La Preuve Pénale et des Tests Génétiques: United States Report

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La Preuve Pénale et Tests Génétiques
United States Report

THE U.S. PROBLEM OF FEDERAL—STATE JURISDICTION

A major problem for those analyzing U.S. criminal law and procedure is that it does not fit the Continental or British mold. There is no one single system, but parallel federal and 50 state systems each with its own legislature, laws, courts (including trial, appellate, and supreme courts), police, prosecutors and prisons. The authorities who enact and implement these laws are sovereign within their respective jurisdictions. Each state has police power over its people. The 10th amendment to the U.S. Constitution controls allocation of federal and state authority. It provides that whatever the Constitution has not designated as being within federal competence and jurisdiction or has not been denied to the states, belongs to each state, which has its own procedural system to enforce its criminal laws, within the framework of basic constitutional protections.¹ The one unifying feature is constitutional law. U.S. criminal procedure is intricately and intimately intertwined with constitutional law. This has tremendous impact on law enforcement procedure and technique, including that on evidence taking, testing, and use in trial.

Primary responsibility of controlling criminality and defining crime rests with the states, although the list of federal crimes and federal jurisdiction keep expanding. Despite the fact that the individual states are generally in the forefront of the confrontation between the nation and the criminal, the dictates of the U.S. Constitution set the parameters of that confrontation. State constitutions may provide more protection, but not less. Today, many provide more. Thus, federal jurisdiction obtains for certain constitutionally listed offenses,

¹ Kamisar, LaFave & Israel: Basic Criminal Procedure: Cases Comments, & Questions 2-3 (7th ed. 1990, with Supps.).
including piracy, felonies on the high seas, crimes against the law of nations, and counterfeiting. The list of federal crimes and federal jurisdiction are expanding. Congress has promulgated several federal crimes, such as those relating to hijacking and terrorism. The federal government is assumed to have the authority to prescribe and enforce criminal laws relating to drug smuggling or tainting of food-stuffs because of the constitutional grant of power to protect national health and safety. Federal criminal law covers crimes involving U.S. government instrumentalities, such as post offices or national banks, foreign affairs, and crimes against instrumentalities established by treaty. Federal criminal jurisdiction also applies throughout federal enclaves—specially designated geographical areas such as military bases or national parks.

State and federal criminal law began with English Common Law, and statutory interpretation generally is based on basic common law concepts. Each state has evolved separately, however, with some selective inter-pollination. Each state has its own prescriptive, adjudicative and enforcement jurisdiction and its own procedural and enforcement mechanisms, limited by basic constitutional protections. Fragmentation of procedure and administration, thus, is a serious problem. In a large metropolitan area there may be more than one-hundred separate police systems, each operating independently of [and often competing against] each other. Tremendous variety exists in types and organization of police agencies, of prosecutorial agencies, of judiciaries; there are even two types of defense attorneys (public defenders and private lawyers). Looking from the outside, especially from nations where there is unity, supervision, and control, this may appear to be a pagaille de confusion.

So many variations exist among the states themselves and between the states and the federal system that any short overview must over simplify, but it is clear that there is no one answer to most of the questions in the questionnaire. Thus, I will address these

2. U.S. Const. art. I, sec. 8, cls. 6, 9.
3. See, Kamisar et al., supra n. 1, at 2-3; Christopher L. Blakesley, Terrorism, Drugs, Extradition & the Protection of Liberty, at Ch. 3 (1992).
5. Blakesley, supra n. 3, at Ch. 3.
6. U.S. Const. art. I, sec. 8, cl. 3.
7. Kamisar, LaFave & Israel, supra n. 1, at 2-3. Each state owes the other jurisdictions' records, acts, and judicial decisions Full Faith and Credit. U.S. Const. art. I § 1, which provides that Full Faith and Credit shall be given to public acts, records and judicial decisions of sister states. The enabling legislation, 28 U.S.C. provides that each state give the legislation, records, and judicial decisions of each sister state and the federal government the same effect that legislation and judicial decisions have in their own system.
9. Kamisar et al., supra n. 1, at 4-5. For example, there are at least 3,000 different types of agencies that may be described as prosecutors offices.
questions, sometimes separately and sometimes combined, where this makes sense given our system.

21. & 2. When may DNA sampling and testing occur and What conditions and procedures for taking samples are required?—Impact of Constitution: Seizure of Blood Samples for DNA Testing to determine a person's guilt in a crime is a 4th Amendment Seizure, Requiring Probable Cause & Does Not Violate Other Parts of the Bill of Rights.

1.1 & 1.2 Sampling may be done both at the time of arrest or after the criminal charge has been laid. Sampling and testing may occur at arrest, before arrest, after indictment, or after conviction, depending on the circumstances. DNA samples may be taken and tested when there is probable cause to believe that a person might be responsible for a crime. A warrant is usually required, but this may be dispensed with if there is an exigency. Samples may be taken from individuals, such as those already convicted, before they are released from custody or from individuals in a certain status. These will be discussed further, below.

