

# THE ADMISSIBILITY OF DNA EVIDENCE IN VERMONT COURTS AFTER PFENNING

## INTRODUCTION

My first legal internship was at one of the State's Attorney's Offices in Vermont. About a month into the internship, while trying to find a report for a murder case that was being prepared, I came across my first autopsy photograph. After getting over the initial shock of seeing that picture—the murder was rather heinous—I became interested in the case and inquired about what kind of evidence the prosecution intended to use at trial. To make its case, the office sought to use deoxyribonucleic acid (DNA) evidence; more specifically, evidence derived from polymerase chain reaction-short tandem repeat (PCR-STR) DNA profiling, using the AmpFI STR Profiler Plus (Profiler Plus) kit and its companion AmpFI STR Cofiler (Cofiler).<sup>1</sup> This evidence strongly indicated that the defendant committed the murder. Thus, the State's case would rest in large part on the court admitting this DNA evidence.<sup>2</sup>

The use of DNA evidence in the criminal arena has significantly increased in recent years.<sup>3</sup> The predominant method of generating such evidence is by use of PCR-STR technologies.<sup>4</sup> Profiler Plus and Cofiler are among the most popular and widely used PCR-STR DNA testing systems in the forensic field.<sup>5</sup> Evidence generated by forensic analysts using these kits is “often [the] key to solving a crime, obtaining a conviction, or exonerating

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1. See *infra* notes 78–83 and accompanying text.

2. The case on which this introduction is based is pending.

3. See GREG W. STEADMAN, U.S. DEP'T OF JUSTICE, SURVEY OF DNA CRIME LABORATORIES 2001 (2002), available at <http://www.ojp.usdoj.gov/bjs/pub/pdf/sdnacl01.pdf>.

In calendar year 2000 publicly operated forensic crime laboratories that perform DNA analyses reported analyzing almost 25,000 cases which involved DNA evidence and over 148,000 DNA samples collected from persons convicted of a crime. These are increases over the approximately 14,000 cases and 45,000 convicted offender samples reported analyzed in 1997.

*Id.*

4. See Richard Saferstein, *What Is DNA?* (“The most widely used technique for DNA typing combines PCR . . . with STR . . . analysis.”), at <http://www.expertpages.com/news/dna.htm> (last visited May 17, 2005); see also GREGGORY S. LABERGE, DENVER POLICE DEP'T CRIME LAB. BUREAU, FORENSIC DNA TYPING OF SHORT TANDEM REPEATS (STRS): RESULTS OF QUESTIONNAIRE 1–37 (2000) (indicating that 132 out of 134 surveyed forensic laboratories use some form of PCR-STR technology), available at <http://www.denverda.org/legalresource/survey.pdf>.

5. See LABERGE, *supra* note 4, at 1–37 (showing that more than eighty responding laboratories utilize Profiler Plus and Cofiler); STEADMAN, *supra* note 3, at 7 (“The test kits most commonly used by laboratories for DNA typing of casework evidence at the start of 2001 were CoFiler, by 82 laboratories, and Profiler Plus, by 79 laboratories. . . . Contract [private] laboratories use[] . . . Profiler Plus and CoFiler most often for both casework and convicted offender samples.”).

the falsely accused.”<sup>6</sup> Thus, the question whether such evidence is admissible in court is important to participants at virtually every level of the criminal justice system.

Courts throughout the country admit DNA evidence produced by PCR-STR DNA testing methodologies such as Profiler Plus and Cofiler.<sup>7</sup> Five years ago, however, when the issue of admissibility of PCR-STR evidence came before a Vermont court in *State v. Pfenning*, the court excluded the Profiler Plus evidence.<sup>8</sup> Since *Pfenning*, the matter has not been before a Vermont court. Consequently, *Pfenning* represents the current state of the law in Vermont concerning the admissibility of DNA evidence produced by PCR-STR testing kits. Although trial court decisions do not necessarily bind other courts, they are cited as persuasive authority. The wake of the *Pfenning* decision saw many defendants, from multiple states, citing the rationale of the court as a basis for excluding Profiler Plus evidence.<sup>9</sup> The thesis of this Note is that while the rationale of *Pfenning* may have been appropriate at the time the court decided the case, it is no longer applicable given recent legal and scientific developments.<sup>10</sup>

It seems practical to provide a general overview of the science of DNA and forensic testing before taking up the subject of the admissibility of Profiler Plus evidence in Vermont courts after *Pfenning*. The first part of

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6. *DNA Evidence: What Law Enforcement Officers Should Know*, NAT'L INST. JUST. J., July 2003, at 10, 10, available at <http://www.ncjrs.org/pdffiles1/jr000249c.pdf>.

7. This holds true regardless of whether the state's adopted standard of admissibility originates from *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923), *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), Federal Rule of Evidence 702, or a state equivalent of this rule. See *People v. Shreck*, 22 P.3d 68, 80 (Colo. 2001) (“[M]any courts have found that DNA evidence derived from STR-based testing [including Profiler Plus] is admissible either under *Frye*'s general acceptance test or under Rule 702's reliability test.”); *People v. Rokita*, 736 N.E.2d 205, 211 (Ill. App. Ct. 2000) (noting that it was undisputed that “STR-based DNA testing is now generally accepted in the relevant scientific community”); *Commonwealth v. Rosier*, 685 N.E.2d 739, 743 (Mass. 1997) (holding that PCR-based tests, including STR, are scientifically valid); *State v. Jackson*, 582 N.W.2d 317, 325 (Neb. 1998) (holding that the trial court correctly determined that PCR-based STR DNA testing used in that case was generally accepted); *People v. Owens*, 725 N.Y.S.2d 178, 181 (N.Y. Sup. Ct. 2001) (noting that “[c]ourts throughout the country have found that Short Tandem Repeat (STR) DNA profiling, using . . . Profiler Plus and Cofiler PCR kits are reliable and generally accepted by the scientific community”); see also *infra* Part IV.C.

8. *State v. Pfenning*, No. 57-4-96, slip op. at 2, 49–51 (Vt. Dist. Ct. Apr. 6, 2000); see also *infra* Part III. Cofiler has yet to be the subject of a Vermont court decision.

9. See *Shreck*, 22 P.3d at 82 (rejecting the defendant's assertion that the *Pfenning* decision established the unreliability of Profiler Plus); *State v. Roman Nose*, 649 N.W.2d 815, 824–25 (Minn. 2002) (declining to agree with the defendant that the *Pfenning* decision supported his argument against the admissibility of DNA evidence); *State v. Deloatch*, 804 A.2d 604, 613 (N.J. Super. Ct. Law Div. 2002) (rejecting the *Pfenning* notion that commercial STR kits are not valid); cf. *Owens*, 725 N.Y.S.2d at 182 (noting that the defendant relied upon the *Pfenning* decision to substantiate his contention that Profiler Plus was unreliable).

10. See *infra* Parts IV–V.

this Note is devoted to providing such a synopsis.<sup>11</sup> Part I describes the process of DNA analysis by use of PCR-STR technology. Part II presents an articulation of the standard of admissibility applicable to scientific and technical evidence at the time of *Pfenning*. The rationale and holding of *Pfenning* is the focus of Part III. Part IV analyzes the relatively recent developments in science and law that have effectively addressed the concerns of the *Pfenning* court regarding the reliability of Profiler Plus. Finally, Part V presents the argument that these developments render evidence derived from Profiler Plus admissible, even in light of the court's rationale in *Pfenning*.

## I. BACKGROUND INFORMATION ON DNA AND FORENSIC TESTING

It may be difficult to comprehend fully the *Pfenning* decision without first having a general understanding of the science of forensic DNA testing by the use of PCR-STR technology. First, this section explores, generally, DNA and its use in forensic testing. Next, the discussion turns to an examination of the science behind PCR-STR analysis.

### A. DNA and Forensic Analysis

DNA establishes a unique genetic code for every person.<sup>12</sup> It is literally what makes each individual an individual.<sup>13</sup> For example, your DNA is what makes your hair and eye color different from that of others. In addition, the characteristics of your DNA allow forensic scientists to determine whether a given substance came from your body.<sup>14</sup>

Virtually every cell in the human body contains DNA.<sup>15</sup> DNA is composed of two strands with "rungs" running through them, twisting together to form a "double helix" or "twisted ladder."<sup>16</sup> Each rung on the

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11. The coverage this Note gives to DNA and forensic DNA testing is not meant to be extensive or exhaustive. For detailed coverage of these topics, see JOHN M. BUTLER, FORENSIC DNA TYPING: BIOLOGY & TECHNOLOGY BEHIND STR MARKERS (2001) [hereinafter BUTLER, DNA TYPING], and COMM. ON DNA FORENSIC SCI., NAT'L RESEARCH COUNCIL, THE EVALUATION OF FORENSIC DNA EVIDENCE (1996).

12. BUTLER, DNA TYPING, *supra* note 11, at 13.

13. *Id.* at 20.

14. *See id.* at 23 (stating that "[a] person's genetic makeup can be directly determined from very small amounts of DNA present in blood stains, saliva, bone, hair, semen, or other biological material" and that "any cells collected from [a given] individual . . . provide[] the same forensic information").

15. *State v. Streich*, 163 Vt. 331, 337, 658 A.2d 38, 43 (1995).

