

DISTRICT COURT, COUNTY OF BOULDER, STATE OF COLORADO

Case No. 98CR2475, Division 4

RULING AND ORDER

THE PEOPLE OF THE STATE OF COLORADO,

Plaintiff,

vs.

MICHAEL EUGENE SHRECK,

Defendant.

I. INTRODUCTION

This matter comes before the Court on the Defendant's Motion to Bar the Use of DNA evidence. Having considered the motions, record, and file, the Court enters the following Ruling and Order.

II. BACKGROUND FACTS

The Defendant, Mr. Shreck, has been in and out of custody for the past seventeen years. On August 25, 1983, the Defendant was sentenced to two concurrent five-year sentences in the Department of Corrections (DOC) for forgery and robbery. Released on January 3, 1986, the Defendant violated parole and was returned to custody on March 20, 1986. He was sentenced again to DOC for second degree burglary, paroled on December 5, 1988, and returned yet again on March 21, 1989 on another violation.

His next period of parole began on February 28, 1990 during which time he lived in Westminster, Colorado and in Minnesota where he was convicted of robbery. Mr. Shreck was ordered to serve the Minnesota sentence concurrently with his parole revocation in Colorado. He discharged that sentence in August of 1994 but was soon convicted of criminal mischief and sentenced to DOC for six more years. In early April of 2000, the Defendant was scheduled for release on parole. However, he remains in custody in the Boulder County Jail pending the outcome of this trial.

On April 22, 1990, during one of the Defendant's parole periods, a University of Colorado student was raped near the University's law school. A rape kit was done on the victim but the crime was never solved. In 1998, while reviewing unsolved crimes, a University of Colorado police detective realized that the rape kit had never been tested for DNA. The samples were

turned over to the Colorado Bureau of Investigations (CBI) for DNA analysis and comparison of the results with DOC and CBI's convicted offender DNA profile databases.

In September of 1998, Kathleen Lobato, a DNA analyst at CBI, conducted a series of tests on the samples from the rape kit. Ms. Lobato reported finding a mixture of DNA in the samples, the major contributor being the victim and the minor a semen contributor. She then ran several PCR-based tests on the samples, one for DQ *alpha* (DQa) and Polymarker (PM) and one for D1S80, and obtained a genetic profile of the minor contributor that matched the profile of the Defendant on file in the DOC database. Because Mr. Shreck's DOC samples had not been run for DQa, Agent Lobato reworked his original sample. She then calculated the probability that the minor contributor was not Mr. Shreck but a random third person of Caucasian extraction and found the probability was 1 in 11,000. As the original sample for Mr. Shreck had been obtained in 1991, Agent Lobato obtained another sample from Mr. Shreck, reanalyzed the fresh sample and came up with the same results.

Then, in January of 1999, Agent Lobato performed more tests on the samples. This time she used a PCR-based multiplex STR system using two commercial kits manufactured by Perkins Elmer Biosystems (PE), the AmpFLSTR Profiler Plus™ (Profiler Plus) and the AmpFLSTR Cofiler™ (Cofiler) kits. These kits had just recently come on the market and were purchased by CBI in November of 1998. By combining these results with the earlier DQa and D1S80 tests, Agent Lobato determined that the Defendant could not be excluded as a contributor to the sample. Further, using the database information supplied by PE in the kits, she calculated that the probability that the contributor was not the Defendant but simply a random third Caucasian person was 1 in 5,300,000,000,000,000 or 5.3×10 to the 15th. Based on these results, in conjunction with a positive photo line-up identification by the victim and the fact that the Defendant had been on parole and living in the area at the time of the crime, the Defendant was arrested and charged with second degree kidnapping, two counts of sexual assault in the first degree, two counts of criminal attempt to commit murder in the first degree, assault in the second degree and habitual criminal.

The Defense objects to the use of DNA evidence at trial obtained from the PCR-based tests DQa, PM, D1S80 and STR using the Profiler and Cofiler kits. The Defense claims these test results should not be admitted on the following grounds:

1. PCR is not generally accepted as reliable by the relevant scientific community;
2. STR tests in general are not accepted in the scientific community;
3. The STR multiplex technique as employed by the Profiler Plus and Cofiler kits is not generally accepted;
4. The DQa, PM and D1S80 tests are not generally accepted;
5. The statistical methods used to determine the probability of a match, including the use of the Product Rule, PE's database, and the failure to include error rates, are not generally accepted; and
6. The methods of collection, preservation, and handling of the crime scene samples are not generally accepted as reliable by the relevant scientific community.

I. LEGAL STANDARDS

Admissibility under *Frye*

DNA typing or profiling is a way of identifying the DNA content of an individual. By testing biological tissues collected at a crime scene, scientists can extract DNA and then compare that DNA with the DNA profile from a known suspect. Where the profiles match, the laboratory must then determine the statistical significance of the match. In other words, the laboratory must determine the likelihood that the crime scene sample came from a random third person that has the same DNA profile as the suspect. Obviously, if the suspect's DNA profile occurs with frequency in the relevant population, a match is meaningless. Therefore, the statistical significance of the match is critical.

A claimed DNA match is powerful, persuasive and potentially prejudicial evidence. In Colorado, the *Frye* standard governs the admissibility of DNA evidence. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923); *Fishback v. People*, 851 P.2d 884 (Colo. 1993). *See also People v. Anderson*, 637 P.2d 354 (Colo. 1981) (Colorado adopts the federal *Frye* standard for determining the admissibility of scientific evidence). Under *Fishback*, the admissibility of DNA evidence requires a showing of 1) general acceptance in the relevant scientific community of the underlying theory or principle, and 2) general acceptance in the relevant scientific community of techniques used to apply that theory or principle. Inherent in the second prong of this test is the requirement that the method used to calculate the statistical significance of a declared match is generally accepted as well. *Fishback, supra* at 885. Thus, as the proponents of this evidence, the People must show by a preponderance of the evidence that the technologies used in this case are generally accepted in the relevant scientific community.

The relevant scientific communities in the area of DNA evidence include scientists in the fields of molecular and human genetics, molecular biology, biochemistry, population genetics, human genetics, and demographics. *Fishback, supra* at 892.

General Acceptance

General acceptance in this area does not require unanimity, consensus of opinion, nor even majority support among the scientific community. *Lindsey, supra* at 288. Clearly, debate is inherent in scientific inquiry and a requirement of absolute validity would remove most if not all scientific evidence from the courts. *Fishback, supra* at 884. According to the Colorado Supreme Court, general acceptance does not require even substantial authority but may exist where the methodology is accepted in a "reasonably inclusive manner." *Lindsey, supra*. In making this determination, trial courts should consider the quality of the evidence presented in court, the state of science ascertainable from scientific commentary and journals, and rulings from other jurisdictions that have considered the same questions. *People v. Lindsey*, 892 P.2d 281, 288-89 (Colo. 1995). Even the testimony of one witness may suffice where the witness is "qualified through knowledge, skill, training, education or experience to render an opinion as to the general acceptance of techniques." *Id.* at 288 citing *People v. Perryman*.

