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DNA PROFILING IN NORTH CAROLINA

JAMES MORGAN*

I. INTRODUCTION

Deoxyribonucleic acid (DNA) profiling¹ has been described as the “single greatest advance in the search for the truth . . . since the advent of cross-examination.”² Others have hailed DNA typing as a method of analysis that “could revolutionize law enforcement” by identifying criminal suspects with virtual certainty.³ In 1990, the North Carolina courts approved this powerful forensic scientific procedure that can identify a criminal suspect’s DNA pattern and can determine whether that person was the source of the blood, semen, hair, or tissue found at the crime scene or on the victim.⁴ Similarly, the blood, hair, or other bodily fluids of a victim can be matched for identification purposes to the forensic sample on the criminal defendant. Most often DNA profile tests are utilized in the more serious, violent crimes where identification is often an issue.⁵ With these crimes in particular, the victim is often either deceased or the outcome of the prosecution’s case rests on the victim’s word against that of his or her alleged assailant.⁶ While prosecutors, law enforcement officials, and some scientists are willing to accept unequivocally the find-

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1. DNA profiling has been referred to as “DNA typing,” “DNA fingerprinting,” “DNA printing,” “DNA identification,” and “forensic DNA testing.” However, North Carolina courts have most frequently used the terms “DNA profiling” and “DNA testing” to denote the DNA profiling process. See *State v. Pennington*, 327 N.C. 89, 393 S.E.2d 847 (1990) and *State v. Bruno*, 108 N.C. App. 401, 424 S.E.2d 440, *rev. denied*, 333 N.C. 464, 428 S.E.2d 185 (1993).

2. *People v. Wesley*, 533 N.Y.S.2d 643, 644 (N.Y. Sup. Ct. 1988), *aff’d*, 589 N.Y.S.2d 197 (N.Y. App. Div. 1992).

3. Debra C. Moss, *DNA—The New Fingerprints*, A.B.A. J., May 1, 1988, at 66.

4. Caroline M. Kelly, *Admissibility of DNA Evidence: Perfecting the “Search for Truth,”* 25 WAKE FOREST L. REV. 591 (1990). *State v. Pennington* is the seminal case in this area of law in North Carolina and will be discussed in detail in this article. 327 N.C. 89, 393 S.E.2d 847 (1990).

5. *Id.*

6. Ricardo Fontg, *DNA Fingerprinting: A Guide to Admissibility and Use*, 57 MO. L. REV. 501 (1992).

ings of a DNA analysis as positive proof of identification,⁷ other scientists still question its reliability.⁸

This article will focus on the reliability and the credence the North Carolina courts have given DNA analysis. Part II will provide an overview of the DNA profiling process. Part III will discuss the North Carolina standards for admitting new scientific advancements into evidence and the role of the expert witness in this area. Part IV will analyze North Carolina case law concerning this type of evidence. Finally, Part V will conclude with some projections for the future regarding this area of law and provide some guidelines to assist attorneys practicing in the criminal litigation arena.

II. AN OVERVIEW OF THE SCIENCE OF DNA PROFILING

The science of genetics is extremely complex, and an in-depth analysis of this topic is highly detailed and technical. Thus, an exhaustive discussion of this area is beyond the scope of this article. However, an elementary knowledge of the DNA profiling process and the testing methods employed is vital to an attorney practicing criminal law.

DNA tests were first developed for use in the field of molecular biology to determine the chromosomal location of particular genes.⁹ These DNA tests aided physicians in predicting which individuals would inherit congenital diseases such as Huntington's disease, sickle cell anemia, cystic fibrosis, and other such afflictions.¹⁰ However, forensic scientists recently have begun to use DNA testing for the purpose of identifying the origin of blood, semen, and hair samples found during criminal investigations.¹¹ Two private laboratories, Lifecodes Corporation of Valhalla, New York, and Cellmark Diagnostics, Inc. of Germantown, Maryland, have performed the bulk of DNA testing used in criminal litigation.¹² However, in 1989, the Federal Bureau of Investigation (hereinafter FBI) established a DNA typing facility and began its own testing.¹³ While the precise methods for obtaining a

7. See *FBI DNA Fingerprinting: Hearings Before the Subcommittee on Civil and Constitutional Rights of the House Committee on the Judiciary*, 102d Cong., 1st Sess. (1989) (discussing law enforcement perspectives on DNA fingerprinting). See Dabbs & Cornwell, *The Use of DNA Profiling in Linking Serial Murders*, 37 MEDICO-LEGAL BULLETIN No. 6, Nov.-Dec. 1988 (emphasizing a forensic science perspective).

8. Kelly, *supra* note 4, at 592.

9. Fontg, *supra* note 6, at 502.

10. *Id.* See Laurel Beeler & William R. Wiebe, Comment, *DNA Identification Tests and the Courts*, 63 WASH. L. REV. 903, 955 n. 2 (1988) (discussing the predictability of these congenital diseases).