16. *United States v. Trala*, 162 F. Supp. 2d 336, 340 (D. Del. 2001); *see also* COMM. ON DNA FORENSIC SCI., *supra* note 11, at 12–13 (elaborating on the double helix nature of the DNA molecule). In 1953, scientists James Watson and Francis Crick discovered that the DNA molecule takes the form of

ladder consists of a pair of chemical compounds called bases.<sup>17</sup> There are four bases: adenine, thymine, cytosine, and guanine (A, T, C, and G).<sup>18</sup> The chemical make-up of the bases causes A to pair only with T and C to pair only with G.<sup>19</sup> Large numbers of paired bases form an individual's DNA. Each human being has approximately three billion base pairings in their genetic structure.<sup>20</sup> The various orders in which the bases pair up in a molecule of DNA are referred to as "base sequences."<sup>21</sup> These base sequences are essential to the process of analyzing DNA for forensic purposes.<sup>22</sup>

Approximately ninety-nine percent of human DNA is consistent from individual to individual; with the exception of identical twins, no two persons have identical DNA.<sup>23</sup> Consequently, the areas of DNA that vary among persons are crucial in performing forensic identity testing.<sup>24</sup> These varying areas, or "polymorphisms," are found on the rungs of the DNA ladder—in the base sequences.<sup>25</sup> Two types of variation are important to the process of identity testing: "sequence polymorphisms" and "length polymorphisms."<sup>26</sup> A sequence polymorphism is an area on the DNA strand with a sequence of bases that differs from the sequences of bases

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a double helix. George Bundy Smith & Janet A. Gordon, *The Admission of DNA Evidence in State and Federal Courts*, 65 *FORDHAM L. REV.* 2465, 2465 (1997).

17. *Trala*, 162 F. Supp. 2d at 340; BUTLER, DNA TYPING, *supra* note 11, at 14. See generally COMM. ON DNA FORENSIC SCI., *supra* note 11, at 12 (discussing the chemical make-up of the rungs on the DNA molecule).

18. BUTLER, DNA TYPING, *supra* note 11, at 14.

19. *Id.* at 15; see also COMM. ON DNA FORENSIC SCI., *supra* note 11, at 12 (examining the base-pairing rule). It is the character of the pairing up of the bases that creates the double helix phenomenon. BUTLER, DNA TYPING, *supra* note 11, at 15. The bond between the "AT base pairs" is made up of two hydrogen bonds while the "GC base pairs" are connected by three hydrogen bonds. *Id.* Because the GC base pair is held together by three bonds, it creates a stronger pull on the two outer strands of the DNA, while the AT base pair, being held by fewer bonds, pulls less on the two outer strands, thus creating a twisting effect. *Id.*

20. BUTLER, DNA TYPING, *supra* note 11, at 14–15.

21. Short Tandem Repeat DNA Internet DataBase, Glossary of Commonly Used Terms [hereinafter STR Glossary], at <http://www.cstl.nist.gov/biotech/strbase/glossary.htm> (last visited May 17, 2005).

22. See *Trala*, 162 F. Supp. 2d at 340 ("The order in which the base pairs appear on the DNA ladder constitutes an individual's genetic code.").

23. *State v. Lyons*, 924 P.2d 802, 807 (Or. 1996).

24. BUTLER, DNA TYPING, *supra* note 11, at 20; see also *State v. Streich*, 163 Vt. 331, 337, 658 A.2d 38, 43 (1995) ("Because 99% of the DNA molecule is the same for all humans, DNA profiling focuses on those areas of the DNA molecule where there is significant differentiation of the base pair pattern.").

25. *Streich*, 163 Vt. at 337, 658 A.2d at 43.

26. BUTLER, DNA TYPING, *supra* note 11, at 20; see also *State v. Pfenning*, No. 57-4-96, slip op. at 18 (Vt. Dist. Ct. Apr. 6, 2000) ("Both kinds of differences can be used to distinguish individuals at a molecular level.").

found at the same location on another individual's DNA.<sup>27</sup> An example of a sequence polymorphism would be a portion of one person's DNA with the sequence AGAA, compared with the same portion of DNA taken from another person displaying the sequence AAAA.<sup>28</sup> Where there is a length polymorphism, the same sequence is present "but it is repeated a different number of times."<sup>29</sup> An example of a length polymorphism is where a specified location on the DNA of one individual has the sequence CATCATCAT, while the same location on the DNA of another person has the sequence CATCATCATCAT.<sup>30</sup> The STR markers discussed in Part I.B are length polymorphisms.

The locations at which variations in DNA are found are referred to as polymorphic "loci."<sup>31</sup> There are a variety of possible arrangements of base pairs that could occur in any given polymorphic area.<sup>32</sup> These possible base pair arrangements are known as "alleles."<sup>33</sup> Alleles describe each individual's genetic make-up or "genotype."<sup>34</sup>

To analyze a DNA sample for the purposes of identification, the forensic analyst "looks at predetermined polymorphic loci, identifies the alleles that make up the DNA sequence at those polymorphic loci, and then determines how likely it is for this sequence to appear in a given population."<sup>35</sup> This practice is referred to as "typing."<sup>36</sup> If the forensic analyst determines that a DNA sample taken from the suspect is sufficiently dissimilar from the sample gathered at the crime scene, then the suspect is ruled out as a possible source of the unknown sample.<sup>37</sup> On the other hand, if the forensic analyst determines that two samples are "sufficiently similar such that they could have originated from the same source," the analyst calculates "the probability that an unrelated person chosen at random . . . would have the same DNA profile as the unknown sample."<sup>38</sup>

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27. *Pfenning*, No. 57-4-96, slip op. at 18.

28. *Id.*

29. *Id.*

30. *Id.*

31. BUTLER, DNA TYPING, *supra* note 11, at 17.

32. *See Trala*, 162 F. Supp. 2d at 340 (noting that differences can result from the arrangement of a single base pair, multiple base pairs, or the amount of base pairs in a particular region). *See generally* COMM. ON DNA FORENSIC SCI., *supra* note 11, at 12-14, 60-65 (providing detail on the basic principles and fundamentals of genetics).

33. *Trala*, 162 F. Supp. 2d at 340; COMM. ON DNA FORENSIC SCI., *supra* note 11, at 145.

34. *Trala*, 162 F. Supp. 2d at 340.

35. *Id.*

36. *Id.*

37. *Id.* at 343.

38. *Id.*

Based on the results of these calculations, an analyst can determine whether there is a “match.”<sup>39</sup>

In the years since DNA testing technology became available, two methodologies have been prevalent.<sup>40</sup> Originally, forensic laboratories employed a method called restriction fragment length polymorphism (RFLP).<sup>41</sup> Although courts routinely found the results of RFLP analysis admissible, the technique had significant limitations that posed practical problems in the forensic setting.<sup>42</sup> These “limitations led scientists to the ‘logical step’ of develop[ing] . . . new methods of DNA analysis that would avoid the pitfalls of RFLP,” including the polymerase chain reaction (PCR) method.<sup>43</sup>

In recent years, DNA analysis techniques utilizing PCR technology have “rapidly overtaken” RFLP typing methods.<sup>44</sup> The following section

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39. *State v. Lyons*, 924 P.2d 802, 808 (Or. 1996).

40. BUTLER, DNA TYPING, *supra* note 11, at 23.

41. *See Dedge v. State*, 723 So. 2d 322, 323 (Fla. Dist. Ct. App. 1998) (mentioning that RFLP was the first type of DNA testing procedure developed); *State v. Roman Nose*, 649 N.W.2d 815, 821 n.6 (Minn. 2002) (“‘Restriction fragment length polymorphism’ was the first DNA technique used in forensic laboratories . . . .”); *State v. Faulkner*, 103 S.W.3d 346, 357 (Mo. Ct. App. 2003) (noting that the State’s witness testified that “the first method developed to analyze DNA evidence was restriction fragment length polymorphism”); *see also* David E. Housman, *DNA on Trial—The Molecular Basis of DNA Fingerprinting*, 332 NEW ENG. J. MED. 534, 534 (1995) (noting that RFLP was “[t]he most widely used technique” for DNA testing).

42. NAT’L COMM’N ON THE FUTURE OF DNA EVIDENCE, U.S. DEP’T OF JUSTICE, THE FUTURE OF FORENSIC DNA TESTING: PREDICTIONS OF THE RESEARCH AND DEVELOPMENT WORKING GROUP 14, 16 (2000), available at <http://www.ncjrs.org/pdffiles1/nij/183697.pdf>; Keith A. Findley, *New Laws Reflect the Power and Potential of DNA*, WIS. LAW., May 2002, at 20, 22; John Gibeaut, *Ruling Every Which Way*, A.B.A. J., Apr. 1998, at 40, 40.

The following are among the limitations of RFLP. First, RFLP requires relatively large DNA samples in order to work and is therefore unusable where only a small sample is available. *State v. Traylor*, 656 N.W.2d 885, 888 (Minn. 2003); *see also* NAT’L COMM’N ON THE FUTURE OF DNA EVIDENCE, *supra*, at 16 (referencing the fact that “relatively large amounts” of DNA are needed to perform RFLP testing); Gibeaut, *supra*, at 40 (noting, as a means of illustration that a “quarter-size blood stain or a dime-size semen stain” would be necessary for RFLP analysis to be conducted). Second, RFLP is ineffective when working with degraded DNA samples—those whose molecular structure has begun to breakdown. *Traylor*, 656 N.W.2d at 888; *Roman Nose*, 649 N.W.2d at 821 n.6. Third, the RFLP process takes approximately one to eight weeks, which can result in a backlog in forensic laboratories. BUTLER, DNA TYPING, *supra* note 11, at 24. Finally, the RFLP process ordinarily utilizes the complete sample, preventing further analysis. *See Roman Nose*, 649 N.W.2d at 821 n.6 (referencing that RFLP “consumes the DNA [sample] during testing”).

43. *Traylor*, 656 N.W.2d at 888.

44. BUTLER, DNA TYPING, *supra* note 11, at 23. PCR technologies have become more popular than RFLP largely because they lack RFLP’s limitations. For example, unlike the RFLP method, PCR processes are able to work with DNA samples of low quantity and poor quality. *Id.*; *see also* *Dedge v. State*, 723 So. 2d 322, 323 (Fla. Dist. Ct. App. 1998) (“The PCR method is . . . the only kind of DNA test that can be used on DNA samples which are old, small, or deteriorated . . . .”). In addition, PCR processes require only one to two days to obtain valid results. BUTLER, DNA TYPING, *supra* note 11, at 24. Further, “unlike RFLP testing, which destroys the sample, PCR processing allows

provides a general overview of what the PCR process entails. The specific focus is on the science underlying PCR amplification of STR markers, otherwise referred to as PCR-STR DNA analysis.