The Defense maintains that the appropriate test for admissibility of DNA evidence is really a three prong test from New York adopted by the Colorado Court of Appeals in *People v. Lindsey*, 868 P.2d 1085 (Colo. App. 1993); *People v. Castro*, 545 N.Y.S. 2d 956 (New York 1989).

Admissibility under *Castro* requires the trial court to determine:

1. Is there a theory, which is generally accepted in the scientific community, which supports the conclusion that DNA forensic testing can produce reliable results;
2. Are there techniques or experiments that currently exist that are capable of producing reliable results in DNA identification and which are generally accepted in the scientific community; and
3. Did the testing laboratory perform the accepted scientific techniques in analyzing the forensic samples in this particular case?

Castro, supra at 987.

Rather than adopting the *Castro* test, however, the Colorado Supreme Court in *Lindsey* held that the two part *Frye* test still applies and that once the *Frye* standard is met, "any challenge to the implementation and execution of those techniques 'goes to the weight to be accorded such evidence.'" *Lindsey*, 892 P.2d at 288, citing *Fishback, supra* at 891. Consequently, the trial court need only determine whether the theories and methods used are generally accepted and leave the determination of laboratory performance and error to the jury.

Admissibility under *Daubert*

In *Daubert v. Merrell Dow Pharmaceuticals*, 125 L.Ed.2d 469 (1993), the United States Supreme Court abandoned the *Frye* test and held that the admissibility of novel scientific evidence is governed solely by F.R.E. 702. Under F.R.E. 702, "if scientific, technical or other specialized knowledge will assist the trier of fact to understand the evidence or to 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 or otherwise." The Court held that "scientific reliability" rather than general acceptance is the key to admissibility. *Daubert* at 589. To aid a trial court in this determination, the Court laid out the following factors for consideration:

1. The testability of the scientific theory or technique;
2. Whether the theory or technique had been subjected to peer review and publication;
3. The known or potential rate of error;
4. The existence or nonexistence of maintained standards; and
5. Whether the theory or technique has general acceptance in a relevant scientific community. *Id.*

In its most recent decision addressing *Frye*, the Colorado Supreme Court refused to abandon *Frye* in favor of *Daubert* in analyzing the admissibility of novel scientific evidence. *Brooks v. People*, 975 P.2d 1105 (Colo. 1999). In *Brooks*, the Court refused to apply *Daubert*, not because the Court rejected the *Daubert* analysis, but because the Court found that the evidence at issue did not concern scientific knowledge. *Brooks, supra* at 1113. Although the Court left open the

question of whether *Daubert* applies in Colorado in the realm of scientific knowledge, the Court stated that a trial court's focus should not be on whether or to what extent *Daubert* applies, but rather on whether the evidence before it is "reasonably reliable information that will assist the trier of fact" as required by C.R.E. 702. *Id.*

General acceptance of DNA profiling techniques

The theory underlying DNA profiling has wide acceptance in the scientific community and is not challenged here. Rather, the Defense maintains only that the second prong of *Frye* has not been met – that the techniques employed to apply that theory do not enjoy such acceptance.

In determining whether the methods employed in this case are generally accepted and reliable, the Court, per *Lindsey*, will look to three main sources: 1) the quality of the evidence presented in court, 2) rulings from other jurisdictions which have considered the same questions, and 3) the state of science ascertainable from scientific commentary and journals. The third source is of particular importance in this area as DNA testing is highly complex. It involves sophisticated and, to this Court at least, difficult concepts. And, as is normal where state of the art technologies are concerned, there is considerable debate about the methodologies employed. To aid the Court in making its decision, as well as to bolster their positions, both sides submitted numerous articles from this field as well as copious cites to other published works. It is easy for the Court to assess the quantity of material in this field; the quality is another matter. Fortunately, the Court is guided somewhat by two authoritative scientific bodies who have addressed the issues of quality assurance in forensic testing. The first is the National Research Council, an arm of the National Academy of Sciences, which published two reports, "DNA Technology in Forensic Science," in 1992 and 1996, which address formal quality assurance standards in DNA testing. The second body is the Technical Working Group on DNA Analysis Methods Working Group (TWGDAM), a group of government and forensic scientists from the United States and Canada. Since 1989, TWGDAM has published numerous quality assurance guidelines that are considered the prevailing standards for forensic DNA analysis. The goal of the guidelines was to provide guidance to forensic laboratories to ensure a high degree of reliability as evidenced by accuracy and reproducibility – "scientifically sound and reliable forensic analysis." These guidelines represent the consensus of the scientific community and set high standards for laboratories doing DNA testing.

The TWGDAM guidelines stress that before a new technology is used forensically, the technology must undergo a stringent validation process. TWGDAM's Section 4 on validation states that "validation is the process used by the scientific community to acquire the necessary information to assess the ability of a procedure to reliably obtain a desired result, determine the conditions under which such results can be obtained and determine the limitations of the procedure. The validation process identifies the critical aspects of a procedure which must be carefully controlled and monitored." The section then details particular studies which should be done and stresses that the results of these studies must be "shared as soon as possible with the scientific community...[I]t is imperative that details of these studies be available for peer review through timely publications in scientific journals." TWGDAM at § 4.1.5.12. These guidelines stress "reproducibility" and "consistency" as evidenced by independent testing. Peer review provides the requisite opportunity for open dialogue, critique, and correction and is the main process by which reliability of technique is ascertained. *See Daubert, supra* at 594 (peer review of developmental data is necessary to increase the likelihood that substantive flaws in

methodology will be detected).

Although TWGDAM's guidelines are not mandatory, they represent the scientific community's consensus as to the minimum quality assurance requirements for DNA analysis. The vast majority of articles submitted to this court, including validation studies of the technologies at issue, reference TWGDAM and attempt to comply with its requirements. Furthermore, the People's expert Bruce Budowle testified, and the Court finds, that TWGDAM is essentially the "Bible" in this field. Consequently, the Court will consider adherence to TWGDAM's validation requirements as an important factor in determining both general acceptance and reliability. However, as stated in the Introduction to the 1991 Guidelines, failure to comply with each and every guideline, or use of alternative or equivalent methods, does not necessitate a finding of unreliable results.

I. FINDINGS OF FACT AND CONCLUSIONS OF LAW

A. PCR and PCR-BASED TESTING

Before turning to a *Frye* analysis of PCR and the PCR-based testing methods at issue in this case, a few basic comments on DNA are in order.

