even between the three laboratories performing RFLP analysis, there are differences in detail such as choice of probe and quality control procedures. In the future, it is likely that further procedures for performing DNA fingerprinting will be devised (*e.g.*, based on DNA sequencing) and that the existing technologies will be licenced to other laboratories.[132] In this situation, a collective endorsement of DNA fingerprinting procedures is meaningless.

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131. *See, e.g.*, *Schwartz*, 447 N.W.2d at 426.

132. Note, *The Dark Side*, *supra* note 10, at 500.

A further cost of foreclosing objections to the reliability of particular procedures is the risk that such objections are not spurious. At least among courts applying the *Frye* test, it is premature to say that a consensus has been reached as to the reliability of particular procedures. If there are remaining doubts about procedures, continued judicial scrutiny may serve to encourage the testing laboratories to improve their procedures and eliminate these doubts. Ironically, the statute does not apply to civil applications of DNA fingerprinting where concerns over reliability are much diminished.[133]

The costs imposed by the second interpretation of the statute could be somewhat reduced by alternative drafting. The legislature could eliminate confusion as to which laboratories have acceptable procedures by expressly naming those laboratories and periodically updating the list. Alternatively, the legislature could follow its Minnesota counterpart's example of instructing an administrative agency to promulgate its own procedures and regulations. Of course, instructing an administrative agency to devise procedures does not solve the problem of what these procedures should be.

The third interpretation of the statute, whereby DNA fingerprinting evidence is virtually per se admissible, would save even more court time than the second and would virtually eliminate challenges to reliability. The difference between the third and second interpretations is that in the former, the reliability of a particular application of a testing procedure will always be left to the jury regardless of alleged departures from purported procedure. In the second interpretation, if the departure is sufficiently egregious, the trial court could hold the evidence legally irrelevant. Eliminating traditional evidentiary challenges to DNA fingerprinting saves time and money and increases predictability. The policy question is whether the saving of time and increased predictability of a per se rule outweigh the possibility that a jury will be unable to take into account even egregious departures from purported procedure and the consequent prejudice to the side opposing admissibility.

DNA fingerprinting is a complex process that is not easily understood by those untrained in molecular genetics. Perhaps with the aid of colorful diagrams and analogies, an expert witness can impart some understanding to a lay jury of the fundamental principles.[134] Yet, to attempt to argue that while the overall principles are sound, departures from purported procedure can make the evidence unreliable, is more difficult. For example, an argument that too much or too little enzyme was added and

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133. *See supra* note 8. Note that MINN. STAT. ANN. § 634.25 (Supp. 1991) applies to both civil and criminal trials.

134. Note, *The Dark Side*, *supra* note 10, at 512.

of its possible consequences to the fragment pattern, might appear as nit-picking to a jury who may get lost in a "mire of details and confusion."[135] There is a considerable risk that the jury will be so overwhelmed by the credentials of the expert presenting the DNA fingerprinting evidence that it will be oblivious to even egregious errors that opposing counsel attempts to draw to its attention. This possibility suggests that at least when the prosecution seeks admissibility of DNA fingerprinting evidence, the defendant should be allowed to challenge departures from a purported procedure in a pretrial hearing. Furthermore, because of the complexity of the DNA fingerprinting procedure, the court should require a stronger rebuttal of alleged departures than would be necessary for other forensic procedures which are less likely to confuse the jury.[136]

Arguably, there is less risk of prejudice when DNA fingerprinting evidence is sought to be admitted by the defendant. In part, this is because society is more concerned with convicting an innocent defendant than with freeing a guilty one. There is, however, a further distinction. When DNA fingerprinting evidence is sought to be admitted by the defendant, the prosecution must have independent incriminating evidence to justify an indictment. This evidence may help to dispel any notion that DNA fingerprinting is infallible. When DNA fingerprinting evidence is sought to be admitted by the prosecution, it may be the only significant evidence in the case, and a jury will be more likely to accept its infallibility.

E. Constitutional Validity of the Statute

Insofar as the statute may facilitate the conviction of a defendant on the basis of unreliable evidence, it is subject to constitutional challenge. The susceptibility to challenge depends on the interpretation of the statute and is most acute for the third interpretation, whereby DNA fingerprinting evidence is virtually per se admissible.

First, the statute may be challenged as a violation of the confrontation clause.[137] It is difficult to effectively cross-examine an expert witness on the reliability of DNA fingerprinting if she is allowed to state the results of a test without antecedent testimony of reliability. This difficulty is exacerbated by commercial laboratories' reluctance to allow pretrial discovery for proprietary reasons.[138] In these circumstances, it could be argued that an expert witness is not available for cross-examination as

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135. *Id.* at 513.

136. United States v. Jakobetz, 747 F. Supp. 250, 262 (D. Vt. 1990).

137. "In all criminal prosecutions, the accused shall enjoy the right . . . to be confronted with the witnesses against him. . . ." U.S. CONST. amend. VI.

138. State v. Schwartz, 447 N.W.2d 422, 428 (Minn. 1989).

required by the confrontation clause. However, the Supreme Court has held that even a witness who has no memory of events in an out-of-court statement is available for cross-examination.[139] There is apparently no requirement that a witness supply an antecedent factual context to facilitate cross-examination. It would seem that an expert witness with a complete but unnarrated source of knowledge is more available for cross-examination that a witness with no memory of the underlying events. Thus, a challenge based on the confrontation clause will probably fail.