### B. Science Underlying PCR-STR Analysis

Scientists began discussing the PCR process as early as 1985.<sup>45</sup> In forensic testing, the PCR process allows analysts to identify and copy DNA regions.<sup>46</sup> Specifically, it increases the quantity of DNA available for typing.<sup>47</sup> “Th[is] method is considered especially beneficial for forensic testing, as the replication allows for testing of both degraded DNA and small amounts of DNA.”<sup>48</sup>

Three steps comprise the PCR “amplification process.”<sup>49</sup> First, a thermal cycler heats the DNA sample.<sup>50</sup> This heating process, called “denaturation,” breaks down the hydrogen bonds connecting the A-T and C-G base pairs, causing the DNA helix to separate into two single strands.<sup>51</sup> Each denatured strand forms a template that allows for the manufacture of a new strand identical to the denatured original.<sup>52</sup> Next, “primers” are used to hybridize each of the single strands.<sup>53</sup> “Primers are short DNA segments . . . designed to bind with the template at particular loci.”<sup>54</sup> “[E]ach primer serves as a starting point for the replication of the target sequence.”<sup>55</sup> In the final step, a polymerase solution, which contains the four bases, “facilitates repeated additions of bases to the primer.”<sup>56</sup> In this

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a technician to reproduce and verify test results by creating a larger sample for testing.” *People v. Shreck*, 22 P.3d 68, 71 (Colo. 2001).

45. BUTLER, DNA TYPING, *supra* note 11, at 9. “The PCR technique was first developed at the Cetus Corporation in 1985.” Jennifer N. Mellon, *Manufacturing Convictions: Why Defendants Are Entitled to the Data Underlying Forensic DNA Kits*, 51 DUKE L.J. 1097, 1107 n.57 (2001). Dr. Kary Mullis, the scientist who developed the technique, received a Nobel Prize for his work. *Id.*

46. Donald E. Riley, *DNA Testing: An Introduction for Non-Scientists*, SCI. TESTIMONY (2005), at <http://www.scientific.org/tutorials/articles/riley/riley.html>.

47. *Id.*

48. *Traylor*, 656 N.W.2d at 888.

49. *United States v. Trala*, 162 F. Supp. 2d 336, 341 (D. Del. 2001); *Smith & Gordon*, *supra* note 16, at 2471. The term “amplification” refers to “[a]n increase in the number of copies of a specific DNA fragment.” STR Glossary, *supra* note 21.

50. *Trala*, 162 F. Supp. 2d at 341.

51. *Id.*; *see also* Mellon, *supra* note 45, at 1107–08 (discussing denaturation in the PCR process).

52. *Trala*, 162 F. Supp. 2d at 341.

53. *Id.* Hybridization refers to “[t]he process of joining two complimentary strands of DNA.” Medical Dictionary Search Engine, at <http://www.books.md/H/dic/hybridization.php> (last visited May 17, 2005).

54. *Trala*, 162 F. Supp. 2d at 341.

55. *Id.*

56. *Id.*

step, the bases in the polymerase solution bond with the exposed bases on the denatured strands “in accordance with the G-C, A-T pairing rule.”<sup>57</sup> This results in the creation of two DNA segments identical to the single original.<sup>58</sup> Forensic scientists repeat this process multiple times, creating numerous duplicates—or amplifications—of the targeted area of the original DNA sample.<sup>59</sup> Once the targeted polymorphic loci of a known sample—typically taken from a suspect or defendant—are amplified, they are typed to determine whether they match an unknown sample—usually gathered from the victim’s person or the crime scene.<sup>60</sup>

As noted above, the PCR process is conducted to amplify a targeted polymorphic locus (or loci) for analysis.<sup>61</sup> One group of such loci is short tandem repeats (STRs).<sup>62</sup> STRs are copies of DNA sequences repeated along the DNA strand.<sup>63</sup> Each individual has a varying length of STR.<sup>64</sup> Thus, “examining a number of the STRs allows for identification.”<sup>65</sup> The number of STRs varies from person to person at thirteen locations, and these locations are widely used for DNA typing purposes.<sup>66</sup>

PCR amplification of STR markers is identical to the amplification of other types of polymorphic loci, with one difference. When STR fragments are subjected to the PCR process, the primers used during the hybridization stage “contain florescent tags, which become incorporated into the STR fragments during amplification.”<sup>67</sup> The florescent tags are critical to the ability of forensic scientists to type DNA samples at STR loci.

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57. *State v. Deloatch*, 804 A.2d 604, 608 (N.J. Super. Ct. Law. Div. 2002).

58. *Id.*

59. *Trala*, 162 F. Supp. 2d at 341; Mellon, *supra* note 45, at 1108.

60. *See Trala*, 162 F. Supp. 2d at 341–43 (discussing the processes of amplification and statistical methodology used in determining the likelihood of a match between a known and an unknown sample); *see also supra* text accompanying notes 35–39.

61. *Trala*, 162 F. Supp. 2d at 340–41. “If the [forensic] laboratory wants to type [a] DNA sample at multiple sites, it can add additional primers which will bind simultaneously to their respective target sites. This process is known as multiplexing.” *Id.* at 341. Multiplexing techniques “perform[] all manipulations of the DNA [sample] at once, [and thus] there is less risk of contamination than when the DNA is manipulated several times,” as with other methods. *State v. Traylor*, 656 N.W.2d 885, 889 (Minn. 2003). Profiler Plus and Cofiler, discussed below, are multiplexing kits. BUTLER, DNA TYPING, *supra* note 11, at 65.

62. *Trala*, 162 F. Supp. 2d at 342.

63. *Traylor*, 656 N.W.2d at 889.

64. *Id.*

65. *Id.*

66. *People v. Shreck*, 22 P.3d 68, 71 (Colo. 2001). These thirteen STR loci are the core markers used in the Combined DNA Index System (CODIS), “a national database containing DNA profiles of convicted felons.” *Trala*, 162 F. Supp. 2d at 342. “All of the samples in the CODIS data bank are typed at the same thirteen STR loci, thus enabling [forensic analysts] to compare unknown samples with samples in the data bank.” *Id.* at 342 n.5.

67. *Trala*, 162 F. Supp. 2d at 342.



Once the PCR amplification of the STR markers is complete, the resultant samples undergo electrophoresis.<sup>68</sup> During the electrophoresis stage of PCR-STR testing, the amplified STR fragments “pass through a gel and eventually pass through a detection window at the end of the gel.”<sup>69</sup> When the fragments reach the detection window, “a laser fires, striking the florescent tags” that are incorporated into the fragments during the hybridization stage of the PCR process.<sup>70</sup> This “caus[es] the tags to emit light,” which is detected by a camera that converts the light into data.<sup>71</sup> A computer software program then analyzes the data.<sup>72</sup> By reading the computer-generated analysis, forensic analysts can “measur[e] the amount of time that it takes a particular fragment to reach the laser.”<sup>73</sup> From this measurement, the analyst can “determine the size of the fragment and, therefore . . . the number of sequence repeats.”<sup>74</sup> Once the forensic analyst ascertains the number of sequence repeats, he or she can “determine the number of alleles present at the target[ed] loci” and thereafter type the sample against another.<sup>75</sup> The odds of a match to a person who is not an identical twin, where at least thirteen STR loci match, has been estimated as high as one in one hundred quadrillion.<sup>76</sup> For this reason, PCR-STR DNA analysis is heralded as among the most accurate methodologies available for forensic identification and is the predominate DNA typing technique in U.S. forensic laboratories.<sup>77</sup>

Today, forensic analysts regularly conduct PCR-STR testing with commercially manufactured kits.<sup>78</sup> The Profiler Plus and Cofiler kits, manufactured by Perkin Elmer Applied Biosystems, Inc. (Perkin Elmer),<sup>79</sup> are among the most popular and widely used in the forensic field.<sup>80</sup> Profiler Plus and Cofiler kits contain the materials required for the PCR

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68. State v. Deloatch, 804 A.2d 604, 609 (N.J. Super. Ct. Law Div. 2002).

69. *Trala*, 162 F. Supp. 2d at 342.

70. *Id.*

71. *Id.*

72. *Id.*

73. *Id.*

74. *Id.*

75. *Id.*

76. State v. Deloatch, 804 A.2d 604, 609 (N.J. Super. Ct. Law Div. 2002).

77. See BUTLER, DNA TYPING, *supra* note 11 at 23–24 (discussing the advantages of using PCR-STR technology and its accuracy); Saferstein, *supra* note 4 (“The most widely used technique for DNA typing combines PCR . . . with STR . . . analysis.”); *cf. Deloatch*, 804 A.2d at 609 (“This science enables the tester to identify 10 markers over as much as 16 loci with sensitivity levels as low as one nanogram of DNA.”).

78. State v. Traylor, 656 N.W.2d 885, 889 (Minn. 2003).

79. Perkin Elmer Applied Biosystems, Inc., formerly Perkin Elmer, was founded in 1980. For more information, including a biographic description of the company, see [http://www.informagen.com/Resource\\_Informagen/Full/3/2773.php](http://www.informagen.com/Resource_Informagen/Full/3/2773.php) (last visited May 17, 2005).

80. See *supra* note 5 and accompanying text.

amplification process to occur: primers, a reaction mix, and a polymerase.<sup>81</sup> They “also contain the fluorescent tags that allow the amplified DNA fragments to be detected during the electrophoresis phase” of PCR-STR analysis.<sup>82</sup> Profiler Plus and Cofiler do not represent a new process for DNA typing—they simply contain the materials required for conducting PCR-STR testing.<sup>83</sup>

Now that a foundation of DNA analysis by use of PCR-STR technology is in place, a discussion of the admissibility of Profiler Plus evidence in Vermont courts after *Pfenning* can be undertaken. An examination of this issue necessarily begins with an explanation of what the standard for the admission of such evidence was in Vermont at the time of *Pfenning*.