DNA is a chemical that carries the blueprint or code for living things. It is found in the nuclei of almost all the cells in our bodies. In the nuclei are chromosomes, made up of DNA and proteins. The DNA sequence of each person is the same from cell to cell, but no two people have the exact same sequence overall. This is so because human DNA is distributed in bundles across forty-six chromosomes, twenty-three of which are inherited from the mother and twenty-three from the father. With the exception of sex cells, each cell with a nucleus contains a complete set of DNA. Each chromosome contains genes. There are between 25,000 and 100,000 genes in the human DNA sequence, or "genome", distributed over the various chromosomes.

Although each individual has a unique DNA code overall, not all DNA is unique. Some genes or gene sequences are the same for all humans. The rest vary to certain degrees from person to person and among distinct population groups. Each gene or gene sequence is located at a specific location or "locus" on the chromosome. Scientists have been able to identify particular locations or loci of DNA which vary a great deal among people. These areas of variation are called polymorphisms. If a gene is polymorphic, meaning there are two or more variations of the gene or genetic sequence, then each different version is called an "allele".

Loci with high variation or polymorphism in the population can be useful in creating genetic profiles. When tests are done on DNA samples which identify highly variant loci, scientists have a better chance of identifying individuals who could have contributed to the sample from those who have not. The more variant loci typed, the more discrimination and the more likely one can create a profile that's either rare or unique. Under current DNA testing, an individual can be definitively excluded as a donor or contributor to a sample. However, if the individual is not excluded, then further mathematical calculations must be done to see how likely it is that the individual was the contributor.

One way to test DNA is through a process called RFLP (restricted length polymorphism). Here, scientists take a known sample, say from a suspect, and an unknown sample from a crime scene. The scientists then extract DNA from that sample, cut it up into fragments, separate these, locate

the loci on the fragments, and then look at the DNA at those loci. The result is a type of bar code which can be used to compare the two samples to see how closely they match. RFLP has been found scientifically accepted by many courts including the Colorado Supreme Court. *See Fishback v. People*, 851 P.2d 884, 893 (Colo. 1993) (trial courts may take judicial notice of the acceptability of the techniques employed in RFLP analysis).

The disadvantage with this type of testing is that it requires large samples of DNA and consumes that DNA during the tests. Furthermore, it is not as useful where samples are environmentally degraded or contaminated. To minimize these problems, scientists use another technique called PCR, or Polymerase Chain Reaction, in which a small amount of DNA is extracted and then copied or amplified many times for testing. Then scientists can separate out the fragments of DNA, as in RFLP, to determine the DNA code at various loci.

PCR, then, is not really a DNA testing method but instead a method of amplifying a sample in preparation for testing. This technique has been used worldwide since 1983 for biological research and medical diagnostics. It is used extensively in the study, diagnosis and treatment of inherited diseases, for prenatal and postnatal diagnostics, and for genetic detection of lethal neurological diseases. It has been used broadly in genetic research in such areas as cloning, genome mapping and nucleic acid sequencing. It has also been used to identify the human remains of victims of war or major disasters, to determine paternity, and even to determine the sex of an individual from bones.

In this case, DNA from the victim's rape kit was compared to a DNA sample taken from the suspect. After collection, the DNA was extracted, weighed, and then amplified through PCR. Next, DQa, PM, D1S80, and STR tests were performed. From these tests, the laboratory created a profile of both samples and compared the two. The Defense objects to the use of these tests based on the grounds that neither PCR nor the PCR-based tests are scientifically accepted.

While no Colorado appellate court has ruled on the admissibility of PCR or the various PCR based typing techniques used in this case, PCR and/or the PCR-based tests DQa, PM, and D1S80 have been found reliable under either *Frye* or *Daubert* in appellate decisions from courts in at least twenty-four states, the U.S. Court of Appeals for the Eighth and Ninth Circuits, the U.S. District Court of Massachusetts, New Hampshire and South Florida and the U.S. Air Force Court of Criminal Appeals. The People also provided the court with 14 Front Range district court cases that admitted DNA evidence using these tests. On the whole, these courts held that the PCR-based testing methodologies had sufficient scientific validation and/or were generally accepted among scientists.

Given the overwhelming number of jurisdictions that have admitted such evidence in trial, the numerous articles submitted by the parties detailing work done in both the forensic and medical fields using PCR-based testing, and the largely uncontroverted testimony by the experts in this case that these systems have been used and are being used throughout the world, the Court finds they are generally acceptable methods of DNA testing. *See Lindsey, supra*, at 288-89 (acceptance evidenced by rulings from other jurisdictions, quality of scientific commentary and journals, and evidence presented in court).

Regardless, the Defense would have the court refuse admittance based on reported problems with the systems, especially with contamination of samples, less than faithful amplification, and

misinterpretation of mixed samples. The Defense submitted several articles detailing these and other problems with these technologies and the Defense experts Dr. Riley and Mr. Taylor testified to the same. Dr. Riley testified that the problems of PCR are well known and hence the technique is not widely used. He cautioned that because of these problems, laboratory technicians performing PCR-based DNA testing must receive training beyond that normally required. However, despite his reservations, Dr. Riley himself has performed over 10,000 PCR-based tests in the medical field and reports having extensive experience in this field. Taylor also admitted to using these technologies routinely in his business.

Undoubtedly there are problems and on-going disputes over PCR-based testing. Acceptance under *Frye*, however, does not require uniformity of opinion nor perfection in technique. See *Fishback, supra* at 890 (a party need not prove the absolute validity of the techniques used in producing novel scientific evidence before it can be admitted); *Lindsey, supra* at 288 (general acceptance does not require unanimity, consensus, or even majority support). Nor does *Daubert* require such absolutes. *Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993) (the subject of scientific testimony need not be known to a certainty to be admissible). Rather, most technologies in this rapidly evolving field will undergo further testing, criticism and fine tuning as scientists learn more and attempt to perfect their techniques. The experts here all testified that these problems are well known and should be considered by analysts in the field, especially in interpreting data. Thus, it would seem incumbent on those working in the field to stay abreast of recent developments and a lack of familiarity with the relevant literature could compromise the performance of a particular laboratory technician. However, such concerns go to the weight and not the admissibility of the evidence. Here, although the articles submitted by the Defense confirm the existence of disputes and concerns, they do not rise to a wholesale rejection of the underlying methods. Until the scientific consensus changes tack and determines these techniques unsound, such disputes merely go to weight and not admissibility and do not alter the Court's view that PCR and the PCR-based tests DQa, PM and D1S80 are generally accepted in the scientific community.