11. Eric S. Lander, *DNA Fingerprinting on Trial*, 339 NATURE 501 (1989).

12. *Id.*

13. R. C. Lweontin & Daniel L. Hartl, *Population Genetics Forensic DNA Typing*, 254 SCI. 1745, 1746 (1991). Even though the private companies mentioned above have contracted with law enforcement agencies to perform DNA testing, governmental funds have also been appro-

DNA print may vary among these laboratories, the principles of the methodologies are consistent.¹⁴

DNA is the fundamental organic material which determines the genetic properties of each person's individual characteristics and traits.¹⁵ For forensic purposes, DNA identification is based on the principle that except for identical twins, no two individuals share the same genetic configuration.¹⁶ DNA is contained in the nucleus of each human cell, except red blood cells, which have no nuclei.¹⁷ Because the majority of an individual's genes, such as those that determine the number of limbs and appendages, are the same for all individuals, the DNA that encodes these genes cannot be used in DNA profiling.¹⁸ Other genes, however, such as those that determine hair color and eye color, vary among individuals and contain unique genetic patterns that can be used to determine a DNA match.¹⁹

The molecular structure of DNA is the same for every living creature.²⁰ All DNA is composed of four bases — adenine, guanine, cytosine, and thymine, which are linked together to form a configuration similar to a long strand of beads.²¹ The bases combine to form what resembles a twisted ladder with the bases adhering together to form the rungs of the ladder and alternating sugars and phosphates combining to form the sides of the configuration.²² These three billion base pairs in the human genome encode approximately one hundred thousand husband genes which serve as the blueprint for the structure of a human being.²³ The variations in the DNA which form these genes account for differences in individual traits.²⁴ Genes combine together to form forty-six packages of genetic material called chromosomes.²⁵ These forty-six chromosomes are comprised of twenty-three

priated for the FBI to conduct its own testing procedures. Moreover, the Department of Justice has funded several academic research programs for limited DNA profile testing.

14. Fontg, *supra* note 6, at 502.

15. Kelly, *supra* note 4, at 593.

16. *United States v. Jacobetz*, 955 F.2d 786, 791 (2d Cir. 1992), *cert. denied*, 113 S. Ct. 104 (1992). In affirming the defendant's conviction and upholding the admission of DNA testing results, this court provided a detailed analysis of the DNA profiling process. Furthermore, the Second Circuit Court stated that any court confronted with a similar issue could take judicial notice of the general theories and specific methods involved in DNA profiling.

17. Kelly, *supra* note 4, at 593.

18. Fontg, *supra* note 6, at 502. See Beverly Merz, *DNA Fingerprints Come to Court*, 259 JAMA 2193 (1988). These genes contain DNA that is known in the scientific community as "junk DNA."

19. Fontg, *supra* note 6, at 502.

20. *People v. Castro*, 545 N.Y.S.2d 985, 988 (N.Y. Sup. Ct. 1989).

21. Kelly, *supra* note 4, at 593.

22. *Id.*

23. *Id.*

24. William C. Thompson & Simon Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Tests*, 75 VA. L. REV. 45, 62 (1989).

25. Kelly, *supra* note 4, at 594.

pairs, with a person inheriting one chromosome of a pair from his mother, the other from his father.²⁶ The DNA configuration of a gene may occur in several different forms called alleles.²⁷ Genes within an individual may have two allelic forms,²⁸ one inherited maternally and one paternally, accounting for the individual's differences, such as the wide variations of hair color.²⁹ The genes that are variable in DNA sequences are described as polymorphic, and these polymorphisms are used to establish an individual's genetic typing.³⁰

Presently, three types of DNA tests exist in the United States — two forms of a restriction fragment length polymorphism (RFLP) analysis and a polymerase chain reaction (PCR) analysis.³¹ However, only the two forms of the RFLP analysis, the DNA Print and the DNA Fingerprinting tests, have been the subject of appellate review.³² Both forms of this test are based on the same techniques and principles.³³ The RFLP test works in the following manner. First, the unidentified DNA source material is gathered from the crime scene, from the alleged perpetrator or from the victim. Then, other DNA source material, usually a purified blood sample, is extracted from a suspect and a victim.³⁴ After the samples are taken, enzymes are used to cut and fragment the DNA, which is then separated according to size.³⁵ This fragmentation and separation process is used to facilitate

26. *Id.*

27. *Id.*

28. *Id.*

29. *Id.*

30. *Id.*

31. *Id.* at 595. See also Fontg, *supra* note 6, at 504. The officials at Cellmark Diagnostics, Inc. claim that with the test they employ there is only a one in thirty billion chance, excluding identical twins, that any two individual's DNA prints will match and create a false positive result. The other two private laboratories performing this type of testing, Lifecodes Corporation and Cetus Corporation claim similar probabilities. Lifecodes claims a 99.9 percent probability that DNA samples are derived from the same individual if a match is obtained. Both Cellmark and Lifecodes use the RFLP test. Cetus uses the PCR test which is only of recent vintage. This test is advantageous because, unlike the RFLP, a much smaller forensic sample may be used since the DNA is amplified and many copies of these DNA samples are made. With the PCR test, a single hair cell or as little as forty sperm heads may produce a viable sample. The RFLP test requires a much larger sample, such as several thousand sperm heads or a blood stain on cloth the size of a quarter. For this reason, many Cellmark and Lifecodes tests have proved to be inconclusive because the samples were too small to produce adequate results. Unfortunately, the police may only find minute DNA samples at the crime scene or on the defendant or victim, and the RFLP is not always usable. However, a drawback with the PCR test is that Cetus can only guarantee that one in several thousand persons could have left the matching samples. Thus, the virtual certainty of the Cellmark and Lifecodes estimates cannot be assured by the Cetus Corporation.