## II. STANDARD OF ADMISSIBILITY APPLIED TO DNA EVIDENCE BY THE PFENNING COURT

The Vermont Supreme Court enunciated the standard of admissibility applicable to DNA evidence in *State v. Streich*.<sup>84</sup> The *Pfenning* court applied this standard when it addressed the question of the admissibility of DNA evidence derived from Profiler Plus and other tests utilizing PCR technology.<sup>85</sup>

In *Streich*, the defendant was convicted of sexual assault.<sup>86</sup> The trial court admitted RFLP DNA evidence offered by the prosecution to establish that the defendant was at the crime scene.<sup>87</sup> On appeal *Streich* argued, among other things, that the admissibility of scientific evidence in Vermont—including DNA profiling evidence—was governed by the test set forth by the D.C. Circuit Court in *Frye v. United States*.<sup>88</sup> The Court

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81. *United States v. Trala*, 162 F. Supp. 2d 336, 343 (D. Del. 2001). Recall that “primers” are small fragments of DNA designed to bind with particular loci on a denatured DNA strand. *Id.*; see also *supra* notes 53–55 and accompanying text. “The reaction mix is a mix of chemicals used in any form of PCR testing that, in essence, creates the proper chemical environment for the PCR process to occur.” *Trala*, 162 F. Supp. 2d at 343. “The polymerase is a class of enzymes that enable bases to be added to the primer” and, thus, for multiple duplicates of the targeted DNA to be replicated. *Id.*

82. *Id.* Where Profiler Plus and Cofiler are utilized, the 310 Genetic Analyzer, also manufactured by Perkin Elmer, generates data at the electrophoresis stage of the PCR-STR process. *State v. Pfenning*, No. 57-4-96, slip op. at 47–48 (Vt. Dist. Ct. Apr. 6, 2000).

83. *People v. Shreck*, 22 P.3d 68, 82 (Colo. 2001); *State v. Whitley*, 821 A.2d 1086, 1096 (N.H. 2003).

84. *State v. Streich*, 163 Vt. 331, 342–44, 658 A.2d 38, 46–48 (1995).

85. See *infra* notes 117–25 and accompanying text.

86. *Streich*, 163 Vt. at 334, 658 A.2d at 42.

87. *Id.* at 335, 658 A.2d at 42.

88. *Id.* at 342, 658 A.2d at 46. In *Frye v. United States*, the court held that scientific evidence could be admitted only if it was generally accepted within the relevant scientific community. 293 F. 1013, 1014 (D.C. Cir. 1923).

rejected the defendant's argument, holding that Vermont Rule of Evidence 702 governed the issue and that *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, a more recent U.S. Supreme Court decision, directed the inquiry.<sup>89</sup>

Vermont Rule of Evidence 702 is identical to the federal rule.<sup>90</sup> Scientific evidence is admitted if it "will assist the trier of fact to understand the evidence or to determine a fact in issue."<sup>91</sup> Under this standard, the admissibility of scientific or technical evidence hinges on a finding that the evidence in question is both reliable and relevant.<sup>92</sup> These "principles are derived from two components of Rule 702, the requirement of 'scientific knowledge' and the requirement that the evidence assist the trier of fact."<sup>93</sup>

Scientific or technical evidence is *reliable*, according to the Rule, if it is supported by "scientific knowledge."<sup>94</sup> Scientific knowledge refers to "information that is more than a subjective belief or unsupported speculation, and that is grounded in the methods and procedures of science."<sup>95</sup> To determine whether evidence that implicates Rule 702 is "sufficiently rooted 'in scientific knowledge'" to satisfy the requirement of reliability, the *Streich* Court directed Vermont trial courts to take into consideration the four factors set forth in *Daubert*.<sup>96</sup> These factors include:

- (1) whether the theory or technique involved is capable of being tested;
- (2) whether the theory or technique has been subjected to peer review and publication;
- (3) the known or potential rate of error associated with the scientific technique; and
- (4) whether the theory or technique has been generally accepted in the scientific community.<sup>97</sup>

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89. *Streich*, 163 Vt. at 342, 658 A.2d at 46. In *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, the U.S. Supreme Court held that Federal Rule of Evidence 702 superceded the *Frye* test, replacing it with a flexible standard governed by the principles of reliability and relevance. 509 U.S. 579, 587 (1993). The Vermont Supreme Court's determination that Vermont Rule of Evidence 702 and *Daubert*, rather than *Frye*, govern the admissibility of DNA evidence was consistent with its previous holdings regarding the standard of admissibility for scientific and technical evidence. See *State v. Brooks*, 162 Vt. 26, 30, 643 A.2d 226, 229 (1993) (establishing that Vermont Rule of Evidence 702 and the principles set forth by the U.S. Supreme Court in *Daubert* govern issues of evidentiary admissibility); *State v. Percy*, 156 Vt. 468, 475, 595 A.2d 248, 252 (1990) (elaborating on the requirements of Vermont Rule of Evidence 702).

90. Compare VT. R. EVID. 702, with FED. R. EVID. 702.

91. VT. R. EVID. 702.

92. *Streich*, 163 Vt. at 342, 658 A.2d at 46.

93. *Id.* at 342-43, 658 A.2d at 46-47.

94. *Id.* at 343, 658 A.2d at 47.

95. *Id.*

96. *Id.*

97. *Id.* (citing *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 593-95 (1993)). This list of factors is nonexclusive. *Id.* Courts often take into consideration other factors, such as the acceptance of the technique or theory in question by other courts. The *Pfenning* court felt that this was an important factor to consider in determining the reliability of PCR-STR DNA testing technologies.

If upon considering the aforementioned factors, a court determines that the evidence in question is sufficiently reliable, it must then determine whether the evidence is *relevant*, “such that it will ‘assist the trier of fact to understand the evidence or to determine a fact in issue.’”<sup>98</sup> In cases where DNA evidence is being used either to inculcate or exculpate a defendant, the relevancy of the evidence will rarely be at issue. This follows from the reality that in such cases “the identity of the perpetrator is a key factual issue, [and] the fact that DNA found on the victim [or at the crime scene either] matches [or does not match] that from [the] defendant is probative and helpful to the trier of fact.”<sup>99</sup> Accordingly, as indicated by the *Streich* Court, an analysis of the admissibility of DNA evidence under Rule 702 will generally focus on the reliability of the DNA analysis method in question.<sup>100</sup>

The above represents the standard of admissibility that was applicable to scientific and technical evidence at the time of the *Pfenning* decision.<sup>101</sup> The *Pfenning* court strictly applied the *Streich* reliability standard and found Profiler Plus evidence inadmissible.<sup>102</sup> This decision is discussed below.

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State v. Pfenning, No. 57-4-96, slip op. at 50 (Vt. Dist. Ct. Apr. 6, 2000).

98. *Streich*, 163 Vt. at 343, 658 A.2d at 47 (quoting *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 580 (1993)); see also VT. R. EVID. 401 (“‘Relevant evidence’ means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence.”).

99. *Streich*, 163 Vt. at 343, 658 A.2d at 47.

100. See *id.* (noting that because it was clear that the disputed DNA evidence was relevant, the Court’s analysis needed only to focus on the reliability of RFLP profiling). The court in *Pfenning* noted that the “relevancy component” of the admissibility was not at issue in that case. *Pfenning*, No. 57-4-96, slip op. at 3.

101. Since *Streich* and *Pfenning*, the Vermont Supreme Court modified the standard of admissibility applicable to scientific and technical evidence after the U.S. Supreme Court’s decision in *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999). In *State v. Kinney*, the Court determined that although scientific evidence must be shown to be reliable and relevant—according to the same type of analysis utilized in *Streich*—a party advocating its admission is neither required nor obligated to present evidence that it meets each and every one of the *Daubert* factors. 171 Vt. 239, 248–50, 762 A.2d 833, 841–42 (2000). As parties are not required to show that each factor has been satisfied, Vermont courts also are not required to make findings on each of those factors. *Id.* at 250, 762 A.2d at 842. *Kinney* permits Vermont courts to find that evidence satisfies the reliability requirement (1) because its reliability equals that of other scientific or technical evidence they have admitted before or (2) because “the evaluation of other courts allowing admission of the evidence is complete and persuasive.” *Id.*

102. See *infra* notes 117–25 and accompanying text.

III. *STATE V. PFENNING*: THE CURRENT STATE OF THE LAW IN VERMONT  
CONCERNING THE ADMISSIBILITY OF EVIDENCE DERIVED FROM PROFILER  
PLUS

In 2000, a Vermont court in *State v. Pfenning* addressed the issue of the admissibility of DNA evidence derived from PCR technologies.<sup>103</sup> The issue was a matter of first impression in Vermont.<sup>104</sup> Profiler Plus was among the methods of analysis under scrutiny in this case.<sup>105</sup> On the basis of the standard for the admission of DNA evidence as enunciated in *State v. Streich*, the court found Profiler Plus unreliable and its evidence inadmissible.<sup>106</sup>

In *Pfenning*, the defendant was charged with murder.<sup>107</sup> During the autopsy of the victim's body, the forensic investigator discovered human hairs that did not match that of the victim.<sup>108</sup> Cellmark Laboratories<sup>109</sup> and Genelex Laboratories<sup>110</sup> conducted DNA analysis on the hair using the Profiler Plus, PowerPlex, Polymarker/DQAlpha, and STR CTT tests—all PCR technologies.<sup>111</sup> Each laboratory came to the conclusion that DNA extracted from the hair found on the victim matched that of the defendant, Michael Pfenning.<sup>112</sup> Before trial, Pfenning filed a motion in limine seeking to have the results of the DNA analysis excluded on the grounds that (1) the laboratories' DNA analysis methods did not meet the "minimum

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103. *Pfenning*, No. 57-4-96, slip op. at 3.

104. *Id.* at 2.

105. *Id.* at 47. The *Pfenning* court also analyzed three other DNA analysis techniques that utilize the PCR amplification process: Polymarker/DQAlpha, STR CTT, and PowerPlex. *See id.* at 25–47, 51–54 (applying the *Streich* standard to the results of these techniques and holding that they would be admissible, but Profiler Plus would not).

106. *Id.* at 49–51, 68.

107. *Id.* at 1.

108. *Id.*

109. *See id.* at 14–15.

Cellmark is a privately-owned laboratory engaged primarily in forensic testing, as well as some research-related contractual work. Cellmark is hired by investigators, prosecutors, defense attorneys, and crime laboratories. It has been in existence since 1987, and is, [sic] accredited by the American Society of Crime Laboratory Directors Laboratory Accreditation[] Board (ASCLD LAB).