B. PCR-STR

The PCR-based test STR (short tandem repeats) is a distinct test from DQa and PM. Whereas the former target individual genes at the identified loci, STR loci consist of tandemly repeated gene sequences. STR's are multiple copies of an identical DNA sequence arranged in direct succession in a particular region of a chromosome. These sequences are widespread throughout the human genome and show sufficient variability among individuals in a population that they have become important in human identity testing. The forensic DNA community has embraced the use of STRs which may be amplified with PCR with greater fidelity than other repeats. The STR loci provide a rich source of polymorphic markers and their use provides a high degree of discrimination. *Id.*

STR testing has been used for research and medical diagnostics for over eight years. It is used to detect residual disease after bone marrow transplants, in parentage assessment and cell line authentication. It has been used forensically since about 1993 in Europe, Canada and the United States.

When STR loci are amplified separately and run on a separate gel, the system is called "monoplex". When the loci are amplified together and run in one gel lane or capillary injection

simultaneously, the system is called "multiplex". Multiplex systems that amplify and run three loci, or "triplex" systems, have been available commercially since 1993, and both monoplex and triplex systems have been in use for many years. Although there are no Colorado appellate decisions addressing PCR-STR testing, the People submitted four appellate cases from other jurisdictions that admitted DNA evidence using this system.

In *Commonwealth v. Rosier*, 685 N.E.2d 739 (Mass. 1997), the court found that DNA testing using an STR triplex kit manufactured by Cellmark was scientifically valid and relevant under *Daubert*. Evidence in support of that finding included the 1996 National Research Council report which concluded that STR testing is "coming into wide use", that "STR loci appear to be particularly appropriate for forensic use", and that "STRs can take their place along with VNTR's as forensic tools." *Id.* at 743. The court also relied on Cellmark's extensive validation tests evaluating the reliability and sensitivity of STR testing, another validation study which found the testing system "sensitive, robust and highly reliable", and expert testimony that, before the kit became available commercially, it had been used by the U.S. government to identify soldiers killed in Operation Desert Storm. *Id.* Additionally, experts testified that the kit had been used in over 50 cases and was the basis for in-court testimony in at least five. *Id.* at 743.

Similarly, in *People v. Allen*, 85 Cal.Rptr.2d 655, (Cal. Ct. App. 1999), the court found Cellmark's triplex system generally accepted based on testimony by the director of Cellmark's laboratory, on the NRC report, and on the holdings in *Rosier*, *supra* and *State v. Jackson*, 582 N.W.2d 317 (Neb. 1998). In *Jackson*, the court found an unspecified form of PCR-STR testing reliable based solely on the director of the University of Nebraska Medical Center's testimony that PCR-STR "has been around several years now, and there is nothing unique about PCR STR versus any PCR." There was no evidence presented as to the type of STR test used or the differences between STR and other PCR tests such as PM and *DQa*, which, according to the evidence in this case, are substantially different from STR testing. Furthermore, Allen presented no evidence whatsoever upon the issue.

Finally, the People cite to *People v. Watts*, 733 S.2d 214 (Miss. 1999) in support of the admissibility of PCR – STR testing. In that case, as in *Jackson*, the defendant objected that all PCR testing was unreliable and the court's holding on that issue was limited to a finding that "PCR testing of DNA samples produces reliable results in the forensic setting" but with no analysis as to STR testing as it differed from other PCR tests. *Id.* at 221. By this finding, however, the court implicitly approved of all the tests used in the case which were *DQa*, PM, DIS80 and STR triplex.

Thus, excepting *Rosier*, these cases fail to provide meaningful analysis regarding STR testing but rather seem to accept that all PCR tests are the same. Nevertheless, the evidence here convinces the Court that, although STR testing is a different technique from the other PCR-based tests, it is generally accepted as to monoplex and triplex applications. All the experts admitted that STR testing is widely used, and Dr. Budowle testified that it is generally accepted. Although most of the articles submitted by the People concern the multiplex system as employed by the Profiler Plus and Cofiler system, the People also submitted printouts from the National Institute of Standards and Technology's DNA STR web site which indicates that monoplex and multiplex STRs are used extensively in the forensic field. The site lists over 900 published articles from the U.S. and abroad detailing the use of STRs in population studies, medical research and diagnosis, and forensic use. It lists around 500 scientists worldwide working with STRs in all fields

including forensics. The cite also provides a list of 23 papers describing common STR procedures, 52 validation studies including validations of multiplex STRs, lists of core STR loci, including monoplex, triplex, tetraplex, quintuplex, pentaplex, and heptaplex loci, lists of primers, allele variants, and so forth. Additionally, Defense Exhibit B is a published TWGDAM validation study of PE's triplex kit which has been used by the FBI, CBI and many other laboratories for several years. From the information presented, it would be difficult to contend that this technology is new, untested, unreviewed, unvalidated and unaccepted, at least as to monoplex and triplex systems. The problems associated with these tests as outlined by the Defense, as with the other PCR-based tests, appear to be anticipated by the scientific community and, rather than preventing the admission of test results at trial, merely go to weight. Thus, the Court finds that monoplex and triplex PCR-based STR testing is accepted by the scientific community.

This finding, however, does not end the inquiry. The multiplex system at issue in this case is a combination nineplex and sixplex system. The People contend that this is merely another application of the already scientifically accepted STR method and hence *Frye* is inapplicable to its admission in court. The Defense argues that the testing using new loci and new primers in one procedure changes the method to such an extent and presents new problems such that it must be considered a novel scientific process subject to *Frye*.

C. PROFILER PLUS AND COFILER

Development of the Profiler Plus and Cofiler Kits

In 1994, the U.S. Congress enacted a statute mandating the FBI to create a national offender databank containing the DNA profiles of persons convicted of crimes. 42 USCA § 14132 (West 2000). To this end, the states would begin to compile databanks of offender DNA profiles and provide these to the FBI who would then compile a national convicted offender database called CODIS, the Combined DNA Index System. To adequately perform this task, according to Dr. Budowle, the FBI wished to encourage the states to adopt a uniform DNA testing system that would guarantee robust, reproducible, cost-effective and reliable data.

Dr. Budowle testified that from the beginning he believed a multiplex PCR-based STR system would be the best and most robust system for national use. Multiplexing has many advantages over monoplex STR systems. First, because it identifies more loci, it gives greater discrimination. (Clearly, the probability of identical alleles in two individuals decreases with an increase in the number of polymorphic or variable loci examined). Second, it requires less material which is vital where availability is limited as it generally is in the forensic setting. Third, because fewer tests are required, the risk of contamination of samples is reduced. Finally, multiplexing saves time and money by allowing more loci to be typed with fewer tests.

Dr. Budowle testified that the only multiplex STR systems available at the time were triplex systems that he felt were inadequate to the task. He thus decided to find a manufacturer who was willing to work with the FBI to develop a more complex multiplex system than the ones in existence. The only commercially available kits at that time were triplex STR systems and only two companies capable of commercial development, Perkins Elmer Biosystems (PE) and Promega. Because the FBI had already worked extensively with PE and PE's triplex kits were being used by the FBI and other state crime laboratories, including Colorado's, Dr. Budowle

decided to approach PE first. Although initially refusing, PE agreed to undertake the project after Dr. Budowle indicated his intent to take the offer to Promega.