2. Collection of Samples. What procedures are required for collection of samples? 2.1 - At the crime scene. No general, national protocols exist for "quality control" in sample taking from crime scenes. Error and contamination occur and cause failure in prosecution and erroneous convictions at trial. 10

2.2 From the individual—What degree of force may be used to obtain samples? Taking a DNA sample is a 4th Amendment search and seizure, but the test is whether the sampling and testing is reasonable. The invasion of a person's body to withdraw blood is quite an intrusive search, so it generally requires authorization by a warrant based on probable cause to believe that the blood constitutes evidence of an offense or will establish the identity of a perpetrator. 11 If blood or other tissue is taken in a reasonable (sterile, medically proper) manner, without excessive violence, it will not violate due process or the 4th Amendment. 12 Also, extraction and use of samples are not violations of the 5th amendment right not to be forced to be a witness against oneself; the blood is not testimonial in nature. 13


13. Schmerber v. California, id.
Texas, the 5th Circuit Court of Appeals approved the taking of blood and hair samples by force from a suspect in custody, even when the suspect violently objected. The suspect was handcuffed between two cots for the extraction, after he had kicked, hit, and attempted to bite the agents who were trying to obtain the sample.

2.3 Special Rules & Requirements Re: Convicts, Military personnel, minors, incompetent adults—Required Testing & Maintenance of DNA Data Banks—Is Informed Consent Required? *Convicts*. Recently, many states and the federal government have promulgated laws mandating DNA testing and storage of samples for persons convicted of various offenses. For example, testing and storage is prescribed for, "person[s] convicted...[even if not sentenced to a term of confinement],...as a condition of [such a sentence]...." These laws often apply to "[a]ny person convicted of...: (a) Sexual crimes, including rape, sodomy, public indecency, incest, or sex-related crimes involving minors; (b) Burglary or robbery; (c) Murder, aggravated murder, felony murder, or manslaughter; (d) Kidnapping; (e) Aggravated assault; (f) Arson; (g) Conspiracy or attempt to commit any felony listed in this section..." Oklahoma's law is typical in providing that the purpose "of the sampling, storage, and maintenance of the database is to detect or exclude of people who may be subjects of investigation of crimes in which biological evi-

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16. E.g., DNA Identification Act of 1994, 42 U.S.C. § 14132 (1995) (federal law which authorizes FBI to create a criminal DNA database — called CODIS — and authorizes funding to states to do the same); Cal.Pen.Code § 290.2 (1995); Ala.Code § 36-18-24 (1995) (allows database use to identify persons in mass disasters, missing persons, or those convicted of certain crimes); Or.R.S. § 137.076 (1995); Okla. Stat. tit. 22, § 991 (Supp. 1996); Maine R.S. tit. 25, § 1574 (1996) (persons, including juveniles convicted of listed crimes); R.S.Mo. § 650.055 (persons "convicted of a felony defined as a violent offense [under Ch. 565] or as a sex offense [under Ch. 566].... shall have a blood sample drawn for purposes of DNA profiling analysis before release from or transfer to, a state correctional institution, county jail or detention facility. Any blood sample taken shall be used solely for the purpose of providing DNA or other blood grouping lists for profiling analysis and prosecution of violent offense or sex offense." Ohio R.C. 2901.07 (calling for DNA testing of those convicted of or who plead guilty to crimes including aggravated murder, murder, kidnapping, rape, and sexual battery, but not robbery); Colo. Rev. Stat. § 17-2-201 (inmates convicted of an offense involving a sexual assault required to provide DNA sample before release on parole); Kansas Stat. Ann. 1991 Supp. 21-2511 (collection of blood & saliva specimens from felons convicted of crimes, including "unlawful sexual act," 1st and 2nd degree murder, incest, aggravated incest, or abuse of a child); McAllister, "The Constitutionality of Kansas Laws Targeting Sex Offenders," 36 Wash. L.J. 419 (1997); State v. Smith, 1997 WL 476662 (Ohio App. 1997).


dence has been recovered; the statute shall be used for no other purpose."\textsuperscript{19} Most states have DNA repositories to maintain the capacity to identify recidivists.\textsuperscript{20}

**No Constitutional Violation?** Drawing a convict's blood, testing, and storage have been held not to be a violation of a convict's reasonable expectation of privacy.\textsuperscript{21} The invasion of a person's body to withdraw blood is one of the more intrusive types of searches, so it normally requires authorization by a warrant based on probable cause to believe that the blood constitutes evidence of an offense or will establish the identity of a person who participated in the crime.\textsuperscript{22} If the blood or other tissue is taken in a reasonable manner (in sterile, medically proper circumstances) it will not violate due process or the 4th amendment.\textsuperscript{23} For convicted felons, however, the rule is different. The "special needs" approach, created by the U.S. Supreme Court, provides the rationale for searches that otherwise would be barred by the 4th Amendment. "Special needs" establish the reasonableness of testing prisoners and other convicted felons.\textsuperscript{24} Courts have found that strong governmental interests, such as preserving a permanent identification record of convicted felons, outweighs the intrusion of taking and testing samples.\textsuperscript{25} Testing is also not held to violate the 5th Amendment right not to be forced to be a witness against oneself, because the blood is not testimonial in nature.\textsuperscript{26} Nor does testing violate the 8th, 9th, and 14th amendments.\textsuperscript{27} Finally,