32. Kelly, *supra* note 4, at 595.

33. *Id.*

34. *Id.*

35. *Id.* at 596.

the viewing of the DNA pattern.³⁶ Then, to make a DNA print, radioactive probes are applied to the DNA fragments.³⁷ These probes attach themselves to the DNA samples, and X-ray film is placed over the probes and DNA samples.³⁸ After the film is developed, black bands, similar to the bar codes found on supermarket product labels, appear on the film marking the location of the probes.³⁹ The bands appear in different locations on the film for each individual based on a person's unique DNA composition.⁴⁰ This process results in what is known as a fingerprint.⁴¹ When the patterns of bands from two different samples match, there is a high probability that the samples belong to the same individual.⁴² Scientists then can determine the statistical probability that these matching samples did not originate from the same individual.⁴³ A detailed discussion of statistical probabilities will be addressed in Part IV. According to most sources, DNA analysis can identify or exonerate a suspect with virtual certainty;⁴⁴ one laboratory claims that there is only a one in thirty billion chance that any two persons' DNA prints will match.⁴⁵

III. NORTH CAROLINA STANDARDS FOR ADMITTING NEW SCIENTIFIC ADVANCEMENTS INTO EVIDENCE AND THE ROLE OF THE EXPERT WITNESS IN DNA PROFILING

Historically, federal and state courts generally have used one of two standards to evaluate the reliability of new scientific evidence. These two standards are the general acceptance test first enunciated in *Frye v. United States*⁴⁶ and the more permissive Federal Rules of Evidence standard.⁴⁷

Under the *Frye* standard, novel scientific evidence will be admitted by the court only when the scientific technique or method has gained

36. Fontg, *supra* note 6, at 504.

37. *Id.*

38. *Id.*

39. *Id.*

40. *Id.*

41. *Id.*

42. *Id.*

43. Kelly, *supra* note 4, at 597.

44. Fontg, *supra* note 6, at 504.

45. *Id.* See *supra* note 31 and accompanying text.

46. 293 F. 1013 (D.C. Cir. 1923).

47. FED. R. EVID. 702. The complete text of this rule is: "If scientific, technical or other specialized knowledge will assist the trier of fact to understand the evidence or determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion."

general acceptance in the relevant scientific community.⁴⁸ This standard attempts to ensure that admitted scientific techniques are reliable.⁴⁹ Thus, under the *Frye* standard, only when the court determines that scientists have generally accepted a new scientific technique as reliable will it admit any scientific results stemming from the technique.⁵⁰ Although the *Frye* test remains the prevailing rule in a majority of jurisdictions, this rule has been perceived as a conservative approach to admissibility and one that can be easily manipulated to ensure that novel evidence will be deemed inadmissible.⁵¹

A minority of jurisdictions, including North Carolina, have adopted the Federal Rules standard,⁵² a more liberal standard which favors the admission of all relevant evidence.⁵³ Under the *Frye* test, courts treat novel scientific evidence the same as any other scientific evidence.⁵⁴ But, under the Federal Rules standard, expert testimony or scientific evidence is admissible if it is probative; however, courts may refuse to admit any expert or scientific testimony if the dangers of admitting the evidence substantially outweigh its probative value.⁵⁵ Evidence is probative when the expert testimony is helpful to the judge or jury and when the evidence is relevant to the case.⁵⁶ Furthermore, the witness testifying must be qualified as an expert on the subject matter of his or her testimony.⁵⁷ Like the *Frye* test, the Federal Rules standard requires scientific acceptance of the novel technique; however, this lenient standard that favors the admissibility of scientific evidence does not require such a stringent threshold for admission as the *Frye* standard of general acceptance.⁵⁸ Courts that apply the Federal Rules standard allow trial safeguards to prevent any potential problems

48. *United States v. Jakobetz*, 955 F.2d 786, 793 (2d Cir. 1992), *cert. denied*, 113 S. Ct. 104 (1992).

49. *Id.*

50. Fontg, *supra* note 6, at 513.

51. *United States v. Jakobetz*, 955 F.2d 786, 793 (2d Cir. 1992), *cert. denied*, 113 S. Ct. 104 (1992).

52. See N.C. GEN. STAT. § 8C-1, Rule 702 (1992) (tracking the Federal Rule provision verbatim). See generally *State v. Bullard*, 312 N.C. 129, 322 S.E.2d 370 (1984) (stating that an expert witness' testimony is properly admitted when such testimony can assist the juror to draw certain inferences from the facts because the expert is more qualified in this subject matter) and *State v. Temple*, 302 N.C. 1, 273 S.E.2d 273 (1981) (where evidence of bite marks was admitted when the evidence established that a dentist's expert testimony was based upon established scientific methods).

53. Fontg, *supra* note 6, at 513.

54. *Id.*

55. *Id.* See *supra* note 47. The text of Rule 403 is: "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." FED. R. EVID. 403.

56. Fontg, *supra* note 6, at 513.

57. *Id.*

58. *Id.*

with the admission of novel scientific methods and presume juries will evaluate the reliability of the evidence.⁵⁹ Such trial safeguards include notice that a scientific test and technique were administered, discovery of any results, cross-examination of expert witnesses, the use of opposing expert witnesses, and the use of a cautionary instruction to the jury.⁶⁰ However, most jurisdictions are in agreement that no matter which rule is followed, neither rule will permit speculative and conjectural scientific evidence which fails the normal foundational requirement necessary for admissibility.⁶¹

The North Carolina courts have codified the Federal Rules standards in their rules of evidence: "If scientific, technical or other specialized knowledge will assist the trier of fact to understand the evidence or determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion."⁶²

The North Carolina courts have eliminated the requirement that an expert be experienced with the identical subject matter and area at issue in a particular case or that an expert be a specialist, be licensed or practice in a specific profession.⁶³ Moreover, a trial judge has much discretion in determining whether the expert has the requisite skills to qualify him as an expert and whether the expert testimony should be admitted.⁶⁴ North Carolina courts have held that it is not mandatory to exclusively adhere to the *Frye* test. A trial judge's findings will not be reversed on appeal unless there is no evidence to support the findings.⁶⁵ In fact, in *State v. Temple*, the court stated a general rule for admitting new scientific techniques and methods:

This court is of the opinion, that we should favor the adoption of scientific methods of crime detections, where the demonstrated accuracy and reliability has becomes established and recognized. Justice is truth in action, and any instrumentality, which aids justice in the ascertainment of truth. should be embraced with delay.⁶⁶

The court in *State v. Bullard* promulgated a second general principle concerning the admissibility of novel scientific evidence in North Carolina. It stated that "[i]n general, when no specific precedent exists, scientifically accepted reliability justifies admission of the testimony of qualified witnesses, and such reliability may be found either by judi-

59. *Id.*

60. *Id.*

61. *See, e.g., United States v. Two Bulls*, 918 F.2d 56 (8th Cir. 1990), *appeal dismissed*, 925 F.2d 1127 (8th Cir. 1991).