Development of the new system took several years and was undertaken in three phases. The first phase, in which the primer sequences were developed, was done largely by PE with developmental milestones set by Dr. Budowle and the FBI. The second and third phases involved developmental and forensic validation. During these stages, PE worked closely with the FBI and a consortium of 21 laboratories chosen by Dr. Budowle. The FBI gave each of the 21 laboratories assignments designed to give PE feedback throughout the process. These laboratories conducted various tests on the early versions of the kits and reported their results back to PE.

In late 1998, after several years and several million dollars, the Profiler and Cofiler kits became commercially available. The two kits used in conjunction amplify the 13 STR loci that were chosen by the FBI as the core STR loci for the national offender database CODIS. The Profiler Plus kit co-amplifies nine of the selected loci plus amelogenin, the sex gene. Cofiler amplifies the four remaining loci plus two also amplified by Profiler Plus and amelogenin. The overlap between the two was designed to provide a check to ensure that the same samples were amplified.

PE's New Multiplex Method

The evidence presented indicates that testing multiple loci in one test can be problematic. According to NIST scientists, multiplexing can save time and money, but difficulties may arise when coamplifying several loci. Multiplex PCR involves adding more than one set of PCR primers to the reaction in order to target multiple locations throughout the genome. Primers for one locus can complex with those of other loci and completely inhibit amplification causing various problems including dropout of a specific STR locus under certain conditions. *Id.*

The Defense expert Dr. Riley agreed that amplifying and testing multiple loci is problematic. He testified that multiplex systems create multiple reactions and that to some extent the additional primers compete with each other. Warning that this may ultimately result in mistyping, Dr. Riley stressed the importance of testing the new primers extensively before their forensic use. This analysis was confirmed by the NIST scientists who unequivocally state, "*Before a new STR system or STR multiplex may be routinely employed in human identity testing it should be extensively validated to insure reliability of results.*"

Further support for this position can be found from the TWGDAM guidelines. Section 4.1.3 states that even when a procedure has been validated, when adding new loci, appropriate studies of limited scope (e.g. population studies and human DNA control value determination) must be available for each new locus used. Section 4.4.1.6 states that when "more than one locus is amplified in one sample mixture, the effects of such amplification on each system (alleles) must be addressed and documented." Additionally this section states that the DNA primers must be readily available to the scientific community.

Here, new loci and new primers were used. Even if the PCR-STR multiplex technique had been previously validated, these guidelines virtually mandate that the addition of new loci and primers triggers further studies and oversight. In fact, even Dr. Budowle testified that when a company modifies a primer, the system goes back through validation. This indicates to the court that these changes are critical and that validation needs to be done.

Additionally, the first NRC report states that scientifically reliable procedures must be established before each new testing method is used in a forensic setting. The report details its concern about the proliferation of commercially available testing kits and recommends stringent testing of these kits before their commercial distribution. *Id.* at 69.

These comments signify that adding loci significantly changes the methodology and involves more than simply "tripling the recipe." It took PE several years and several millions of dollars to develop this technique. The company worked diligently not only in-house but in conjunction with the FBI and 21 other laboratories. PE believes this technique is extremely valuable and has fought hard to protect it as a trade secret. The FBI, too, has worked diligently to ensure that this system will provide the uniformity nationwide necessary to effectuate its statutory mandate. These actions lead the Court to the inescapable conclusion that the technology at issue is hardly commonplace, old hat, or merely a minor twist on an old methodology.

The People disagree and argue that, under *Fishback*, once PCR-STR is found acceptable, courts need not litigate variations of that technique. However, in *Fishback*, the court also pointed out that the underlying techniques of RFLP, such as extraction, digestion, gel electrophoresis, Southern transfer and denaturing, hybridization, autoradiography, and the interpretation of autorads, were generally accepted techniques. *Fishback* at 892. Thus, in finding RFLP admissible in the whole, courts engaged in an analysis of the component parts. Where component methodologies are new or differ in critical ways, a *Frye* analysis is appropriate.

Clearly, numerous courts have taken this approach and have applied either a *Frye* or *Daubert* analysis to various PCR-based techniques each of which, though based on similar methodology, apply that methodology in novel ways. Similarly, other courts have determined the scientific acceptability of the component procedures or instrumentation utilized in RFLP or PCR-based DNA testing. On the whole, these courts took the position that new developments in this field were not necessarily swept into court merely because the underlying technology, whether RFLP or PCR-based, was accepted.

Nevertheless, the People maintain this is not a new method. In support of this position, they cite to a 6/25/99 letter to Dr. Budowle from the editors of the *International Journal of Legal Medicine*. Dr. Budowle and two colleagues had previously submitted a study of commercial STR multiplex kits to the Journal for publication, but the article was rejected. In rejecting the article, the editors stated, "While your manuscript is basically good there does not exist the necessary novelty to merit publication in the International Journal which is to top [sic] journal in the field." In addition, the editors included the following reviewer's comments: "Such validation studies have been published in the kit manual relative to Profiler Plus. In addition there exists [sic] a description to the blue kit (JFS). Also, Promega has published their validation work. Of course, there exist now some more loci but the results are really not new and not original and many such data have been described for other STR loci."

These comments do not dispose of the issue. Here, the editors do not say that the methodology is used so extensively that it is no longer novel. Rather, they simply claim a validation study had already been published by PE and Promega. In fact, Dr. Budowle's article is not a TWGDAM validation study but rather a comparison of DNA typing using the commercial kits Profiler Plus and Cofiler by PE, GenePrint™ and PowerPlex™ by Promega, and subsets of these. Furthermore, in rejecting Dr. Budowle's articles, the reviewer seemed to feel that the validation study of PE's AmpFISTR Blue kit, a triplex system, and other published data about individual loci are analogous to studies detailing the results of tests using these new loci in conjunction with many others. This position is contrary to the positions of the scientists outlined above who caution that the addition of loci and change of primers may change the product substantially.

The People also cite to a recent Minnesota District Court case that refused to recognize the system employed in PE's kits as a new testing procedure which triggers *Frye*. In *State v. Dishmon*, 99047345, Hennipin County District Court, 4th Judicial District (3/3/00), the defendant claimed that DNA typing using the Profiler Plus and Cofiler kits with the ABI 310 Genetic Analyzer were not yet accepted in the scientific community and hence the testing results obtained from the use of these kits were inadmissible. Because the defendant did not challenge the underlying methodology of monoplex or triplex PCR STR testing, the court, without analysis, found PCR-based STR testing acceptable to the scientific community and thus reliable. Evidently the court believed there were no substantial differences between the various STR systems, whether monoplex or multiplex, and found that testing utilizing these kits was simply a matter of applying a well accepted technique under a different label. That court thus failed to analyze the techniques at issue and found that the only issue in controversy was whether laboratory procedures met accepted standards and controls.