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\item \textsuperscript{19} Okla. Stat. tit. 74, § 150.27a (Supp. 1996) (emphasis added); Huseman, Taylor v. State, id.
\item \textsuperscript{21} E.g., Cooper v. Gammon, 943 SW.2d 699 (Mo.App. 1997).
\item \textsuperscript{22} See, e.g., State v. Dickens, 484 S.E.2d 553, 558 (N.C. 1997). A warrant is not needed, if probable cause and an exigency exists.
\item \textsuperscript{23} See, Schmerber v. California, supra n. 12; Rochin v. California, supra n. 12.
\item \textsuperscript{24} Under the "special needs" approach, searches are allowed upon less than probable cause. See, e.g., N.J. v. T.L.O., 469 U.S. 325 (1985); Griffin v. Wisconsin, 483 U.S. 868 (1987). See, Jones v. Murray, 962 F.2d 302 (4th Cir.), cert. denied, 506 U.S. 977 (1992) (upholding Virginia statutory requirement that all convicted felons be given DNA tests, noting that "there is no per se 4th amendment requirement of probable cause or even a lesser degree of individualized suspicion, when government officials conduct a limited search for the purpose of ascertaining and recording the identity of a person who is lawfully confined to prison."); State v. Olivas, 856 P.2d 1076 (Wash. 1993) (upholding Washington State statute that required drawing of blood and DNA testing of those convicted of sexual and violent offenses, so as to create a DNA data bank for use in future prosecution of recidivism). See also, Rise v. Oregon, 59 F.3d 1556 (9th Cir.1993) (statute requiring involuntary DNA tests of inmates is a minimal intrusion upon 4th amendment interests).
\item \textsuperscript{25} See, e.g., Jones v. Murray, id., at 307; Rise v. Oregon, id., at 1561.
\item \textsuperscript{26} Schmerber v. California, supra n. 12.
\item \textsuperscript{27} See, e.g., Boling v. Romer, 1336 (10th Cir. 1996) (re Colorado statute, holding that while obtaining and analyzing DNA or saliva of inmates is a search and seizure under the 4th amendment, it is "reasonable" under that amendment and not testimonial in violation of the 5th); Schlicher v. Peters, 103 F.3d 940 (10th Cir. 1996) (upholding Kansas statute as not being in violation of 4th amendment).
\end{itemize}
punishment for refusal to submit to drawing blood or testing includes placement in solitary confinement or other administrative punishment; this has been held not to violate due process, nor to be cruel and unusual punishment, nor ex-post-facto punishment even for those who were convicted prior to the enactment of the law.\textsuperscript{28}

\textbf{2.4. Minors and Incapables.} In 1996, the Alabama Senate issued SB 264, which allowed taking fingerprints, photographs, and DNA samples from students, without prior permission.\textsuperscript{29} In some arenas, such as the proposed Genetic Privacy Act, special protections are indicated for minors and incapables,\textsuperscript{30} although some say that the protections are hollow.

\textbf{2.5. Military Personnel.} The Department of Defense requires soldiers to provide DNA samples to create a DNA registry, which is to be used "to identify the dead in all future wars and to prevent [having] any more unknown soldiers."\textsuperscript{31} This requirement was challenged by military personnel, who claimed that taking without consent is an unreasonable search and seizure. The 9th Circuit Court of Appeals, however, held that the potential nefarious uses about which plaintiffs worried were too remote and speculative to be justiciable.\textsuperscript{32}

\textbf{2.6. Retention & Storage of Samples/test Results—Protection of Confidentiality & Sanctions for Unlawful dissemination.} States that have promulgated DNA database laws have included rules on confidentiality and penalize unlawful use.\textsuperscript{33} There is, however, a dearth of national safeguards or standards regulating DNA data banks.\textsuperscript{34} Federal law fails to address the procedure for disposition of the DNA samples themselves.

\textbf{2.7. Exoneration of Convicted Persons by DNA testing.} Several states have passed new legislation allowing convicts within certain categories to obtain DNA and other scientific testing to try to

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\textsuperscript{28} E.g., Cooper v. Gammon, 943 S.W.2d 699, 706-707 (Mo. App. 1997).
\textsuperscript{29} Alabama SB 264 (1996); 57 Ala. Lawyer 224, 234 (July 1996). The "special needs" rationale will certainly be the basis for justifying this. Cf., Veronia School Dist. v. Acton, 115 S.Ct. 2386 (1995) (drug testing of high school athletes).
\textsuperscript{31} Huseman, supra n. 18; Daryl van Duch, "DNA = Do not Appropriate, Say Soldiers & Civilians," Nat'l L.J. of May 27, 1996, at B-1; Mealey's Litigation Reports: Concerns About Privacy of Military Specimens are Address, Court says (April 11, 1997).
\textsuperscript{32} Mayfield v. Dalton, No. 95-16626, 37 Fed.R.Serv.3d 458 (9th Cir.1997); Mealey's Litigation Rpts., supra n. 31.
\textsuperscript{33} E.g., Maine R.S. tit. 25, § 1577, provides that "DNA records are confidential and may not be disclosed to any person or agency unless disclosure is authorized by this section..." and § 1578 makes knowing dissemination a "class E crime."
\end{flushright}
obtain review of their convictions.\textsuperscript{35} For example, four men imprisoned for some 18 years (two on death row) were released after being conclusively proved innocent in Illinois.\textsuperscript{36} The U.S. Department of Justice commissioned a study of wrongful convictions, which notes 28 sexual assault or rape/murder decisions in which defendants were released from prison after DNA evidence conclusively exonerated them.\textsuperscript{37}

2.8. Errors in Gathering, Testing Procedures, or Statistical Analysis—Weight or Admissibility? Human error, contamination, band shifting, and the subjective nature of interpreting results, among other things, can cause erroneous decisions.\textsuperscript{38} Contamination and human error may occur at the crime scene, during transport, storage or testing. We will consider each in turn.