62. N.C. GEN. STAT. § 8C-1, Rule 702 (1992).

63. *State v. Bullard*, 312 N.C. 129, 322 S.E.2d 370 (1984).

64. *Id.*

65. *Id.*

66. 302 N.C. 1, 12, 273 S.E.2d 273, 280 (1981).

cial notice or from the testimony of scientists who are experts in the subject matter, or a combination of the two."⁶⁷

Some formerly novel scientific evidence and testimony now accepted into evidence in North Carolina are bite mark identification techniques,⁶⁸ gun shot residue tests,⁶⁹ and physical anthropology footprint techniques.⁷⁰ However, hypnotic techniques⁷¹ and polygraph evidence⁷² have not been allowed into evidence, for they have not yet attained scientific reliability in ascertaining truth or deception. As of 1990, North Carolina courts added DNA testing to the growing scientific methods which can be admitted into evidence.⁷³

IV. NORTH CAROLINA CASE LAW CONCERNING DNA PROFILING

The seminal case in North Carolina in DNA profiling is *State v. Pennington*.⁷⁴ In *Pennington*, the North Carolina Supreme Court promulgated the general rule that DNA evidence is sufficiently reliable to be admitted into evidence.⁷⁵ However, in qualifying this rule, the *Pennington* court stated that:

The admissibility of any such evidence remains subject to attack. Issues pertaining to relevancy or prejudice may be raised. For example, expert testimony may be presented to impeach the particular procedures used in a specific test or the reliability of the results obtained In addition, traditional challenges to the admissibility of the evidence such as the contamination of the sample or chain of custody questions may be presented. These issues relate to the weight of the evidence. The evidence may be found to be so tainted that it is totally unreliable and, therefore, must be excluded.⁷⁶

In *Pennington*, the defendant was convicted of first degree rape, first degree sexual offense, first degree arson, assault with a deadly weapon with intent to kill or inflicting serious injury, and felonious breaking and entering.⁷⁷ The North Carolina Supreme Court found no error in this case, and the DNA analysis was admitted into evidence.⁷⁸ During this trial, most of the States' evidence concerning the

67. *Bullard*, 312 N.C. at 148, 322 S.E.2d at 381.

68. *See State v. Temple*, 302 N.C. 1, 11, 273 S.E.2d 273, 279 (1981).

69. *See State v. Crowder*, 285 N.C. 42, 49, 203 S.E.2d 38, 44 (1974).

70. *See State v. Bullard*, 312 N.C. 129, 144, 322 S.E.2d 370, 379 (1984).

71. *See State v. Peoples*, 311 N.C. 515, 319 S.E.2d 177 (1984).

72. *See State v. Foye*, 254 N.C. 704, 705, 102 S.E.2d 169, 170 (1961).

73. *State v. Pennington*, 327 N.C. 89, 100, 393 S.E.2d 847, 854 (1990).

74. *Id.* The *Pennington* case was the first case in which the North Carolina courts discussed and allowed the admission of DNA evidence and statistical probabilities as to the likelihood of a random person's DNA matching the forensic samples taken at the crime scene.

75. *Id.*

76. *Id.* (citations omitted).

77. *Pennington*, 327 N.C. at 90, 393 S.E.2d at 848.

78. *Id.* at 100, 393 S.E.2d at 854.

identification of the perpetrator revolved around semen samples found on the bed sheets.⁷⁹ In this case a fire produced a great deal of smoke and soot which blanketed much of the house making it difficult to lift fingerprints.⁸⁰ Further, the victim had been severely beaten, which impaired her perception.⁸¹ The trial court conducted an extensive voir dire hearing on the admissibility of the DNA analysis and testing as administered by Cellmark Diagnostic, Inc.⁸² The court concluded that the proffered evidence had probative value and was reliable based on established scientific methods generally accepted within the fields of microbiology and molecular biology.⁸³ For these reasons, the court allowed the admission of the evidence pertaining to the DNA analysis.⁸⁴

Moreover, the *Pennington* court discussed the purpose and reliability of DNA analysis. An expert witness testified that DNA is a chemical which encodes all human genetic information and is found in the nucleus of all cells.⁸⁵ Furthermore, the expert stated that the DNA remains constant throughout a person's life and is identical in each cell (i.e., the DNA found in blood cells is identical to DNA found in sperm cells, hair follicle cells, skin cells and other blood cells — those samples commonly found at a crime scene and used as forensic evidence).⁸⁶ He concluded by stating that every person's DNA is unique, with the exception of that of identical twins who share identical DNA throughout their cells.⁸⁷ After four DNA probes, the bed sheet sample yielded five or six bands of matching DNA.⁸⁸ In his testimony, the expert stated that the sperm sample taken from the bedding matched the defendant's DNA taken from a blood sample, and that the statistical probability of a similar banding pattern occurring randomly in the Caucasian populations would be one in twenty-four million.⁸⁹ Here, the statistical probability was admitted into evidence as readily as the evidence of the match. Other testimony damaging to the defendants were statements made by the expert witness who testified that without human error or deliberate tampering, there would be no way to achieve a false match.⁹⁰ He continued by testifying that

79. *Id.* at 92, 393 S.E.2d at 849.