*Id.*

110. *See id.* at 16.

Genelex Corporation conducts paternity testing, forensic testing, and convicted felon data bank testing for the State of Indiana. It is hired by prosecution and police agencies, defense lawyers and defense agencies, and citizens who need paternity or forensic testing done. It has been in existence since 1987, and is accredited by the . . . (ASCLD LAB).

*Id.*

111. *Id.* at 1, 19, 68.

112. *Id.* at 1.

standards” of *Daubert* and *Streich*; (2) the test results were unreliable due to the “[d]eficient laboratory methodology”; and (3) the probative value of admitting the evidence was outweighed by its “prejudicial effect.”<sup>113</sup>

Before the court determined whether it should exclude the evidence on the grounds advocated by the defendant, it considered the question whether it should apply the standard of admissibility to the technologies that comprise the Profiler Plus system—namely PCR amplification and STR testing—or to the system as a whole.<sup>114</sup> The court determined that the standard was applicable to Profiler Plus as a whole, rather than to the individual technologies integrated in the kit.<sup>115</sup> The court reasoned:

[T]he basic technologies incorporated in Profiler Plus have been utilized as independent entities for longer periods of time, and are generally recognized as valid scientific techniques.

. . . the Profiler Plus system is greater than the sum of its parts [and] . . . it is [therefore] necessary that the entire system, as a package, be examined and validated.<sup>116</sup>

Upon applying the *Streich* standard to Profiler Plus as a whole, the court held that the system failed admissibility in three regards.<sup>117</sup> First, the court determined that “the failure of [Perkin Elmer] to disclose [Profiler Plus’s] primer sequences . . . [was] problematic from the perspective of scientific knowledge and, consequently, validation.”<sup>118</sup> In the court’s opinion, the system could not be adequately tested and scrutinized by other scientists without access to the primer sequences.<sup>119</sup> Thus, the court held that “[i]n view of the mandate of *Streich*—particularly the first and second factors”—capability of being tested and subsection to peer review—Profiler Plus failed to satisfy the standard of admissibility.<sup>120</sup> Second, the court found that Profiler Plus was not sufficiently subjected to scrutiny of the scientific community because there were no “articles in peer-reviewed

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113. *Id.* at 1–2.

114. *Id.* at 47, 49.

115. *Id.* at 49.

116. *Id.* Many courts have rejected the reasoning of *Pfenning* on the issue of whether admissibility standards should be applied to PCR-STR testing kits themselves or to the technologies they utilize. *See, e.g.*, *People v. Shreck*, 22 P.3d 68, 82 (Colo. 2001) (holding that the reliability inquiry is applicable to PCR and STR DNA testing methodologies generally, rather than to the Profiler Plus and Cofiler kits themselves, since they simply contain the materials required for conducting PCR-STR multiplexing).

117. *Pfenning*, No. 57-4-96, slip op. at 49–51.

118. *Id.* at 49.

119. *Id.*

120. *Id.*

journals” or published validation studies focusing on the kit.<sup>121</sup> According to the court, “[w]ithout the scrutiny of the scientific community, [it could] not establish whether Profiler Plus [was] a reliable system, or one . . . prone to error.”<sup>122</sup> Consequently, the court held that Profiler Plus failed to satisfy the second and third factors mandated by *Streich*—peer review and known or potential rate of error.<sup>123</sup> Finally, the court found that “legal research . . . disclosed [no] appellate court in the country—or even a trial court—which has held that Profiler Plus is valid and reliable.”<sup>124</sup> Ultimately, the *Pfenning* court concluded that Profiler Plus was not legally reliable under the *Streich* standard and that the evidence it produced was inadmissible.<sup>125</sup>

*Pfenning* stands as the first and last decision in Vermont ruling on the admissibility of evidence derived from PCR-STR DNA technologies. Hence, *Pfenning* represents the current state of the law in Vermont on the issue. The rationale of the *Pfenning* court may have been appropriate at the time it was decided, given the court’s findings. Nevertheless, recent scientific and legal developments render the *Pfenning* court’s rationale inapplicable to current cases questioning the reliability of Profiler Plus.

#### IV. THE CONCERNS OF THE PFENNING COURT HAVE BEEN ADDRESSED BY RECENT DEVELOPMENTS IN THE SCIENTIFIC AND LEGAL COMMUNITIES

*Pfenning* stands as the only court decision in the country finding evidence derived from the Profiler Plus PCR-STR kit inadmissible on the grounds elaborated in Part III.<sup>126</sup> Since *Pfenning*, both the legal and scientific communities have embraced Profiler Plus and Cofiler as valid and reliable DNA testing techniques.<sup>127</sup> The following sections elaborate on how these developments have addressed the *Pfenning* court’s three concerns regarding the reliability of Profiler Plus—namely the unwillingness of kit manufacturers like Perkin Elmer to disclose primer sequences, the scrutinizing of Profiler Plus through articles in peer-

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121. *Id.* at 49–50.

122. *Id.* at 50.

123. *Id.*

124. *Id.*

125. *Id.* at 50–51.

126. Although California’s Superior Court found evidence derived from STR DNA profiling inadmissible in *People v. Bokin*, it made its determination on grounds different from the court in *Pfenning* and, in any event, was not ruling on evidence derived from either Profiler Plus or Cofiler. *People v. Bokin*, No. 168461, slip op. at 7, 9, 16 (Cal. Super. Ct. May 6, 1999). Further, while it is true that a Colorado trial court found evidence derived from Profiler Plus inadmissible in *People v. Shreck*, the Supreme Court of Colorado reversed the decision of that case and the evidence was ultimately found admissible. *People v. Shreck*, 22 P.3d 68, 82 (Colo. 2001).

127. *See infra* Parts IV.A–C.

reviewed journals and published validation studies, and the acceptance of Profiler Plus by state and appellate courts.

*A. Disclosure of Primer Sequences*

The Profiler Plus system contains the components needed to perform PCR-STR analysis.<sup>128</sup> Among the necessary components are primers, or primer sequences.<sup>129</sup> Recall that primers are “small fragments of DNA designed to bind with particular loci when the two strands of the DNA sample are separated” during the PCR process.<sup>130</sup> The primers used in PCR-STR DNA testing “do not represent new methods of performing PCR,” they are “simply known sequences of DNA bases which have been identified as occurring in every human on the boundary of the locus to be tested” utilized in the process.<sup>131</sup> Recall also that the refusal of Perkin Elmer to disclose the primer sequences employed by Profiler Plus was one of the *Pfenning* court’s primary justifications for finding the results of the kit inadmissible.<sup>132</sup>

Manufacturers of commercial PCR-STR kits, like Perkin Elmer, view primer sequences as proprietary in nature and are therefore reluctant to release them.<sup>133</sup> In response to the reluctance and/or refusal of manufacturers to release primer sequences, defendants argue that PCR-STR DNA evidence generated by commercially manufactured kits should be inadmissible in court.<sup>134</sup> Defendants advance two types of arguments in

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128. *People v. McCraw*, No. B154790, 2003 WL 21061481, at \*6 (Cal. Ct. App. May 13, 2003).

129. *Id.*

130. *United States v. Trala*, 162 F. Supp. 2d 336, 343 (D. Del. 2001); *see also supra* notes 54–56 and accompanying text.

131. *Trala*, 162 F. Supp. 2d at 343.

132. *See supra* notes 118–20 and accompanying text.

133. *State v. Lynch*, No. CR 98-11390, slip op. at 4 (Ariz. Super. Ct. Aug. 20, 1999); *People v. McCord*, No. H024155, 2003 WL 22854283, at \*10 (Cal. Ct. App. Dec. 3, 2003); *State v. Traylor*, 656 N.W.2d 885, 899 (Minn. 2003); *State v. Dishmon*, Nos. 99047345, 99069306, 99079650, slip op. at 13 (Minn. Dist. Ct. Mar. 3, 2000).

Much of the reluctance manufacturers have toward a broad disclosure of primer sequences stems from the belief that they will suffer economically as a result. Mellon, *supra* note 45, at 1121. This belief is grounded in the notion that with such information, other corporations will have the ability to create identical testing systems and thereby use the manufacturer’s technology without buying the manufacturer’s kits. *Id.* Manufacturers also argue against broad revelation of primer sequences on the ground that the market may stand to lose the innovative technologies of private corporations in the process of developing kits if disclosure is forced. *Id.* The basis of this argument is that without some assurance of proprietary protection, there is little incentive for corporations to keep their products on the market. *Id.*

134. *See Traylor*, 656 N.W.2d at 898–99 (referencing the defendant’s argument that Perkin Elmer’s refusal to disclose the primer sequences utilized by Profiler Plus violated his due process rights and that therefore the results of the test should be suppressed); *State v. Pfenning*, No. 57-4-96, slip op. at 1–2, 49 (Vt. Dist. Ct. Apr. 6, 2000) (agreeing with the defendant that the failure of Perkin Elmer to



these situations. The first is grounded in reasoning that without access to primer sequences, other scientists cannot validate testing kits and therefore cannot satisfy the *Daubert*, *Frye*, or Rule 702 admissibility standards.<sup>135</sup> Based on a developed understanding of the role of primer sequences in DNA testing by the use of manufactured kits, courts now routinely reject this argument.<sup>136</sup> The second argument is founded on the Due Process Clause, which posits that a defendant's possibility of receiving a fair trial is diminished when information—especially regarding scientific technology used to inculcate a defendant—is withheld.<sup>137</sup> In response, courts take an approach that validates both a defendant's constitutional rights and a manufacturer's proprietary interests in primer sequences, in what may be referred to as the "protective order approach."<sup>138</sup>

At the time of the *Pfenning* decision, Profiler Plus had only recently been released for use in forensic DNA testing.<sup>139</sup> Then, the legal community had little information on the role of primer sequences in the process of forensic PCR-STR DNA testing. Defense attorneys and courts seemed to assume that access to primer sequences was necessary in order for testing kits to be validated within the scientific community. Courts are now more informed about the function of primer sequences, and they consistently hold that the refusal of manufacturers to release primer sequences is no bar to the admissibility of DNA evidence.<sup>140</sup>

*People v. McCord*, a California Court of Appeals decision, is illustrative of how courts presently handle arguments against the admissibility of DNA evidence when testing kit manufacturers refuse to release primer sequences.<sup>141</sup> In *McCord*, the defendant was convicted of forcible rape.<sup>142</sup> On appeal, the defendant argued that the Profiler Plus DNA evidence used to prosecute him was inadmissible because "Perkin Elmer had not identified the primer sequences used in the testing

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disclose Profiler Plus's primer sequences had the effect of rendering evidence from that test inadmissible).