\textbf{Human Error.} There are many points in the process of gathering samples and testing DNA where human error can affect the outcome. Mixing samples, contaminating samples, mislabeling, using unsterile tools or repositories can do this. In a recent California case, a lab accidentally switched the victim's reference samples with those from the defendant, then mistakenly interpreted the victim's own DNA in a vaginal sample as "matching" defendant's DNA.\textsuperscript{39} Accuracy of test results requires a competent staff and a properly designed set of laboratory procedures.\textsuperscript{40} Poor lab work causes error.\textsuperscript{41} Laboratory error involves all human and technical errors, including: mislabel-
ings, misrecordings, misrepresentations, case mix-ups, contaminations, and all sorts of interpretive errors. There is a constant danger of samples being switched, of cross-contamination, of contamination during sample-taking. Errors are not uncommon, due to the storing of tools or devices involved in the taking, storing, and sending of the samples to the testing laboratory.

In addition, moisture and bacteria cause DNA degradation. Bacteria, foreign blood, or other material may contaminate materials or tools utilized in the testing. These contaminate the sample; misleading results occur. Dr. Michael Baird, Director of forensic and paternity testing at Lifecodes, testified in the famous Castro case that his company knowingly continued to use contaminated containers and tools used in the testing process. Indeed, "it was not his practice to even bother to record in a laboratory notebook the fact that a probe was found to be contaminated." This practice "invites the occurrence of false positives and false negatives." True, many laboratory technicians are hardworking, dedicated, and capable. Still, the DNA replication process that makes possible the testing of minute samples or the repeated testing of small samples lends itself to the possibility of confounding problems of contamination. Since most samples come from sources that may be contaminated with bacteria, there is the possibility that the DNA replicated is that of the contaminant. Some technicians are simply incompetent; some may be dishonest. Any reasonably effective defense should mount an attack on every phase, but this requires sufficient expertise.

**False Positives.** Most false positives are caused by human error, yet, it is frequently stated, incorrectly, that false positives are impossible in DNA (RFLP) analysis. Whether a "false positive" is possible depends on how one defines "false positive." If one asks, on the other hand whether there can be a "false positive" if the actual testing system fails, there is little likelihood that there can be a "false positive."

46. Id.
If one asks whether human error or design can cause a “false positive,” the answer, is obviously yes, as in any science. Although there are few published studies of actual error rate in forensic DNA testing, those which have been done seem to suggest an error rate of about one percent.

**Contamination.** Vigilance is required to prevent contamination or other degradation of DNA. Sunlight, temperature, bacteria, and other environmental conditions can break DNA down. Soil, detergents, and carpet cleaners among other things, can contaminate and degrade DNA. Contamination can make the DNA incapable of analysis. More dangerously, it may cause the restriction enzymes used in RFLP step 2 (fragmentation) to cut the DNA in the wrong place. When bacteria is allowed to grow on a sample or contaminants containing non-human DNA is allowed to corrupt it, the contaminant DNA will show up on the audiograph (RFLP step 6). This obviously is a potential problem; consequently, human and non-human DNA must be distinguished. Still, some courts have held that contamination in both RFLP and PCR methods go to weight rather than to admissibility.

**Impact of Procedural Errors.** Scholars and courts in the U.S. are split over whether procedural errors in gathering, storing, and testing samples should render the evidence inadmissible or