80. *Id.*

81. *Id.*

82. *Id.*

83. *Id.*

84. *Id.*

85. *Id.* at 93, 393 S.E.2d at 849-50.

86. *Id.* at 93, 393 S.E.2d at 850.

87. *Id.*

88. *Id.* at 95, 393 S.E.2d at 851.

89. *Id.*

90. *Id.* at 95-96, 393 S.E.2d at 851.

technical difficulties would lead to no result or to a false negative rather than to a false positive.⁹¹ Thus, in *Pennington*, the court concluded that based on expert testimony, which the court found to be uncontradicted, DNA profile testing uses established scientific methods considered reliable within the scientific community, and the DNA evidence was properly admitted.⁹² Moreover, the court found that other jurisdictions have reached similar conclusions and results.⁹³ Specifically, the court noted that even when DNA tests are held to be inadmissible under the particular facts of a case, the reliability of DNA tests is now generally accepted, and such DNA is generally admissible.⁹⁴

In *State v. Bruno*, the North Carolina Court of Appeals adhered to the precedent set in *Pennington*, allowing the evidence of a DNA match to be admitted.⁹⁵ However, the *Bruno* court cited one major exception. The *Bruno* court left undecided the question of whether the FBI's data base was sufficiently broad to allow the introduction of evidence regarding the statistical probability of a given defendant being the perpetrator of an alleged offense.⁹⁶

In *Bruno*, the defendant was charged and subsequently convicted of second degree sex offense, second degree rape, and first degree burglary.⁹⁷ On appeal, this conviction was affirmed.⁹⁸ The evidence tended to show that the defendant was the former boyfriend of the mother of the victim.⁹⁹ Because of this relationship, the defendant was familiar with the layout of the victim's home.¹⁰⁰ The defendant had frequented the victim's home while the victim's father was away so that he could visit the victim's mother.¹⁰¹ The relationship between the victim's mother and the defendant became more tenuous in late 1988.¹⁰² On April 5, 1989, the defendant accosted the victim's mother at a local bar and asked whether she was dating her companion for the evening.¹⁰³ She replied that she was not and heard the defendant

91. *Id.*

92. *Id.* at 100, 393 S.E.2d at 853.

93. *Id.*

94. *Id.* See *State v. Woodall*, 385 S.E.2d 253 (W. Va. 1989).

95. 108 N.C. App. 401, 424 S.E.2d 440, *rev. denied*, 333 N.C. 464, 428 S.E.2d 185 (1993). The Court of Appeals recognized the difficulty of deciding this issue and refused to entertain the question.

96. *Id.* at 415, 424 S.E.2d at 448.

97. *Id.* at 403, 424 S.E.2d at 441.

98. *Id.* at 415, 424 S.E.2d at 448.

99. *Id.* at 403, 424 S.E.2d at 441.

100. *Id.*

101. *Id.*

102. *Id.*

103. *Id.*

state something to the effect of "you will get yours."¹⁰⁴ It was during that night that the defendant broke into his former girlfriend's home.¹⁰⁵

As part of the prosecutorial evidence, the State had a DNA probe conducted, comparing semen on the victim's nightgown to the defendant's blood.¹⁰⁶ While the testimony as to the number of matches was conflicting, there was agreement that at least two matches were obtained.¹⁰⁷

The State's expert witness testified that the defendant's blood matched the semen sample on the victim's nightgown in three of four probes.¹⁰⁸ Thus, the State's expert witness found that these matches were strong evidence that the defendant was the actual perpetrator of the crime, especially since the evidence regarding the probes was taken cumulatively rather than individually.¹⁰⁹ The expert witness for the State further stated that "every time you add an extra probe and get an additional match it further strengthens the significance of your DNA analysis."¹¹⁰

The defendant's expert witness retested the blood and semen samples and could only conclude a match of two probes. He testified that this evidence was inconclusive as to whether the defendant was the source of the genetic material.¹¹¹

Citing the rule in *Pennington*, the *Bruno* court held that DNA test results were sufficiently reliable to be admitted into evidence, but the results were still subject to attack based on prejudice, relevancy, and the reliability of particular laboratory procedures and protocol.¹¹² Furthermore, the *Bruno* court found that the trial court did not err by admitting the DNA analysis into evidence.¹¹³ The *Bruno* court did, however, outline another specific situation in which DNA evidence may be excluded. When the contamination of the forensic sample and chain of custody problems are provable, the DNA evidence may not be admitted.¹¹⁴ The *Bruno* court then stated that all the aforementioned exceptions to the general rule of admissibility of DNA evidence relate to the weight and credibility of the evidence, not to its

104. *Id.*

105. *Id.*

106. *Id.* at 405, 424 S.E.2d at 443.

107. *Id.*

108. *Id.*

109. *Id.* at 406, 424 S.E.2d at 443-44.

110. *Id.* at 406, 424 S.E.2d at 444.

111. *Id.*

112. *Id.* at 410, 424 S.E.2d at 445.