135. This was among the arguments advanced by the defendant in *Pfenning* against the admissibility of Profiler Plus evidence. *Pfenning*, No. 57-4-96, slip op. at 1-2, 49.

136. See, e.g., *McCord*, 2003 WL 22854283, at \*10 (rejecting the defendant's argument that knowledge of primer sequences is indispensable to the determination of Profiler Plus's reliability).

137. See *Traylor*, 656 N.W.2d at 899-900 (referencing the defendant's arguments that Perkin Elmer's refusal to disclose primer sequences impinged on his due process right to a fair trial).

138. See *id.* at 899 (addressing Perkin Elmer's disclosure of Profiler Plus's primer sequences to the defendant under a protective order).

139. See STEADMAN, *supra* note 3, at 7 (noting that by the beginning of 2001, Profiler Plus was one of the most commonly used DNA test kits).

140. E.g., *Traylor*, 656 N.W.2d at 899; *State v. Lynch*, No. CR 98-11390, slip op. at 6 (Ariz. Super. Ct. Aug. 17, 1999); *People v. Cavin*, No. 00-4395-FY, slip op. at 2, 16 (Mich. Cir. Ct. Oct. 18, 2000).

141. *McCord*, 2003 WL 22854283, at \*10.

142. *Id.* at \*1.

process.”<sup>143</sup> According to the defendant, without a disclosure of Profiler Plus’s primer sequences, the test could not be validated and therefore could not be considered accepted in the scientific community.<sup>144</sup> The court rejected the defendant’s argument and held that the refusal of Perkin Elmer to make a broad disclosure of its primer sequences was no bar to the admissibility of Profiler Plus.<sup>145</sup> The court grounded its holding on expert testimony.<sup>146</sup> This testimony indicated a general approval in the scientific community of the notion that forensic scientists do “not need to know the exact primer sequences in order to be confident of [Profiler Plus] test results” because they “know the general area the Profiler Plus primers attach to on the DNA molecule during the amplification process,” and therefore can test the validity of the kit on their own.<sup>147</sup> The approach of this court is typical of those taken by other courts faced with arguments against the admissibility of DNA evidence based on manufacturer refusal to make general disclosures of primer sequences.

Some defendants, perhaps aware of the current view that availability of primer sequences has no bearing on the reliability of testing kits, choose to take a different approach to attacking the admissibility of PCR-STR DNA evidence. These defendants often opt to attack the admissibility of DNA evidence on due process grounds. They maintain that their right to a fair trial, guaranteed by the Due Process Clause, is negatively impacted where manufacturers decline to reveal primer sequences.<sup>148</sup> In such cases, courts vindicate the defendant’s due process rights by requiring corporations to make a disclosure of primer sequences, while at the same time protecting the manufacturer’s proprietary interests by limiting the required disclosure to the defendant and his/her experts under a protective order.<sup>149</sup>

*State v. Traylor*, a Supreme Court of Minnesota decision, exemplifies this protective order approach.<sup>150</sup> In *Traylor*, the defendant was convicted of second-degree assault.<sup>151</sup> On appeal, the defendant argued that DNA evidence was erroneously admitted at trial, as Perkin Elmer’s refusal to disclose Profiler Plus’s primer sequences violated his due process right to a

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143. *Id.* at \*10. Perkin Elmer based its refusal on the proprietary nature of the primer sequences.  
*Id.*

144. *Id.* at \*1, \*10.

145. *Id.* at \*10, \*16.

146. *Id.* at \*16.

147. *Id.* at \*10.

148. *E.g.*, *State v. Traylor*, 656 N.W.2d 885, 898–99 (Minn. 2003).

149. *Cf. Mellon*, *supra* note 45, at 1129–37 (arguing that all courts should require disclosure to protect defendants’ due process rights).

150. *Traylor*, 656 N.W.2d at 885.

151. *Id.* at 887.

fair trial.<sup>152</sup> Although the Court agreed that a defendant's due process rights may be negatively impacted where the defense does not have the same amount of information on a scientific test as the prosecution, it rejected the defendant's argument that only a general disclosure would sufficiently protect a defendant's rights.<sup>153</sup> Rather, the Court found that it could sufficiently protect a defendant's due process right to a fair trial by requiring disclosure of primer sequences under a protective order so that the defendant and his/her experts could evaluate them in the same fashion as the prosecution.<sup>154</sup> In this way, the Court vindicated the defendant's constitutional right to a fair trial and validated Perkin Elmer's proprietary interest in Profiler Plus's primer sequences. Other courts faced with similar situations take this approach.<sup>155</sup>

Manufacturers respond well to the protective order approach and routinely comply with court orders requiring disclosures of primer sequences to defense attorneys and experts. Perkin Elmer is among the manufacturing corporations in the industry that has been willing to disclose primer sequences under protective orders.<sup>156</sup> Since *Pfenning*, Perkin Elmer has done so in a number of cases.<sup>157</sup>

The refusal of manufacturers to disclose primer sequences is no longer considered a convincing ground for challenging the reliability of PCR-STR kits like Profiler Plus. Further, Perkin Elmer is willing to make disclosures under protective orders. Thus, questions pertaining to the disclosure of Profiler Plus's primer sequences should no longer be a source of concern for Vermont courts.<sup>158</sup> Like the issue of primer sequence disclosure, the matter of scrutinizing Profiler Plus through peer review and validation is not a persuasive ground for arguing against the admissibility of Profiler Plus evidence.

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152. *Id.* at 890, 898–99.

153. *Id.* at 899–900.

154. *Id.*

155. *See, e.g.*, *People v. Frediani*, No. D037695, 2003 WL 190767, at \*7 (Cal. Ct. App. Jan. 29, 2003) (addressing Perkin Elmer's disclosure of Profiler Plus's primer sequences to the defendant under a confidentiality agreement).

156. *E.g.*, *People v. McCord*, No. H024155, 2003 WL 22854283, at \*10 (Cal. Ct. App. Dec. 3, 2003).

157. *See, e.g.*, *Traylor*, 656 N.W.2d at 898–99 (referring to Perkin Elmer's offer to disclose Profiler Plus's primer sequences under a protective order); *cf. Frediani*, 2003 WL 190767, at \*7 (noting that Perkin Elmer disclosed the primer sequences for Profiler Plus under an agreement of confidentiality for the purposes of the litigation).

158. Another reason why many courts find PCR-STR evidence admissible, even where manufacturers refuse to disclose primer sequences, is because they have determined that the DNA Advisory Board (DAB) guidelines have replaced earlier guidelines implemented by the Technical Working Group on DNA Analysis Methods (TWGDAM). *E.g.*, *Traylor*, 656 N.W.2d at 894–97. Unlike the TWGDAM guidelines, the DAB guidelines do not mandate disclosure of primer sequences. *See id.* for a thorough analysis of this issue.

*B. Published and Peer-Reviewed Validation Studies*

Recall that the *Pfenning* court's second reason for finding the results of the Profiler Plus system inadmissible was that it had not been sufficiently subjected to scrutiny through articles in peer-reviewed journals and that there had been no published validation studies of the kit.<sup>159</sup> Since *Pfenning*, a voluminous number of validation studies have been published in peer-reviewed journals addressing this issue.<sup>160</sup> Courts throughout the country have found that this influx of validation studies in such journals renders concerns about peer review "moot."<sup>161</sup>

*People v. Smith*, a California Court of Appeals decision, is illustrative of this view.<sup>162</sup> In *Smith*, the defendant, convicted of forcible rape, argued on appeal that the trial court improperly admitted DNA evidence generated by Profiler Plus and its companion kit Cofiler.<sup>163</sup> Among the bases of the defendant's argument was that Profiler Plus and Cofiler had not been sufficiently subjected to peer review and published validation studies and therefore could not be considered as generally accepted in the scientific community.<sup>164</sup> The appeals court rejected the defendant's arguments, holding that the trial judge did not err in relying on the literature submitted by the State to find that the kits had been sufficiently subjected to peer review and published validation studies.<sup>165</sup> The literature relied upon by the trial court included numerous validation studies published in *The Journal of Forensic Sciences*, a peer-reviewed journal, and three validation studies published by Perkin Elmer.<sup>166</sup> Each and every one of the validation studies

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159. See *supra* notes 121–22 and accompanying text.

160. See generally Short Tandem Repeat DNA Internet DataBase, Reference Listing Regarding STRs and DNA Typing [hereinafter STR Reference Listing] (listing a multitude of peer-reviewed journal articles and validation studies centered on Profiler Plus and its companion Cofiler), at [http://www.cstl.nist.gov/biotech/strbase/str\\_ref.htm](http://www.cstl.nist.gov/biotech/strbase/str_ref.htm) (last visited May 17, 2005).

161. *McCord*, 2003 WL 22854283, at \*15; see also *United States v. Trala*, 162 F. Supp. 2d 336, 347 (D. Del. 2001) (noting that Profiler Plus and Cofiler have been "subjected to sufficiently vigorous peer review"); *Traylor*, 656 N.W.2d at 892–93 (finding that validation studies published in peer-reviewed journal articles have extensively scrutinized Profiler Plus and its companion Cofiler); *State v. Deloatch*, 804 A.2d 604, 611–13 (N.J. Super. Ct. Law Div. 2002) (upholding the lower court's finding that the 1500 articles submitted by the state were sufficient to establish that Profiler Plus had been peer reviewed and validated).