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50. *DNA Evidence*, supra n. 48, at 464; cf., Daubert v. Merrell Dow Pharmaceuticals, Inc., 113 S.Ct. 2786, 2787 (1993) (noting the known or potential error rate as one of factors). Daubert is analyzed infra.
51. Goodwin & Gurule, supra n. 38, at 302.
55. See, e.g., U.S. v. Hicks, 103 F.3d 837, 845-846 (9th Cir. 1996) (although PCR is especially susceptible to contamination the issue goes to weight, not admissibility), citing, U.S. v. Chischilly, 30 F.3d 1144, 1153 (9th Cir. 1994) cert. denied, 115 S.Ct. 946 (1995) (RFLP contamination potential goes to weight, not admissibility); see also State v. Lyons, 924 P.2d 802, 813 (Or. 1996) (holding that PCR contamination goes to admissibility: “[t]he potential for contamination may present an open field for cross-examination or may be addressed through the testimony of defense experts at trial, . . . [but] it does not mean that the PCR method itself is inappropriate for forensic use . . .”)
56. See, e.g., State v. Davis, 814 S.W.2d 593, 603 (Mo. 1991) (concludes, applying the Frye test, that the “manner in which the [DNA] tests were conducted goes more to the credibility of the witnesses and the weight of the evidence . . .”); Walker v. State, 1997 WL 539438 (Fla. 1997) (defendant’s concerns go to the weight of the DNA evidence not admissibility); State v. Islay, 936 P.2d 275, 279-81 (Kan. 1997) (applying Frye to hold that both the scientific DNA tests and the statistical significance go to weight); St. v. Campbell, 691 A.2d 564, 571 (R.I. 1997)(to weight); State v. Harvey, 1997 WL 422956 (N.J. 1997) (to weight); U.S. v. Jakobetz, 955 F.2d 786, 800 (2d Cir. 1992) (pre-Daubert case holding that this is a matter of weight); U.S. v. Bonds 12 F.3d 613 1998
whether this goes to the weight of the evidence. The Arizona Supreme Court held that the DNA testing process has three steps: (1) a DNA "print" or "profile" has to be made of the "crime scene sample" and of the sample that will be compared to that from the crime scene. (2) a determination of whether these two profiles match must be made. (3) If the samples "match," the probability of a random match must be computed. The complexity of the several step process, the fact of human fallibility, and other attendant problems create a significant potential for error. This has caused some courts to hold that the issue of whether correct procedures were utilized is a matter of admissibility, not weight. Even laboratories using only one particular test (RFLP, for example) apply different testing protocols. The Alabama Supreme Court held that, although both DNA testing theory and matching technique are generally accepted in the scientific community, the chance of error in performance is serious enough that a third prong or inquiry must be satisfied before DNA evidence may be admitted. Generally accepted techniques must be used in the particular case and they must be performed without error. The Maine Supreme Court held in 1997, that errors in procedures and controls may go to admissibility; DNA theory and techniques are scientifically reliable, "if conducted in accordance with appropriate laboratory standards and controls." The Indiana Supreme Court noted: "...DNA test results are not magic words, which once uttered, cause the doors of admissibility to open..." It went on: "[a]lthough Indiana Code... attempted to make DNA evidence per se admissible without an inquiry into whether it is scientifically reliable in a partic-

540, 563 (6th Cir. 1993) (alleged mistakes by the laboratory go to weight; their impact is for the jury); U.S. v. Chischilly, 30 F.3d 1144, 1154 (9th Cir. 1994) (impact of mistakes in lab procedures goes to weight not to admissibility).

57. State v. Stenson, 940 P.2d 1239, 1270, 1273 (Wash. 1997) (admissibility, per Frye); State v. Schwartz, 447 N.W.2d 422, 428 (Minn. 1989) (applies Frye to determine that proper testing performance is a matter of admissibility, not weight); Murray v. Fla., 692 So.2d 157, 161-63 (Fla. 1997). See, also., U.S. v. Black Cloud, 101 F.3d 1258 (8th Cir.1996) (DNA procedures and techniques used in DNA testing were sufficiently reliable to make the test results admissible).


60. Goodwin & Guralé, supra n. 38 at 290; Perry v. State, 586 So.2d 242 (Ala. 1991).

61. Goodwin & Guralé, supra n. 38, at 299.


ular case, . . . DNA testing, like any other evidence aided by expert testimony, must be offered in conformity with Indiana Rules of Evidence. Specifically, the court must satisfy itself that the scientific principles upon which the expert testimony rests are reliable. . . ."66 The Florida Supreme Court held that scientific evidence was not admissible when it failed to meet the

"three requirements . . . for the admission at trial of expert testimony concerning a new or novel scientific principle like DNA. First, the expert’s testimony . . . is not the kind that will assist the jury in understanding the DNA tests or determining a fact in issue because the expert simply did not explain how he performed the DNA tests or the basis of his statistical conclusions. Second, this evidence did not meet the ‘general acceptance’ standard of Frye for admissibility because the expert . . . misled the court as to the general acceptance of the PCR method . . . in the relevant scientific community. . . [T]hird, this expert was simply not qualified to report the population frequency statistics at issue . . . because the expert had no knowledge about the database upon which his calculations were based. . . ."67 “[W]e relied heavily on the [NRC 1992 Report], . . ., and took judicial notice that DNA test results are generally accepted as reliable in the scientific community, provided the laboratory has followed accepted testing procedures that meet the Frye standard to protect against false readings and contaminations. The burden is on the proponent of the evidence to prove the general acceptance of both the underlying scientific principle and the testing procedures used to apply that principle to the facts of the case. . . .68

The Kansas Supreme Court explained. “DNA print testing and the process of [RFLP] analysis have been recognized as reliable, have gained general acceptance in the scientific community, involve scientifically and professionally established techniques, and thus, meet the criteria for admissibility. . . ."69 Statistical analysis is crucial. Whether a match occurs has no evidentiary significance, unless the match is statistically significant. If a large percentage of the general population would match the crime scene sample, the match is not very incriminating to any particular suspect.70 Several state supreme

courts have held that the accuracy of the statistical probability claims based on DNA analysis and the FBI data base, go to weight not admissibility.\textsuperscript{71} The argument is that, like in any expert testimony, the opposing side may challenge it and present its experts. The Minnesota Supreme Court, although acknowledging the validity of DNA printing, refused to admit evidence when the testing laboratory had not published its population genetics studies.\textsuperscript{72}