113. *Id.*

114. *Id.*

admissibility.¹¹⁵ However, the court went on to say that in some cases, the evidence may be found to be so tainted that it becomes totally unreliable and therefore must be excluded.¹¹⁶ As to the testimony among the experts, the courts found that where unfair prejudice is not apparent and the expert testimony concerning the interpretation of the DNA evidence and its genetic source is conflicting, the issue becomes one of credibility of the expert witness, not admissibility of the DNA evidence.¹¹⁷ Furthermore, the court stated that in this situation it is within the province of the jury to determine what weight each expert's testimony should receive.¹¹⁸

Additionally, the *Bruno* court found that because the defendant failed to object to evidence similar to that which was previously objected to, but overruled, the benefit of the subsequent objection was lost.¹¹⁹ Specifically, two expert witnesses were allowed, over objection, to testify that the combined results of several probes resulted in a much stronger and more significant association than any probe taken individually. When a third expert witness gave similar testimony, the defendant did not object; thus, his objection was lost, and the court found no error with the trial court's decision.¹²⁰

The final issue the *Bruno* court addressed regarding DNA analysis concerned the reference to any numerical figure [statistical probability] in connection with the DNA testing at trial.¹²¹ The defense made a motion in limine to suppress any of the numerical or statistical information related to probabilities, based on the argument that the FBI data base for attaching a numerical probability figure was inadequate and insufficient.¹²² The trial court allowed the defendant's motion in limine, and it was upheld on appeal.¹²³ The court stated that when the defendant sought to exclude the statistical data of a match because of the inadequacy of the FBI's data base, the defendant could not later complain that his own expert was not allowed to testify to impeach the data base evidence that the defendant had successfully excluded.¹²⁴ The court then stated it was not directly confronted with the issue of the sufficiency of the FBI's data base in allowing the evidence of the statistical probabilities that the defendant

115. *Id.*

116. *Id.*

117. *Id.*

118. *Id.* at 441, 424 S.E.2d at 446.

119. *Id.*

120. *Id.*

121. *Id.* at 412, 424 S.E.2d at 447.

122. *Id.* at 411, 424 S.E.2d at 446.

123. *Id.*

124. *Id.* at 412, 424 S.E.2d at 447.

was the actual perpetrator of the crime, and thus refused to entertain the question.¹²⁵

In *State v. Futrell*, the court was faced directly with the issues that the *Bruno* court had refused to entertain — the sufficiency of the FBI data base and the reliability of statistical probabilities that a defendant is the actual perpetrator of an alleged offense.¹²⁶ In that case, the defendant asserted that the trial court erred by admitting the evidence of the DNA profiling test.¹²⁷ The defendant argued that the evidence should be excluded by contending that the statistical probability compilation methodologies employed by the FBI were insufficient and unreliable and that he was unfairly prejudiced by the admission of this evidence.¹²⁸ However, this argument did not persuade the court.

In a very detailed analysis, the court discussed the matching process alluded to in Part II of this article. In this case, the defendant had been convicted of second degree rape and assault on a female.¹²⁹ From the State's evidence, it was revealed that the defendant had apparently broken into the victim's apartment through a window. Once inside, the defendant went to the victim's bedroom, awakened her and threatened her with a knife to submit to nonconsensual intercourse.¹³⁰

Upon investigation of the victim's undergarments, stains were found which were determined to be spermatozoa; the DNA analysis took place as a result of this forensic sample.¹³¹ In the RFLP procedure, after probing DNA samples obtained from the crime scene, the defendant and the victim, the samples are exposed to film during a process known as autoradiography.¹³² This process yields autorads which resemble the bar codes found on supermarket products. These lines or bands form a pattern which is the substance of the DNA profile.¹³³

These bands derived from the forensic samples and the blood samples are compared after they are arranged in three parallel lines. After a visual comparison is made, more exacting computer measurements are done to determine whether a match is present. This process of comparing the bands is known as an interpretation.¹³⁴ After the comparison is made, the FBI experts must determine the statistical relevance of a match by ascertaining the probability of finding that

125. *Id.* at 415, 424 S.E.2d at 448.

126. 112 N.C. App. 651, 436 S.E.2d 884 (1993).

127. *Id.* at 659, 436 S.E.2d at 888.

128. *Id.*

129. *Id.* at 655, 436 S.E.2d at 885.

130. *Id.*

131. *Id.*

132. *Id.* at 660, 436 S.E.2d at 888.

133. *Id.*

134. *Id.*

another individual's DNA band patterns would be identical to that of the defendant. The probability is determined by utilizing the product rule to calculate the frequency of certain patterns of bands which appear within a relevant population.¹³⁵ The populations are usually distinguished by race and by reference to a pertinent data base compiled by the FBI.¹³⁶

In *Futrell*, the defendant argued that the statistical interpretation based on these methods used by the FBI were not sufficiently reliable, and, as a result, he was unfairly prejudiced by the use of these calculations at trial. Moreover, he alleged that if the rarity of the matching patterns is unascertainable, then the evidence of a match is wholly irrelevant as well.¹³⁷

The State's first expert witness was an FBI special agent who supervised the DNA analysis and was certified as an expert in forensic DNA analysis. He testified that all four probes and subsequent DNA autorads yielded a match of the spermatozoa sample from the victim's panties to the defendant's blood sample.¹³⁸ Thus, he concluded that the defendant could not be excluded as a possible source of the forensic semen sample. Moreover, the State's expert testified that when the DNA samples from the defendant were compared to the FBI's relevant population data base, there was approximately a 1 in 2.7 million chance that another individual's blood sample would match the forensic semen sample.¹³⁹ During the State's rebuttal, another expert witness' estimation coincided with the State's first expert witness testimony.¹⁴⁰

Experts for the defense attacked the FBI's procedure for determining statistical probabilities by testifying that the FBI's methodology and results were distorted because of the small size and unknown details of the data base it used.¹⁴¹ The defense's first expert witness testified that based on his recalculations of the same DNA samples, there was a one in 237,000 probability of finding another male in the black population data base with the same four profiles.¹⁴² The defense's second expert witness reiterated the notion that the FBI's data base was much too small to calculate accurate statistical probabilities and

135. *Id.*

136. *Id.*

137. *Id.*

138. *Id.* at 657, 436 S.E.2d at 886. The State's first witness was Special Agent Dwight Adams, Ph.D., who was assigned to the DNA Analysis Unit for the FBI laboratory in Washington, D.C.