In its holding, the *Dishmon* court relied primarily on *State v. Jobe*, 486 N.W.2d 407 (Minn. 1992), in which the Minnesota Supreme Court determined that, once DNA typing evidence using the older RFLP technique had been found scientifically acceptable, courts need not relitigate the issue. In *Jobe*, however, there was no contention that the methods employed were new or novel. Rather, the defendant challenged the underlying principles supporting the method as well as the laboratory's proficiency and operating procedures. The court ultimately found that these challenges to a generally accepted scientific method went to weight and not admissibility.

Unlike *Jobe*, however, the method utilized here, as in *Dishmon*, differs in critical ways from previously recognized systems. The *Dishmon* analysis fails to appreciate these crucial differences.

Dishmon is certainly correct, however, in recognizing that courts can not and should not be required to relitigate every change in laboratory technique. The Court agrees that scientific techniques are inherently in flux, especially in areas such as DNA testing in which human knowledge is rapidly expanding and techniques ever evolving. It would thus be time-consuming and grossly uneconomical to require a *Frye* hearing every time a new adjustment or correction is applied. However, where a procedure varies substantially from what has been done before such that the character of the results and their reliability are in question, a *Frye* hearing is appropriate. This is such a case. It is not a case, as *Dishmon* assumed, in which a laboratory technique "at bottom does the same things as the old technique." Therefore, the Court finds that the multiplex techniques employed by the Profiler Plus and Cofiler kits are novel scientific methods subject to the requirements of *Frye* which requires general acceptance in the relevant scientific community

of the techniques used to apply the theory or principle of DNA analysis.

Is the Technique employed by Profiler Plus and Cofiler scientifically accepted?

The Defense argues that the Profiler Plus kit has not been properly validated as required by TWGDAM, that PE's failure to release the primer sequences renders adequate peer review impossible, that there has been no meaningful peer review and thus there can be no general acceptance by the relevant scientific communities. Further, they argue that the system has so many flaws that there can be no general acceptance and the system is unreliable.

The People argue that validation has been more than adequate, that there is evidence the system is being used throughout the world in the fields of medical research, diagnosis, population studies, and forensics, and that the problems outlined by the Defense are similar to other DNA testing methods, that these are well known and that experts in the field take these into account in implementation.

Validation/Peer Review

In support of their position, the People submitted ten studies which, though not validation studies per se, address the consistency and reliability of Profiler Plus. These studies were conducted by laboratories in Portugal, Italy, Austria, Japan, Spain and the United Kingdom. Another four assessed its use forensically in paternity cases, to identify victims of mass disasters, and for criminal casework. These were from Italy, Switzerland, and Canada. Fourteen described population studies conducted with the Profiler, only one of which was conducted by a laboratory in the United States and it was co-authored by Dr. Budowle.

These articles were published in a recently released book, March 2000, Progress in Forensic Genetics 8, edited by George Sensabaugh. Evidently this publication is not well-known. Although one of the defense experts admitted he had heard of the editor, none had heard of the book. Therefore, it would seem that these articles have not been submitted for peer review as envisioned by TWGDAM. The articles do, however, provide evidence that these kits have been marketed extensively abroad.

The Defense also produced the study done by Dr. Budowle. The unpublished study has not been subject to peer review. Although Dr. Budowle testified that he did not believe publication for peer review was necessary, he stated that he has resubmitted the article for publication in the *Journal of Forensic Sciences* in an attempt to satisfy the U.S. courts under *Frye/Daubert*. This study evaluated the 13 core CODIS loci for forensic use by comparing results obtained by the Profiler Plus and Cofiler kits by PE and the GenePrint and PowerPlex kits by Promega. It does not purport to be a TWGDAM validation study and does not analyze the effects of adding more loci nor does it conduct the limited scope studies as recommended by TWGDAM where new loci and primers are used. Obviously, as the primers were never released, the study does not analyze the primer sequences.

The only other validation study produced was that by PE included in its User's Manual. From the

Court's perspective, however, PE's validation study is a mere summary and does not comply with TWGDAM guidelines. Certainly, PE recognizes the importance of TWGDAM validation studies and knows how to conduct one. Defendant's Exhibit A, a TWGDAM validation of PE's AmpFISTR™ Blue kit, a triplex system, is extremely thorough and covers in depth the TWGDAM validation guidelines. The study, by PE scientists in conjunction with scientists from the California Department of Justice DNA Laboratory, was published in the *Journal of Forensic Sciences*, a journal which the experts at the hearing all agreed is a peer reviewed publication. In that study, PE states:

To systematically evaluate the reliability of this STR kit for forensic applications, studies as suggested by the Technical Working Group on DNA Analysis Methods (TWGDAM) committee were performed. The TWGDAM committee has published recommended studies as guidelines to evaluate, and thus to "validate" the performance of a new DNA assay under consideration for forensic applications. Forensic samples of biological origin are unique because they may be exposed to an infinite variety of environmental elements. Validation is particularly important to empower the forensic analyst to understand how to reliably interpret results from such unique samples. (Defendant's Exhibit at 855)

By comparing PE's User's Manual "validation study" to its published TWGDAM validation study, one can conclude three things: One, that PE recognizes the need to validate new methodologies under TWGDAM; two, that the triplex test performed by its kits was such a methodology; and three, that PE's chapter on validation in its User's Manual is not a validation study in any meaningful sense. This study does not comply with TWGDAM's rigorous demands. It fails to include its developmental data nor the results of its studies, and is more a brief summary than a validation study. Furthermore, PE has resisted releasing its developmental data claiming that the data was unavailable, that it had never been systematically recorded, that it was scattered throughout various departments at the company and its collection at this time would be unduly burdensome.

Despite the scientific community's consensus that developmental validation studies are key, Dr. Budowle, Dr. Dressell and Ms. Lobato all testified that the lack of a TWGDAM validation study was insignificant here given that information about this method has been widely disseminated through numerous poster sessions and symposia. The Court has no evidence confirming these presentations as a substitute for validation, e.g. the number of presentations, the attendance, depth of coverage, or data exchanged.

Dr. Budowle also testified that partial validations were done by the 21 labs during the development of the system. The testimony, however, was that these laboratories worked on early versions of the kits and none actually performed validation studies on the final product. And no evidence was presented that these studies were published.