**Band Shifting.** Band shifting occurs when identical DNA fragments travel through the agarose gel at different rates in step 3 of the RFLP process (the electrophoresis stage).\textsuperscript{73} This may be caused by differences in the amount of DNA loaded, especially when ethidium bromide is used in the gel.\textsuperscript{74} It may occur because of variations in voltage applied, or placing too much DNA into the gel or even from using certain chemical dyes.\textsuperscript{75} The scientist is attempting to determine whether two DNA fragments are identical, based on how far they travel through this gel. Thus, if one fragment travels further than the other or both travel further than they should, an incorrect result can occur.\textsuperscript{76} Before the restriction endonuclease digestion, the technician would normally measure the concentration of DNA in each sample, and then digest equal amounts to be run in each lane.\textsuperscript{77} Inaccuracy in the measurement can result in one lane being overloaded with DNA. This lane will run differently from adjacent lanes loaded

\textsuperscript{71} State v. Isley, supra n. 69, at 280-81; State v. Campbell, supra n. 56, at 571; State v. Buckner, 941 P.2d 667 (Wash. 1997) ("[W]e now conclude that there should be no bar to an expert giving his or her expert opinion that, based upon an exceedingly small probability of a defendant's DNA profile matching that of another in a random human population, the profile is unique. As in the case of all expert testimony, the opposing side will be able to challenge the expert's opinion and present its own experts."). The claim of extremely small probabilities have been admitted in several recent cases. E.g., Smith v. State, 478 S.E.2d 379, 380 (Ga. 1996) (prosecution and defense experts agreed on match probability of 1 in 100 billion); People v. Miller, 670 N.E.2d 721, 272, 732 (Ill. 1996) (no abuse of discretion admitting expert testimony of probabilities, involving several forensic samples, of 1 in 465 million Caucasians, 1 in 1.1 trillion Caucasians, and 1 in 466 billion Caucasians, given the level of acceptance of the product rule); People v. Blasioli, 685 A.2d 151, 165-66 (Pa. Super. 1996) (1 in 10 billion probability based upon product rule).

\textsuperscript{72} State v. Schwartz, 447 N.W.2d 422 (Minn. 1989).

\textsuperscript{73} Goodwin & Gurulé, supra n. 38, at 302.


\textsuperscript{75} Goodwin & Gurulé, supra n. 38, at 202; Fishback v. People, 851 P.2d 884, 887, n. 7 (Colo. 1993).

\textsuperscript{76} Goodwin & Gurule, supra n. 38, at 202.

\textsuperscript{77} Id., at fn. 99. DNA concentration can be measured by determining the amount of UV light of 280 nanometer wavelength that is absorbed by a sample. The more UV light is absorbed by the sample, the greater the concentration of DNA in the sample. This measurement is inherently inaccurate because UV light absorption can be caused by other contaminants like proteins, ribonucleic acids and free nucleotides. A more accurate technique is to add a fluorescent dye that binds to DNA and to measure the amount of sample fluorescence. Results obtained with the fluorescence technique can still be skewed by sample contamination.
with a "normal" amount of DNA." 78 A monomorphic probe should be used to test for band shift, 79 but, even if no such probe is used, courts are prone to consider the risk of error as going only to the weight and not the admissibility of the evidence. 80

**Daubert & Correction for "Band Shifting."** The Louisiana Supreme Court recently focused on the troublesome problem of band shifting. The defendant had stipulated that DNA profiling in general and RFLP analysis were admissible, but argued that the specific method employed by the testing laboratory to "correct" for band shifting was unreliable because there is no scientifically accepted protocol on how to adjust the bands. An expert had testified that band shifting is common in DNA analysis, explaining that that the company, Lifecodes, uses monomorphic probes, a method of correction which allows the technician to resolute the bands where they would have appeared had they not shifted. He maintained that this method corrects the problem allowing the laboratory to declare a match, even where band shifting has occurred. This expert and another testified that the laboratory "had declared a match between the defendant's DNA imprint and the seminal fluid found on the towel near the victim's leg even though the autorad showed evidence of band shifting." The Lifecodes expert testified that his laboratory was the only one that attempts to correct for band shifting and still declares a match. He maintained that the correction procedure is valid, reliable, and had been reviewed by the scientific community. The laboratory had submitted one paper for publication on the use of monomorphic probes to correct for band shifting, but the paper had not yet been published and was undergoing peer review by the date of the trial. 81

Defendant's experts disputed the lab's claims. The first testified that there was no way to correct for band shifting and that scientists generally disregarded results when it occurs. He remarked that the fact that the laboratory independently created its own correction factor — "their own personal fudge factor that no one else accepts," and that it had not even been documented. This was extremely disturbing. 82 Without correction, some of the bands would be outside of laboratory's "match" criterion of 2% deviation. The other defense expert explained further that no valid methods exist to correct the bands and that the laboratory expert's claim that the laboratory's method had been peer reviewed was unfounded. Defendant cited ju-

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82. Quatrevingt, id. He noted that the Lab's process had not even been documented.
risprudence from other jurisdictions applying the "general acceptance" or Frye standard as the basis for disallowing DNA test results when obtained after correction for band shifting.83 In addition, findings presented in the 1992 NRC Report; directly addressed band shifting. The Louisiana Supreme Court took note:

Testing for band shifting is easy, correcting for it is harder. The best approach is to clean the samples . . . and repeat the experiment in the hope of avoiding band shifting. When that is impossible because too little sample is available or it fails . . ., it is possible in principle to determine the molecular weights of polymorphic fragments in a sample by comparing them with monomorphic human bands in the same lane—so called internal molecular weight standards. These monomorphic fragments are expected to have undergone the same band shift, so they should provide an accurate internal ruler for measurement. . . .84

The use of internal standards presents serious difficulties in actual practice, however:

accurate size determination requires a number of internal standards. If band shifting caused all fragments to change their mobility by the same percentage, one would need only a single monomorphic fragment to determine the extent of shift. But band shifting appears to be more complex than that. Different regions of the gel shift by different amounts.