139. *Id.*

140. *Id.* at 658, 436 S.E.2d at 887. During rebuttal, the State called Dr. Bruce Weir who is a professor of statistics and genetics at North Carolina State University.

141. *Id.* at 657, 436 S.E.2d at 886.

142. *Id.* The defense's first expert witness was Dr. Moses Schanfield, an expert in DNA analysis.

that a population data base containing several thousand random blood samples would be required for valid computations.¹⁴³ The defense's experts, in sum, testified that the FBI's black population data base only contained samples from five hundred individuals and that the FBI had no way of knowing if the samples may have been taken from a subgroup or which of the samples were actually obtained from black individuals.¹⁴⁴ On rebuttal, the State's expert witness acknowledged the limitations of using such a small data base, but that his calculations of 1 in a 2.8 million frequency were accurate based on the adjustment and accommodations he made to counteract the negative aspects of using a smaller data base.¹⁴⁵

In ruling that this DNA evidence was admissible, the *Futrell* court relied on the precedents of both the *Pennington* and *Bruno* courts. The court reiterated the general rule of *Pennington* that DNA profile testing is generally admissible and acknowledged that DNA evidence is still subject to attack when the defendant raises issues related to relevancy or prejudice or chain of custody questions because this evidence may be found to be so tainted that it is totally unreliable and must be excluded.¹⁴⁶ The *Futrell* court also followed the ruling of the *Bruno* court which qualified this unfair prejudice and reliability exception by finding that when unfair prejudice is not clear or when there is conflicting evidence by expert witnesses regarding the interpretations of DNA evidence or when two or more experts, based on independent analysis of DNA samples, have differed in their interpretations and findings, the issue becomes one of the credibility of the experts.¹⁴⁷ When such a situation arises, it is within the province of the jury to determine the weight each expert's testimony should receive.¹⁴⁸

Relying on these rules, the *Futrell* court upheld the defendant's conviction and denied his motion to exclude the DNA profile testing evidence based on unfair prejudice. The court stated that while the expert testimonies presented at trial were conflicting in that the defendant offered evidence to impeach the methodologies used and the reliability of results obtained, the issue was one of credibility of the experts.¹⁴⁹ The court further held that it was the jury's role to deter-

143. *Id.* The defense next called Dr. Ted Emigh, an associate faculty member in the Department of Genetics at North Carolina State University, who testified as an expert in statistics and population genetics.

144. *Id.* at 663, 436 S.E.2d at 890. A subgroup would be a community of persons who live in an isolated, rural area and who share many traits and characteristics resulting from inbreeding and intermarriage.

145. *Id.*

146. *Id.*

147. *Id.*

148. *Id.*

149. *Id.* at 664, 436 S.E.2d at 890.

mine what weight each expert's testimony should have received.¹⁵⁰ Accordingly, the court found that mere conflicting expert testimony concerning the FBI's statistical methodologies neither suggests nor implies prejudice so unfair, nor shows those procedures to be so totally unreliable, as to justify the exclusion of the resulting compilations. Because the trial judge properly instructed the members of the jury that they were the sole judges of the credibility of each witness and that they were to assess the weight given to the testimony of all witnesses, the appellate court found that the trial court did not err in its decision to admit the DNA evidence.¹⁵¹

Finally, the defendant alleged that his Sixth Amendment constitutional right to confront any witness against him was violated by the admission of the DNA profile test and results into evidence because the laboratory technician who actually performed the test did not testify at trial.¹⁵² The DNA testimony was actually given by the agent who supervised the technician in testing procedures. The *Futrell* court quickly disposed of this question by finding that the expert in this case based his opinion on the findings that he monitored, and the defendant was able to cross-examine this witness, which he did vigorously and thoroughly.¹⁵³ Moreover, the defendant never even attempted to subpoena the laboratory technician nor sought the court's assistance in securing her presence at trial.¹⁵⁴

V. CONCLUSION

The status of the law in North Carolina is seemingly well settled in that the courts generally will be amenable to the admission of DNA evidence unless the evidence is shown to be wholly unreliable or unfairly prejudicial. Furthermore, DNA profiling tests and subsequent results of the testing may be excluded on a case-by-case basis if there are any inadequate or improper laboratory procedures present or if any chain of custody problems existed in obtaining the forensic samples. The *Bruno* court did refuse to address the question of whether the FBI's data base, or any data base for that matter, was sufficiently broad to allow the introduction of evidence concerning the probability that a given defendant was actually the perpetrator of a crime. However, in *Futrell*, the court allowed the admission of the statistical probabilities and DNA profiling results, thus providing more latitude for this type of evidence to go to a jury to determine its credibility and

150. *Id.*

151. *Id.* at 665, 436 S.E.2d at 891.

152. *Id.* at 666, 436 S.E.2d at 892.