162. See *People v. Smith*, 132 Cal. Rptr. 2d 230, 246–50 (Cal. Ct. App. 2003) (listing numerous validation studies in peer-reviewed journals and finding that they establish that Profiler Plus has been sufficiently subjected to peer review and validation).

163. *Id.* at 231–32.

164. *Id.*

165. *Id.* at 231, 249–50.

166. *Id.* at 246–50. The literature submitted by the State and relied upon by the judge included the following: Bruce Budowle & Cynthia J. Sprecher, *Concordance Study on Population Database Samples Using the PowerPlex™ 16 Kit and AmpFLSTR® Profiler Plus™ Kit and AmpFLSTR® Cofiler Kit*, 46 J. FORENSIC SCI. 637, 641 (2001) (determining that "the primers used in the . . . Profiler Plus™",

concluded that Profiler Plus and Cofiler produce valid and reliable results.<sup>167</sup> In the course of validating the kits, scientists discovered that the kits have the capacity to produce reliable results even where they are used to test samples that come from more than one contributor and samples that have been “exposed to extreme conditions.”<sup>168</sup> Based on the ability of the State to direct the trial court’s attention to the multitude of published validation studies finding Profiler Plus and its companion Cofiler reliable, the appeals court determined that the trial court correctly concluded that the kits had been sufficiently subjected to peer review and validation. Thus, the court found the kits reliable, and the evidence they produced admissible.<sup>169</sup>

*Smith*, and cases like it, demonstrate that Profiler Plus has been more than adequately subjected to scrutiny through peer-reviewed journal articles and published validation studies.<sup>170</sup> Consequently, peer review and validation should no longer be issues jeopardizing the admissibility of

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and COfiler™ kits are reliable for typing reference samples destined for use in CODIS”); Tamyra R. Moretti et al., *Validation of Short Tandem Repeats (STRs) for Forensic Usage: Performance Testing of Fluorescent Multiplex STR Systems and Analysis of Authentic and Simulated Forensic Samples*, 46 J. FORENSIC SCI. 647, 659 (reporting that Profiler and Cofiler could “be used to amplify and type STR loci successfully from DNA derived from human biological specimens”); Tamyra R. Moretti et al., *Validation of STR Typing by Capillary Electrophoresis*, 46 J. FORENSIC SCI. 661, 671 (finding the “310 Genetic Analyzer for the electrophoresis and detection of DNA samples amplified using the . . . Profiler Plus and Cofiler PCR Amplification Kits” reliable); Bruce Budowle, *STR Allele Concordance Between Different Primer Sets—A Brief Summary*, PROFILES IN DNA (Progema Corp., Madison, Wis.), Feb. 2000, at 10–11 (concluding that Profiler Plus and Cofiler kits produced by commercial manufacturers, such as Perkin Elmer, can produce reliable results when proper protocols are followed), at [http://www.promega.com/profiles/303/ProfilesinDNA\\_303\\_10.pdf](http://www.promega.com/profiles/303/ProfilesinDNA_303_10.pdf). Each of Perkin Elmer’s validation studies concluded that Profiler Plus and Cofiler “provide robust, reliable results.” *Smith*, 132 Cal. Rptr. 2d at 249.

167. *Smith*, 132 Cal. Rptr. 2d at 249.

168. *Id.* (quoting Marcia J. LaFountain et al., *TWGDAM Validation of the AmpFtSTR Profiler Plus and AmpFtSTR Cofiler STR Multiplex Systems Using Capillary Electrophoresis*, 46 J. FORENSIC SCI. 1191, 1197 (2001)).

169. *Id.* at 246–50.

170. Proponents of evidence derived from Profiler Plus can do more than direct a court’s attention to cases like *Smith*, where the amount of peer review and published validation studies was found more than sufficient to establish the reliability of the kit. They can also direct a court’s attention to a voluminous number of articles published in *The Journal of Forensic Sciences* concerning the validation of the kit. E.g., Edward L. Buse et al., *Performance Evaluation of Two Multiplexes Used in Fluorescent Short Tandem Repeat DNA Analysis*, 48 J. FORENSIC SCI. 348 (2003); William E. Frank et al., *Validation of the AmpFtSTR™ Profiler Plus PCR Amplification Kit for Use in Forensic Casework*, 46 J. FORENSIC SCI. 642 (2001); Cydne L. Holt et al., *TWGDAM Validation of AmpFtSTR™ PCR Amplification Kits for Forensic DNA Casework*, 47 J. FORENSIC SCI. 66 (2002); Marcia J. LaFountain et al., *TWGDAM Validation of the AmpFtSTR Profiler Plus and AmpFtSTR Cofiler STR Multiplex Systems Using Capillary Electrophoresis*, 46 J. FORENSIC SCI. 1191 (2001). Further, proponents can direct courts to the database maintained by the National Institute of Standards and Technology (NIST). The NIST database contains one of the most comprehensive collections of works concerning the validation of Profiler Plus and Cofiler available. See STR Reference Listing, *supra* note 160 (listing 2272 references as of January 24, 2005).

evidence derived from Profiler Plus in Vermont courts. Since *Pfenning*, not only has Profiler Plus been subjected to peer review and validation, but also it has been held valid and reliable by courts throughout the country.

### C. Findings of Validity and Reliability in the Courts of Other States

In recent years, use of PCR-STR DNA evidence—especially evidence derived from Profiler Plus and its companion kit Cofiler—has increased exponentially.<sup>171</sup> Thus, numerous trial and appellate courts have ruled that such evidence is admissible.<sup>172</sup> Whether these decisions originate from a *Frye*, *Daubert*, or Rule 702 jurisdiction, they consistently find Profiler Plus a reliable system and the evidence it produces admissible. A plethora of cases could be cited to illustrate this point. While this is true, only three decisions from the supreme courts of Minnesota, New York, and New Hampshire are discussed below. These decisions are the focus of this section because the defendants in these cases raised the same arguments against the admissibility of Profiler Plus as did the defendant in *Pfenning*.

#### 1. *State v. Traylor*

In 2003, the Supreme Court of Minnesota held Profiler Plus and Cofiler evidence admissible, rejecting the defendant's assertion that Perkin Elmer's failure to disclose primer sequences made it impossible for the scientific community to validate the kits.<sup>173</sup> In this case, the defendant was convicted of second-degree assault for stabbing a woman, along with other crimes.<sup>174</sup> The Minnesota Bureau of Criminal Apprehension collected the knife used in the stabbing at the scene.<sup>175</sup> It then used Profiler Plus and

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171. *See supra* notes 3–5 and accompanying text.

172. *E.g.*, *United States v. Ewell*, 252 F. Supp. 2d 104, 112 (D. N.J. 2003) (citing *United States v. Trala*, 162 F. Supp. 2d 336, 347 (D. Del. 2001)); *People v. McCord*, No. H024155, 2003 WL 22854283, at \*16–20 (Cal. Ct. App. Dec. 3, 2003); *People v. McCraw*, No. B154790, 2003 WL 21061481, at \*18–19 (Cal. Ct. App. May 13, 2003); *People v. Smith*, 132 Cal. Rptr. 2d 230, 231 (Cal. Ct. App. 2003); *People v. Allen*, 85 Cal. Rptr. 2d 655, 659–60 (Cal. Ct. App. 1999); *People v. Shreck*, 22 P.3d 68, 82–83 (Colo. 2001); *Lemour v. State*, 802 So. 2d 402, 408 (Fla. Dist. Ct. App. 2001); *People v. Rokita*, 736 N.E.2d 205, 212 (Ill. App. Ct. 2000); *Overstreet v. State*, 783 N.E.2d 1140, 1151 (Ind. 2003); *Commonwealth v. Rosier*, 685 N.E.2d 739, 743 (Mass. 1997); *State v. Traylor*, 656 N.W.2d 885, 900 (Minn. 2003); *State v. Faulkner*, 103 S.W.3d 346, 358–59 (Mo. Ct. App. 2003); *State v. Salmon*, 89 S.W.3d 540, 545 (Mo. Ct. App. 2002); *State v. Jackson*, 582 N.W.2d 317, 325 (Neb. 1998); *State v. Whittey*, 821 A.2d 1086, 1097 (N.H. 2003); *State v. Deloatch*, 804 A.2d 604, 613 (N.J. Super. Law Div. 2002); *People v. Owens*, 725 N.Y.S.2d 178, 180–81 (N.Y. Sup. Ct. 2001); *State v. Butterfield*, 27 P.3d 1133, 1143 (Utah 2001).

173. *Traylor*, 656 N.W.2d at 900.

174. *Id.* at 887.

175. *Id.*

Cofiler to analyze blood found on the knife.<sup>176</sup> The results of the Profiler Plus and Cofiler analysis indicated that the defendant had likely committed the crime.<sup>177</sup> This evidence was offered by the State to establish the defendant's guilt.

At trial and on appeal, the defendant argued that Profiler Plus and Cofiler did not meet the requirements for admissibility, specifically reliability.<sup>178</sup> The defendant based his argument on the fact that Perkin Elmer had not disclosed the kits' primer sequences.<sup>179</sup> According to the defendant, this made it impossible for the kits to be validated and accepted by the scientific community.<sup>180</sup> The Court rejected the defendant's argument, determining "that disclosure of the primer sequences . . . [is] not necessary for the scientific community to validate the Profiler Plus and Cofiler kits."<sup>181</sup> Thus, the Court upheld the defendant's conviction.<sup>182</sup>

## 2. *People v. Owens*

In 2001, the Supreme Court of New York held that evidence derived from Profiler Plus and Cofiler was admissible over the defendant's claims that the kits were not sufficiently validated and subjected to peer review.<sup>183</sup> In this case, the defendant was charged with crimes against three victims: the rape and murder of two victims and the multiple rapes of another.<sup>184</sup> Cellmark Diagnostic Laboratory and the Monroe County Public Safety Laboratory analyzed DNA samples taken from the victims and the defendant.<sup>185</sup> These laboratories used Profiler Plus and Cofiler to examine the samples, and their results indicated a match.<sup>186</sup> The State offered this evidence to connect Owens to the crimes.