Little has been published on the nature of band shifting, on the number of monomorphic internal control bands needed for reliable correction, and on the accuracy and reproducibility of measurements made with such correction. For the present, several laboratories have decided against attempting quantitative corrections; samples that lie outside the match criterion because of apparent band shifting are declared to be "inconclusive." The committee urges further study of the problems associated with band shifting. Until testing laboratories have published adequate studies on the accuracy and reliability of such corrections, we recommend that they adopt the policy of declaring samples that show apparent band shifting to be "inconclusive."85

84. Quatrevign, supra n. 81, citing 1992 NRC Report, supra n. 83.
85. Id. at 60-61.
Finally the Court noted that, under the Daubert/Foret test, as well, the practice of using monomorphic probes to correct for band shifting had not been proven reliable. The state had failed to demonstrate: (1) that the technique was testable; (2) that the technique has been subjected to peer review and publication; (3) the known or potential rate of error; or (4) that the methodology is generally accepted in the scientific community. The Louisiana Supreme Court, thus, held that "[w]hile the results of DNA and RFLP analysis are generally admissible . . . so long as the trial court's 'gatekeeping' function has been performed in accordance with Daubert/Foret, Lifecodes' use of monomorphic probes to correct for band shifting was not shown to be reliable . . . , and the trial court erred in admitting the DNA evidence. . . ." 87

4. Use of DNA Test Results in the Criminal Process—

Pre-Trial. 4.1 Discovery—Are DNA test results made available to the Defense? The amount and type of discovery depends on the states. See discussion above regarding the 4th, 5th, 6th, 8th amendments, and due process.

At Trial. 4.2—4.7, Combined: Some Applications of Admissibility Standards. Types of Tests & Admissibility. Constitutional Arguments Opposing Admission: Motions to Suppress. The 4th, 5th, 8th, 9th, and 14th amendments to the U.S. Constitution have all been claimed as a basis for suppression of DNA evidence. Courts have tended not to suppress the evidence. For example, in a case in which blood was drawn for DNA testing without a warrant and without any exigent circumstances and outside the ambit of the inevitable discovery exception, the motion to suppress nevertheless was denied because blood had been tested subsequently based on a proper warrant. This was allowed even though the blood tested by the FBI and used at trial was the very same blood that had been taken in the first draw without a warrant!

It is potentially a violation of due process and a fair trial for the prosecution to comment on a party's failure to be tested to "clear his name." Prosecution should not be allowed to comment on defendant not allowing his DNA to be tested to prove his innocence.

86. Daubert, 113 S.Ct., at 2796-97.
87. Quatrevingt, supra n. 81.
88. See, e.g., Boling v. Romer, 1336 (10th Cir. 1996) (re Colorado statute, holding that while obtaining and analyzing DNA or saliva of inmates is a search and seizure under the 4th amendment, it is "reasonable" under that amendment and not testimonial in violation of the 5th); Schlicher v. Peters, 103 F.3d 940 (10th Cir. 1996) (upholding Kansas statute as not being in violation of 4th amendment).
90. Id.
91. See, State v. Ashby, 567 N.W.2d 21, 27 (Minn. 1997) (holding that in the instant case such comment was "harmless error," because of the strength of the evidence against defendant).
The overwhelming majority of courts in the U.S. admit DNA evidence in criminal trials. Challenges to the propriety of the sampling generally takes place at a hearing to exclude the evidence. Some courts are beginning to take judicial notice of the tests’ validity. Forensic DNA testing and use at trial, nevertheless, remains controversial and results will be excluded in certain circumstances. There are now at least three types of DNA tests, two of which have now generally been accepted as sufficiently well established for courts to admit them into evidence. Both federal and state courts have found that DNA profiling is a reliable technique. The original test was the restriction fragment length polymorphism (RFLP) test. Next came the polymerase chain reaction (PCR) test or method. These two methods test for DNA in the cell nucleus. Both the RFLP and PCR methods have generally been found admissible. The third, recently developed test, is the mitochondrial DNA test. This test was used for the first time in a U.S. criminal trial in 1996.


93. Goodwin & Gurulé, supra n. 38, at 285, citing U.S. v. Martinez, 3 F.3d 1191, 1197 (8th Cir. 1993).


95. See, e.g., U.S. v. Beasley, 102 F.3d 1440 (8th Cir. 1996), cert. denied, 117 S.Ct. 1856 (1996) (PCR method is admissible and deficiencies in administering testing go to weight, not admissibility); U.S. v. Martinez, supra n. 93, at 1197 (recognizing admissibility of RFLP testing); U.S. v. Jakobetz, supra n. 56, at 799-800.