153. *Id.*

154. *Id.*

weight. With the *Futrell* ruling, it is apparent that the North Carolina courts have begun to align themselves with the majority of jurisdictions that have already allowed admission of all DNA profiling evidence.¹⁵⁵

Thus, the question is raised as to the future of criminal litigation in North Carolina in this area. The State now has a powerful force in the prosecution of criminal defendants, especially in murder and rape cases when forensic samples found at a crime scene or on a victim's body can be matched to the blood samples drawn from the defendant. When a jury hears expert testimony of devastating statistical probabilities, it is unlikely that the jury will exonerate the defendant even if the defendant has an alibi and there are no eyewitnesses to link the defendant to the scene of the crime. This guilty finding may result even after the judge has instructed the jury that they may believe any, all, or none of the testimony of each witness and should not accept the opinion of an expert witness to the exclusion of other facts and circumstances disclosed by the testimony and the evidence.

Conversely, the criminal defense attorney, if the evidence precludes the possibility of a DNA match, has the ammunition he or she needs to persuade the jury to acquit his or her client. However, if the evidence is unfavorable to the defense's case, the criminal defense attorney may still attack DNA profile testing and results on several grounds. The criminal defense attorney should inform the court that when a scientific process such as DNA profiling is new and complex, more than one expert may be needed to explain and interpret the scientific process and results to the jury even if the expert witnesses are from different disciplines.¹⁵⁶ Additionally, the defense attorney should ask the court to consider whether the laboratory followed generally accepted standards in its analysis and testing so that reliable estimates of a statistical probability of a match have resulted.¹⁵⁷ The defense attorney should also advise the court of any chain of custody problems and should ask the court to consider whether the police investigators used small, possibly contaminated forensic samples of un-

155. See *Wenzel v. State*, 815 S.W.2d 938 (Ark. 1991) (where the court found that the lack of any leftover forensic evidence for independent testing did not defeat the State's right to present DNA test results); *People v. Axell*, 1 Cal. Rptr.2d 411 (1991) (where the Court found that there was a consensus that DNA fingerprinting procedures had gained general acceptance in the scientific field to which they belong); *Andrews v. State*, 535 So.2d 851 (Fla. Ct. App. 1988) (where the court found both the DNA profiling results and statistical probabilities admissible); *United States v. Jakobetz*, 955 F.2d 876 (2d Cir. 1992), cert. denied, 113 S.Ct. 104 (1992).

156. BOARD ON BIOLOGY, COMMISSION ON LIFE SCIENCES, NATIONAL RESEARCH COUNCIL, *DNA TECHNOLOGY IN FORENSIC SCIENCE* (National Academy Press, Washington, D.C. 1992) 133.

157. *Id.* at 135.

known origin, such as a blood stain on a piece of fabric.¹⁵⁸ Moreover, the criminal defense attorney should determine if there is a need for expert assistance in reviewing laboratory work and interpreting DNA profiling test results even if the expert is not called to testify.¹⁵⁹

Finally, the court should be advised and cognizant of the need to read Rule 702 of the North Carolina Rules of Evidence in conjunction with Rule 403, which requires to court to determine the admissibility of any evidence by balancing its probative force against its prejudicial effect.¹⁶⁰ For example, when determining the admissibility of the results of DNA testing into evidence, the court should consider the possibility that admission of this evidence may mislead, confuse, or overwhelm a jury.¹⁶¹ Furthermore, the criminal defense attorney should ask the court to consider whether the admission of that evidence is only relevant to a collateral issue in the case.¹⁶²

DNA profiling evidence will have a phenomenal impact on criminal litigation in the future. With the three cases discussed above, North Carolina has promulgated the necessary rules and established the boundaries of when DNA profiling tests and results will be admitted into evidence. Although the *Futrell* case is only an appellate case and the issue will be likely heard by the North Carolina Supreme Court,

158. *Id.* at 134.

159. *Id.* at 137. See also *State v. Mills*, 332 N.C. 392, 429 S.E.2d 114 (1992). In this case the court denied the defendant's pretrial motion for the appointment of an expert witness in the area of DNA identification testing based on the failure of the defendant to demonstrate a sufficient and particularized need for the expert. The State argued that the defendant failed to show the availability of an expert witness and failed to present any reasonable assessment of the cost involved.

The law in North Carolina regarding the appointment of expert witnesses for indigent defendants is well settled. "Whenever a person, under the standards and procedures set out in this Subchapter, is determined to be an indigent person entitled to counsel, it is the responsibility of the State to provide him with counsel and other necessary expenses of representation." N.C. GEN. STAT. § 7A-450(b) (1992). "The court, in its discretion, may approve a fee for the service of an expert witness who testifies for an indigent person, and shall approve reimbursement for the necessary expenses of counsel. Fees and expenses accrued under this section shall be paid by the State." N.C. GEN. STAT. § 7A-454 (1992).

In *Mills*, the North Carolina Supreme Court found that a general desire to have an expert in DNA testing assist a defendant in some vague manner in the event that this sort of evidence might be introduced at trial is an insufficient showing of a particularized need for a DNA expert, even if the need becomes apparent during the course of the trial. If the need becomes apparent during the trial, the court suggested that the defendant should renew his motion for the appointment of an expert.

160. BOARD ON BIOLOGY, COMMISSION ON LIFE SCIENCES, NATIONAL RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE (National Academy Press, Washington, D.C. 1992) 136.

For a complete text of N.C. GEN. STAT. § 8C-1, Rule 403, see *supra* note 55 and accompanying text.

161. BOARD ON BIOLOGY, COMMISSION ON LIFE SCIENCES, NATIONAL RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE (National Academy Press, Washington, D.C. 1992) 136.

162. *Id.*

the trial court judge presently has much discretion in allowing the evidence of a DNA match and evidence regarding the statistical probability of a match randomly occurring. As courts, attorneys, juries, and society as a whole become more acclimated to DNA analysis and results, absolute truth may begin to be ascertained with or without the support of traditional evidential means.