Both Dr. Dressell and Agent Lobato testified that the system had been internally validated by CBI as required by TWGDAM before its use forensically. This enables the laboratory to ensure reproducibility and consistency and is necessary before a purchasing laboratory begins forensic casework with the kits. This would seem to go more to laboratory procedures, however, which are issues of weight and do not address general acceptance.

The People in their brief argue that Promega's system, GenePrint™ and PowerPlex™, is substantially similar to PE's and that a validation study of that system is available. This study was not made available to the court, however, such evidence, as well as evidence of peer review, would have aided the Court. Although the Promega validation was not entered into evidence, the Court downloaded a validation study of Promega's system performed according to TWGDAM guidelines by GeneLex Corporation. The study noted several problems with the system but concluded that it is a robust and "powerful technology that *may* significantly improve the utility of DNA testing for the criminal justice system." (*emphasis added*) The Court has no further information as to other studies conducted with these kits, no information as to whether the underlying developmental data or primer sequences were released or how extensively the system is being used forensically and otherwise which would give weight to the People's argument.

Finally, both sides admit there are problems with STR multiplexes such as stutter, peak height ratio thresholds, allelic drop-out and pull up which make informed interpretation of test results extremely important. In recognition of some of these problems, and after conducting its own tests on the kits, the FBI altered its standard operating procedures from those recommended by PE in its manual. This illustrates the need for peer review and justifies TWGDAM's concern about the proliferation of commercial kits. Without meaningful peer review, without some time period for corrections, laboratory technicians may be tempted, as was CBI, to simply follow the kit's User's Manual without discretion.

Taking TWGDAM and the NRC as representative of the scientific community's consensus, the Court is convinced that validation data must be available in some form for dissemination and there must be enough time between development and forensic casework to allow for critical assessment. Here, the kits became available commercially around November or December of 1998 and CBI conducted Mr. Shreck's tests in January of 1999. The People's experts testified that the systems were reviewed at poster sessions and seminars, but the Court does not know the details of these symposia. There were no published validation studies. Although the articles introduced into evidence were not peer reviewed, they do indicate that the system is being widely used. In fact, within less than a year of the kits' release, over 100 laboratories were using the kits in the U.S. and many more internationally. Dr. Budowle testified that as part of its statutory mandate, the FBI conducts yearly audits of the laboratories submitting profiles for inclusion in CODIS. He said that 98% of this typing is done in forensic laboratories and that of these, nine out of 10 are using the Profiler Plus and Cofiler kits and not Promega's. Given the fact that Dr. Budowle testified that the kits are essentially the same and both perform equally well, this popularity is more a reflection of aggressive and successful marketing by PE rather than a filtering through the scientific community of the kits' proven reliability.

In view of the consistent reference and adherence by the scientific community to TWGDAM's guidelines, the Court finds it difficult to understand Dr. Budowle's position that in this case, TWGDAM's requirements may be dispensed with. When asked why he has, then, resubmitted his article for publication, he stated that he is doing so only to satisfy U.S. courts under *Frye/Daubert*. Thus, he infers that validation/peer review is unnecessary and that he is merely going through the exercise to satisfy some outdated legal standard. This Court, however, does not consider the requirements of general acceptance as evidenced by peer review and validation outdated, especially in this area of science and technology which has great potential to significantly influence a jury. These requirements are necessary protections both for the jury and

the defendant. Thus, the Court is not willing to depart from 77 years of jurisprudence that began with the Supreme Court's decision in *Frye* and extends even to *Daubert* which clearly underscores the importance of peer review. Therefore, because PE's developmental data were never published and there is no evidence of adequate peer review, the Court finds that adequate validation has not been done on PE's multiplex system.

Expert testimony

Although Dr. Budowle testified that the method has been generally accepted and is reliable despite the lack of validation per TWGDAM, under the circumstances, the Court does not feel it can rule on this testimony alone. The Court does not doubt Dr. Budowle's credentials. They are impressive, impeccable and inspiring. However, Dr. Budowle is not entirely disinterested. He was instrumental in the development and promotion of these kits. One of his primary goals from the beginning was uniformity in testing and adoption of the system by the laboratories which would be providing data to the national CODIS databank. Consequently, he has a vested interest in seeing the system succeed. He has expended considerable time, energy and funds to this end and has much to lose if these results are inadmissible in court. Although the Court does not doubt his professional expertise, nor his view that the kits are reliable, under these circumstances, the Court can not rest its decision on his word alone.

Caselaw supporting the admissibility of DNA evidence from the Profiler Plus and Cofiler

The People provided the Court with three district court cases which admitted DNA evidence obtained using PE's new multiplex system. The Court has already determined that the analysis in *Dishmon* is insufficient to provide guidance here. In the Utah District Court case *State v. Butterfield*, 981909353, Salt Lake County (April 26, 1999), the court found that PCR is accepted in the scientific community. Next, the court found that, based on the state's expert witness, STR tests are reliable. Further, the court found that the methods employed in STR testing are sufficiently similar to those in RFLP to enable the court to find them similarly reliable. The court's ruling, then, included no analysis of the various multiplex STR systems and how they differ from RFLP and thus provides little guidance to this Court.

The final case is *People v. Bersch and Hronis*, 94FO7295, Sacramento County Superior Court (October 20, 1999). There, the court recognized that PCR tests vary and found that the requirement of general acceptance extends to the particular test employed and not simply all PCR-based tests. However, the court determined that the issue was not the kit, but simply STR tests in general. Thus, finding that PCR-STR is generally accepted, the court found the evidence obtained with PE's multiplex kits admissible. But, the court also noted that in some contexts, the information regarding the kits merges with the question of general acceptance itself. The court then proceeded to rule, in the alternative, that PE's system met the requirements of general acceptance. In making this determination, the court concluded that validation was a factor to consider and found that validation of the system had been extensive and substantially complied with TWGDAM. The court based this on internal validation done by the DOJ, and partial developmental validation studies conducted by the DOJ and various other laboratories. These studies, together with expert testimony and other scientific literature, convinced that court that the kits' multiplex technique was generally accepted.

This is the only decision on these multiplex systems provided by the People that engaged in a

meaningful analysis of the evidence. However, the Sacramento court was evidently provided with evidence not provided to this Court. Therefore, based on the evidence this Court received and the analysis herein, this Court disagrees with the result reached by the California Superior Court.

Conclusion

The FBI has invested a great deal of money and time on this system as have the laboratories that purchased the kits. There is great incentive to prove their reliability. They will probably be found reliable after the shortcomings noted above are addressed. However, "probably reliable" is not the standard for admissibility in a court of law. The Court understands that, in this rapidly changing field, the time frame in which acceptance is evidenced may be accelerated, especially where market competition drives the technology. But, where a defendant's freedom is at stake, market competition is no substitute for good science.