The statute may also be challenged as a violation of due process. It could be argued that when reliability of evidence is questionable, the defendant has a due process right to a pretrial hearing to determine legal relevancy of the evidence outside the presence of the jury. In some circumstances, the Supreme Court has recognized that when reliability of evidence is in doubt, the defendant has a due process right to a pretrial hearing. In *Jackson v. Denno*,[140] the Supreme Court held that when a genuine issue of voluntariness of a confession is raised, due process requires that the defendant be granted a hearing out of the presence of the jury to determine voluntariness and hence, admissibility.[141] The Court noted that involuntary confessions are inadmissible both because they are likely to be unreliable and because of the "strongly felt attitude . . . that important human values are sacrificed where an agency of the government, in the course of securing a conviction, wrings a confession out of an accused against his will."[142]

The due process right to a pretrial hearing was, however, limited in *Watkins v. Sowders*.[143] The *Watkins* Court held that no due process right to a pretrial hearing existed when the defendant alleged that identification evidence was tainted by suggestive out-of-court identification procedures.[144] The Court distinguished *Jackson* on the grounds that an involuntary confession was not excluded simply because it was unreliable, but because of society's abhorrence of the manner of its extraction.[145] The Court found that infirmity of suggestive identification procedures only affected the reliability of the evidence which could adequately be drawn to the jury's attention by cross-examination.[146]

The effect of the Indiana statute is to reduce or eliminate a defendant's right to a pretrial hearing and thereby arguably allow legally

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139. United States v. Owens, 484 U.S. 555, 564 (1988).
140. 378 U.S. 368 (1964).
141. *Id.* at 377.
142. *Id.* at 386 (quoting Blackburn v. Alabama, 361 U.S. 199, 206-07 (1960)).
143. 449 U.S. 341 (1981).
144. *Id.* at 349.
145. *Id.* at 347.
146. *Id.* at 348.

irrelevant evidence to go to the jury subject only to doubts cast by the defendant in cross-examination. As in *Watkins*, the alleged infirmity goes only to reliability, suggesting that there is no violation of due process. However, *Watkins* may be distinguishable. Although a jury may be capable of understanding how suggestive procedures can taint identification evidence, it may not be capable of appreciating how nuances of molecular biology and population genetics can affect the reliability of DNA fingerprinting evidence.

F. Impact of the Statute on Future Trials

The impact of the statute on future trials depends on how the courts interpret it. The first interpretation of the statute, whereby it represents a legislative determination that DNA fingerprinting satisfies the first two prongs of the *Frye* test, may result in a small saving of trial time by abbreviating testimony required for noncontentious issues. The more contentious issue of the reliability of particular procedures will continue to be resolved on a common-law basis. Such an approach may waste court time and may, in some instances, lead to the rejection of DNA fingerprinting evidence based on spurious arguments. However, continued judicial scrutiny should provide an incentive for testing laboratories to further improve the reliability of their procedures. Eventually, trial court decisions on the reliability of particular procedures will be appealed to higher courts creating precedent, and the need for and scope of pretrial hearings will diminish.

The second interpretation of the statute, whereby it represents a legislative endorsement of particular testing procedures, will save appreciable court time and reduce the opportunity for spurious argument. However, absent consensus among the courts of other jurisdictions following *Frye* that particular procedures are reliable, such endorsement may be premature. Its effect may be to exclude spurious and well-founded objections alike. Furthermore, present legislative endorsement of particular procedures removes an incentive for future improvements in reliability. The second interpretation will also create confusion as to which laboratory procedures the legislature intended to endorse. This confusion will increase as the technology is licensed to other laboratories and other methods for performing DNA fingerprinting are devised.

The third interpretation of the statute, whereby DNA fingerprinting evidence is virtually per se admissible, will probably be challenged as a violation of due process. This interpretation of the statute is likely to survive constitutional challenge, but it has little else to commend it. DNA fingerprinting evidence is likely to influence the jury, notwithstanding defects sought to have been revealed by cross-examination, with the result that defendants may be convicted on the basis of evidence that should have been excluded as legally irrelevant.

VI. Conclusion

The Indiana DNA fingerprinting statute is poorly drafted. Although the statute's purpose of facilitating the admission of DNA fingerprinting evidence is obvious, the extent to which it reduces the expert testimony required to establish a foundation of reliability is less clear. Case law from other jurisdictions and analogous statutes do not unambiguously reveal which of three possible interpretations the Indiana legislature intended. Policy concerns suggest that the statute should be given the most limited of these interpretations. Accordingly, it reflects a legislative determination that the principles underlying DNA fingerprinting are sound and that reliable procedures for performing DNA fingerprinting can be devised. The reliability of particular procedures of specific testing laboratories should continue to be judged on a common-law basis. This interpretation of the statute will result in some saving of court time by reducing the need for testimony on noncontentious issues. More court time could be saved, albeit at the possible risk of eliminating well-founded challenges to reliability, through statutory endorsement of particular procedures. The present statute could, but should not, be interpreted to be such an endorsement. If the legislature wishes to endorse particular procedures, it should at least name the laboratories performing approved procedures, or preferably, promulgate its own approved procedures via an administrative agency. Regardless of whether the present statute is interpreted as an endorsement of particular procedures, it should not be regarded as a per se rule of admissibility. The possibility of traditional evidentiary challenge to individual applications of particular procedures should be left open.

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