The defendant, relying on the *Pfenning* decision, argued against the admissibility of the Profiler Plus and Cofiler evidence, asserting that the kits had not been sufficiently validated and peer reviewed.<sup>187</sup> The court rejected the defendant's contentions and found the evidence admissible upon the State's showing that courts throughout the country had found

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176. *Id.* at 887, 890.

177. *Id.* at 887.

178. *Id.*

179. *Id.* at 890.

180. *Id.* at 900.

181. *Id.*

182. *Id.*

183. *People v. Owens*, 725 N.Y.S.2d 178, 180, 183 (N.Y. Sup. Ct. 2001).

184. *Id.* at 179.

185. *Id.* at 180.

186. *Id.*

187. *Id.*

STR-PCR DNA profiling—using Profiler Plus and Cofiler—reliable.<sup>188</sup> The court also based its decision upon a review of the State’s offer of “ample abstracts of symposium and conference presentations and articles supporting the validation of both . . . Profiler Plus and Cofiler PCR kits and STR/DNA profiling in general.”<sup>189</sup> Even in light of the *Pfenning* decision and the defendant’s arguments, the court found more than enough evidence in scientific literature to support a finding of the admissibility of evidence derived from Profiler Plus and Cofiler.<sup>190</sup> Accordingly, the court allowed the State to admit the Profiler Plus and Cofiler evidence.

### 3. *People v. Shreck*

In 2001, the Supreme Court of Colorado held that evidence derived from the Profiler Plus and Cofiler kits was admissible as a matter of first impression.<sup>191</sup> The defendant in this case was charged with the sexual assault of a University of Colorado student.<sup>192</sup> The Colorado Bureau of Investigation (CBI) analyzed a blood sample taken from the defendant against rape kit results gathered from the victim.<sup>193</sup> To conduct the analysis, CBI utilized Profiler Plus and Cofiler.<sup>194</sup> As a result, CBI concluded that the defendant had assaulted the victim.<sup>195</sup> The State offered this evidence to inculcate the defendant.

Shreck argued that the Profiler Plus and Cofiler evidence was inadmissible because the kits’ reliability had not been established.<sup>196</sup> He asserted, among other things, that there had not been a sufficient number of court decisions finding the kits valid and reliable to establish their legal reliability and acceptance.<sup>197</sup> According to the Court’s research, “[t]he majority of courts in other jurisdictions that have considered the issue . . . [hold] that DNA evidence derived from” PCR-STR testing kits like Profiler Plus and Cofiler “satisfies the standards for admissibility under

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188. *Id.* at 182–83.

189. *Id.* at 182.

190. *Id.* at 181–82.

191. *People v. Shreck*, 22 P.3d 68, 79, 80 (Colo. 2001). Colorado Rule of Evidence 702, like Vermont Rule of Evidence 702, is concerned with whether proffered scientific evidence is both reliable and relevant. *Id.* at 79.

192. *Id.* at 71–72.

193. *Id.* at 72.

194. *Id.*

195. *Id.*

196. *Id.*

197. *Id.*



either *Frye* or Rule 702.”<sup>198</sup> Consequently, the Court found the evidence produced by Profiler Plus and Cofiler admissible.<sup>199</sup>

V. PROFILER PLUS EVIDENCE SHOULD NOW BE ADMISSIBLE IN VERMONT  
EVEN IN LIGHT OF *PFENNING*

Recall from Part II that the standard of admissibility in Vermont for scientific and technical evidence is governed by Vermont Rule of Evidence 702 and that under that standard, reliability and relevance are of paramount importance.<sup>200</sup> Recall further that the reliability analysis is directed by the factors set forth by the U.S. Supreme Court in *Daubert*.<sup>201</sup> Even in light of the *Pfenning* decision, given recent scientific and legal developments, Vermont courts should find Profiler Plus reliable, and evidence derived from it admissible. This argument is substantiated by an application of Vermont’s standard of admissibility to the Profiler Plus system, taking into account the scientific and legal developments discussed above.

Under Vermont Rule of Evidence 702 and *Streich*, a determination of the reliability of a DNA testing kit like Profiler Plus begins with an analysis of whether the technique consists of a testable hypothesis.<sup>202</sup> As a New Jersey District Court stated:

There is little doubt that [PCR-STR DNA typing] has a testable hypothesis. “The hypothesis of PCR/STR DNA typing [utilizing Profiler Plus and Cofiler] is that with proper procedures an expert can determine the allelic types of given DNA samples at the thirteen core STR loci.” . . . [T]his hypothesis can be tested by any laboratory with the proper equipment to perform the PCR process.<sup>203</sup>

Thus, the Profiler Plus kit satisfies the first factor for consideration under the admissibility standard.

The second factor to consider in determining the reliability of a DNA testing procedure like Profiler Plus is whether the procedure has been subjected to peer review and published validation studies.<sup>204</sup> Since

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198. *Id.* at 79.

199. *Id.* at 82.

200. *See supra* notes 90–95 and accompanying text.

201. *See supra* notes 96–97 and accompanying text.

202. *State v. Streich*, 163 Vt. 331, 343, 658 A.2d 38, 47 (1995) (citing *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 593–95 (1993)).

203. *United States v. Ewell*, 252 F. Supp. 2d 104, 111 (D.N.J. 2003) (quoting *United States v. Trala*, 162 F. Supp. 2d 336, 346 n.11 (D. Del. 2001)).

204. *Streich*, 163 Vt. at 343, 658 A.2d at 47 (citing *Daubert v. Merrell Dow Pharmaceuticals*,

*Pfenning*, as examined in Part IV.B above, there have been numerous validation studies focusing on Profiler Plus published in peer-review journals, such as *The Journal of Forensic Science*.<sup>205</sup> Hence, the Profiler Plus system satisfies the second aspect of the reliability analysis under Vermont Rule of Evidence 702 and *Streich*.

The third factor to consider is the known or potential rate of error associated with the system or methodology.<sup>206</sup> “[T]he FBI has established protocol to be followed in performing the PCR amplification and typing of the thirteen core STR loci using the Profiler Plus and Cofiler kits in order to produce consistently reliable results.”<sup>207</sup> This protocol “has been widely disseminated to the scientific community.”<sup>208</sup> If analysts “follow[] the FBI protocol and use[] properly calibrated instruments, there is essentially zero rate of error, i.e., obtaining a wrong result, within established measurement conditions.”<sup>209</sup> This result is of course prone to human error.<sup>210</sup> Although the rate of laboratory error cannot be exactly quantified because of the variety of laboratories utilizing the kits, the fact that the scientific method underlying the kits has a virtually zero rate of error is sufficient to allow Profiler Plus to satisfy this criterion of reliability.<sup>211</sup> Therefore, Profiler Plus can satisfy the third factor in determining reliability.

The final factor to consider in determining whether a DNA testing method is sufficiently reliable for its results to be admissible in court is whether it has been generally accepted in the scientific community.<sup>212</sup> There is no dispute concerning the general acceptance of Profiler Plus in the forensic community, as experts have noted in numerous cases regarding

Inc., 509 U.S. 579, 593 (1993)).

205. *See supra* Part IV.B.

206. *Streich*, 163 Vt. at 343, 658 A.2d at 47 (citing *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 594 (1993)).

207. *Ewell*, 252 F. Supp. 2d at 113.

208. *Id.* at 114. Vermont’s forensic laboratory has implemented the FBI protocol. VT. STAT. ANN. tit. 20, § 1942(c) (2000).

209. *Ewell*, 252 F. Supp. 2d at 113.

210. *Id.*

211. *See id.* at 113–14.

Laboratory error may only form the basis for exclusion of an expert opinion if “a reliable methodology was so altered . . . as to skew the methodology itself . . . .” As noted, however, the defendant’s argument is not based on evidence of actual errors by the laboratory, but instead has simply challenged the Government’s failure to quantify the rate of laboratory error. To the contrary, the Government has demonstrated the scientific method has a virtually zero rate of error, and that it employs sufficient procedures and controls to limit laboratory error and thus, maintain the integrity of the method.

*Id.* (citations omitted) (omissions in original).

212. *State v. Streich*, 163 Vt. 331, 343, 658 A.2d 38, 47 (1995) (citing *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 594 (1993)).

PCR-STR testing.<sup>213</sup> Consequently, Profiler Plus can be considered as generally accepted in the relevant scientific community—namely the forensic community.

Although it was not a factor specifically mentioned by the *Streich* Court as a requirement to establish reliability, the *Pfenning* court indicated that findings by other courts concerning the reliability and admissibility of a DNA testing methodology are important to consider.<sup>214</sup> As indicated in Part IV.C, since the *Pfenning* case, courts throughout the country have found Profiler Plus to be a reliable testing system and have found its results admissible. Accordingly, this “fifth factor” for determining reliability can be satisfied by Profiler Plus.

The above analysis illustrates that, given recent scientific and legal developments, the Profiler Plus DNA testing system satisfies the reliability analysis required by Vermont Rule of Evidence 702, and, therefore, Vermont courts should admit its results. This analysis further demonstrates that the reasoning of the *Pfenning* court is no longer applicable to questions regarding the admissibility of evidence derived from the Profiler Plus kit.

#### CONCLUSION

DNA evidence often proves invaluable to prosecutors seeking to inculcate a defendant and defense attorneys wishing to exculpate their clients. Profiler Plus and Cofiler are currently the most widely used means of analyzing DNA. The ability of practitioners in Vermont to utilize evidence derived from Profiler Plus was called into question in *Pfenning*, where the court held that the kit failed to satisfy the reliability requirement for the standard of admissibility. Since that decision, developments in the scientific and legal communities have addressed the concerns of the *Pfenning* court and have rendered Profiler Plus a reliable DNA analysis method according to the strictures of the admissibility standard. Consequently, there should now be no question in Vermont courts, even in light of the *Pfenning* decision, that evidence produced by Profiler Plus is admissible.

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213. State v. Traylor, 656 N.W.2d 885, 892 (Minn. 2003).

214. State v. Pfenning, No. 57-4-96, slip op. at 50 (Vt. Dist. Ct. Apr. 6, 2000).