PE's desire to establish a foothold in this market and aggressively and quickly market these kits is understandable. The system is already being used widely in various applications other than forensic casework and, at this point, these uses may be appropriate. But its use for forensic casework is not appropriate until there is evidence of its reliability and reliability is not shown simply by aggressive marketing. Laboratories which choose to begin using such systems before appropriate validation has occurred, or systems which make adherence to TWGDAM difficult, as PE did by refusing to release its primer sequences and developmental data, must live with the possibility that their testing results may not be admissible in court. Dr. Dressell testified that after Mr. Shreck's tests, CBI suspended the use of these kits for forensic work. Although she testified that CBI stopped using the kits because of policy decisions as to the best use of resources, it is hard not to draw the inference that the laboratory is waiting until the system has been properly validated before continuing its use for casework. No doubt that is one reason Dr. Budowle is currently pursuing publication of his study.

The Court has had great difficulty in resolving this case. This may simply reflect the complexity of the subject matter, but it also indicates that the Prosecution has been unable to meet its burden of proof at this point in time. In coming to a final decision, the Court finds the analysis in *State v. Dishon*, 687 A.2d 1074 (N.J. Super. A.D. 1997) particularly illustrative. There, in finding DQa generally accepted, the court stated: "The reports also explain that the reliability and validity of DQ alpha tests have been demonstrated by blind trials, population studies and analyses performed on over 10,000 samples by laboratories including Cetus Corporation, the FBI and numerous other scientific centers. The testing procedure has been the subject of over 3,000 publications. This wide recognition and use of the PCR-DNA procedure establishes acceptance in the scientific community." *Id.* at 1085. While *Dishon* only illustrates the type of evidence that leads to a finding of general acceptance, it also highlights the fact that the system at issue here is still relatively new and thus the evidence presented in support of that system is still being developed. Therefore, the Court finds that, at this point in time, the multiplex technique employed by the Profiler Plus and Cofiler kits has not been generally accepted in the scientific community. Therefore, these test results are not admissible against Mr. Shreck.

Reliability under *Daubert*

Should the Colorado Supreme Court accept *Daubert*, the Court's conclusions here are the same.

Analyzing the evidence according to the factors laid out in *Daubert*, the Court finds:

1. Testability of the scientific theory or technique - Although Dr. Budowle testified that the technique can be tested without disclosure of the underlying primer sequences, this position is contrary to the scientific consensus as expressed in TWGDAM and results in forcing independent laboratories to purchase the kits in order to test the system.
2. Whether the theory or technique has been subject to peer review and publication - The technique has not been subject to meaningful peer review; the developmental validation study by PE was never published and the underlying data hidden from view.
3. The known or potential rate of error – Although there is dispute as to the need to adjust the statistical calculations for error, the NRC has concluded that this is not necessary. Dr. Budowle testified that the FBI adjusts its results for error after having conducted the statistical analysis. The People's expert on statistical analysis, Dr. Sandy Zabell, concluded that error rates are a problem and that the better practice is to include error rates in the statistical calculations, but that at the least, the issue should be presented to the jury. Therefore, the issue of error rates goes more to weight than admissibility.
4. The existence or nonexistence of maintained standards – Although there was evidence that CBI has standard operating procedures, the scientific community has set clear standards for validation through TWGDAM which have not been followed.
5. Whether the theory or technique has general acceptance in a relevant scientific community - There is no evidence of general acceptance apart from the quantity of laboratories using the kits.

For these reasons, the Court fails to find sufficient reliability even under *Daubert*.

THE PRODUCT RULE

Due to the fact that DNA typing is only an examination of a DNA sample's sequence and/or length at discrete locations, a match in DNA typing is always a statistical exercise. In order to determine the probability that a particular genotype might occur at random in a population, population data must be gathered to make an estimate of the frequency of each allele and genotype. The genotype of each allele found in DQa, PM, D1S80 and STR has a probability frequency based on how often it is observed in the population. In general, the allelic frequency is determined for sample populations based on ethnic or race origins. Therefore, the probabilities are usually calculated according to the racial group of the suspect. In order to determine the probability that a particular genotype might occur at random in a population, population data must be gathered to make an estimate of the frequency of each possible allele and genotype. Not only must the population size be adequate, but the individuals must have been chosen in a random fashion. Usually a sample size of greater than 100 samples is sufficient to make reliable projections about a genotype's frequency in a larger population. Similarly, each genotype or allele typed must occur independently, in other words, the appearance of one allele must be

random and not linked to the appearance of another. If so, then the probability frequency of each genotype is multiplied by the probability frequency of the other genotypes to calculate the overall probability that the entire allele profile is found in a given population. This is called the Product Rule.

The Defendant objects to the DNA results in this case in part because he claims that the Product Rule is not generally accepted in the scientific community and PE's database was too small and not random.

The second NRC report concludes that the Product Rule should be used to calculate a profile frequency for PCR-based systems. Furthermore, numerous jurisdictions have found the Product Rule generally accepted. Thus, the Court declines to relitigate this issue as it finds that the Product Rule has been found generally accepted by courts throughout the nation, including Colorado.

There was conflicting evidence as to the sufficiency of PE's database. The FBI utilizes its own database that was created according to generally accepted techniques, according to Dr. Budowle. Although both Agent Lobato and Dr. Budowle testified that there was no statistical significance between calculations done with the FBI database and that done with PE's database, Agent Lobato says she refigured the STR loci according to the FBI numbers. The original DQa, PM and D1S80 had all been done using the FBI data. Because the People state they are willing to use only the FBI data in their calculations for presentation at trial, the Court need not examine the validity of PE's database. Therefore, the Court finds that the FBI population database is admissible under *Frye* with any concerns by the Defense going to weight and not admissibility.

COLLECTION, PRESERVATION, AND HANDLING OF CRIME SCENE SAMPLES

Because the Court finds that the issues of collection, preservation and handling are issues of weight and not admissibility under *Lindsey*, the Court declines to engage in a *Frye* analysis of these techniques. The Court further finds Dr. Dressell's testimony that CBI has established and follows adequate standard operating procedures in this area credible. The fact that the laboratory has only had one case of in-house self contamination is impressive, especially as that occurred during a training session. Attacks on these procedures, including the lack of accreditation, are matters for the jury's consideration.

V. CONCLUSION

In sum, the Court finds that PCR amplification, PCR-STR monoplex and triplex testing, and the statistical analysis used in this case, including the Product Rule and the FBI's population database, are reliable and generally accepted in the relevant scientific communities. The Court further finds that the Prosecution failed to prove by a preponderance of the evidence that the STR

multiplex techniques used in this case are generally accepted and the results reliable. Therefore, these DNA tests are inadmissible against Mr. Shreck. The DNA evidence from the other tests, however, is admissible at trial.

Done this _____ day of _____, 2000.

BY THE COURT

Daniel C. Hale

District Court Judge