96. See, e.g., U.S. v. Hicks, 103 F.3d 837, 845-846 (9th Cir. 1996) (although PCR is especially susceptible to contamination, this goes to weight, not admissibility) (RFLP contamination potential goes to weight, not admissibility); see also State v. Lyons, 924 P.2d 802, 813 (Or. 1996) (PCR contamination goes to admissibility: “[t]he potential for contamination may present an open field for cross-examination or may be addressed through the testimony of defense experts at trial, but it does not mean that the PCR method itself is inappropriate for forensic use. . .”). U.S. v. Jakobetz, supra n. 56; Hayes v. State, 660 So.2d 257 (Fla. 1995); Commonwealth v. Rodgers, 413 Pa.Super. 498, 605 A.2d 1228 (1992); Trimboli v. State, 817 S.W.2d 785 (Tex. App. Waco 1991), affd, 826 S.W.2d 953 (Tex. Cr. App. 1992); Caldwell v. State, 393 S.E.2d 436 (Ga. 1990).


100. See, e.g., U.S. v. Beasley, supra n. 95 (“we note that a number of state appellate courts have examined the PCR method, and . . . have sustained the admission . . . We now join their ranks . . . ”); State v. Fleming, 1997 WL 430024 (Me. 1997) (“. . . a number of state and federal court[s] have addressed] the admissibility of DNA evi-
tion procedure is newer than RFLP analysis and works differently. PCR analysis is less definitive than RFLP, because it can only exclude an individual as being a possible donor of the sample. The final result is merely that the tested individual is not the sample donor or that the individual is within a certain percentage of the population which could have donated the sample. The advantages of the PCR, as compared with the RFLP, method are that PCR is faster, cheaper, and can be performed at more facilities. In addition, it can be performed on samples too small or in a condition too poor to be tested by the RFLP procedure. 101 The Massachusetts Supreme Court held in August 1997, that "... PCR-based testing at [the DQA1, the PM, and the D1S80 loci] ... have been scientifically validated." 102 All courts require strict compliance with mandated admission procedures. 103

Although more problematic, several statistical theories and methods have been accepted as admissible, such as the unmodified product rule. 104 The 1996 NRC Report, The Evaluation of Forensic

dence as a forensic tool in criminal cases, we join the overwhelming number of jurisdictions that have found the overall theory and techniques of DNA profiling scientifically reliable if conducted in accordance with appropriate laboratory standards and controls. . . .") (footnotes omitted); cf., Barnes v. State, 1997 WL 545770 (Ala. App. 1997) (remanding case to apply standards of Ex Parte Ferry, 586 So.2d 242, 255 (Ala. 1991) (discussed infra) to determine admissibility of PCR testing results. See also, State v. Hill, 895 P.2d 1238 (Kan. 1995) (PCR method admissible); So. Dakota v. Moeller, 548 N.W.2d 465 (S.D. 1996); Oregon v. Lyons, 924 P.2d 802 (Or. 1996); Spencer v. Virginia, 393 S.E.2d 609 (Va. 1990); N.Y. v. Morales, 643 N.Y.S.2d 217 (N.Y. App. Div. 1996);

101. State v. Isley, supra n. 69, at 279; citing, State v. Hill, supra n. 100 (recognizing and explaining the two methods).

102. Commonwealth v. Va SOK, 1997 WL 488945 (Mass. 1997), noting, "[a]n authoritative work in this field by the National Research Council Committee on DNA Forensic Science, The Evaluation of Forensic DNA Evidence (1996) [1996 NRC Report, at 72], has found that PM testing "is beginning to be widely used" and has been validated with tests for 'robustness' (reliability) by various studies. . . .[T]he value of the D1S80 technique for forensic analysis has been validated in a number of tests." [NRC Rpt. at 72, 117, . . .]. The Court continued, holding that the reliability of PM and D1S80 testing has been demonstrated. Id., citing, Gross, "HLA DQA1 and Polymarker Validations for Forensic Casework: Standard Specimens, Reproducibility, and Mixed Specimens," 41 J. Forensic Sci. 1022 (1996); Walkinshaw, "DNA Profiling in Two Alaskan Native Populations Using HLA-DQA1, PM, and D1S80 Loci," 41 J. Forensic Sci. 478 (1996); Word, "Summary of Validation Studies from Twenty-Six Laboratories in the United States and Canada on the Use of the AmpliType PM PCR Amplification and Typing Kit," 42 J. Forensic Sci. 39 (1997).

103. Goodwin & Gurulé, supra n. 38, at 290-91; Teacher's Manual, at 100.

104. People v. Givens, 61 Cal.Rptr.2d 816, 824 (Cal. App. 1997) (the unmodified product rule used in calculating statistical frequencies in connection with DNA testing — as opposed to now questioned ceiling principle, is generally accepted by scientific community, hence, statistical evidence is admissible). But see, State v. Hollis,1997 WL 306432 (Wash. App. 1997) (reversing the trial courts ruling that neither the interim ceiling principle nor the product rule are generally accepted within the relevant scientific community). Extremely small probabilities have been admitted in several recent cases. E.g., Smith v. State, 478 S.E.2d 379, 380 (Ga. 1996) (prosecution and defense experts agreed on match probability of 1 in 100 billion); People v. Miller, 670 N.E.2d 721, 727, 732 (Ill. 1996) (no abuse of discretion admitting expert testimony of probabilities, involving several forensic samples, of 1 in 465 million Caucasians, 1 in
DNA Evidence (1996), which is given much deference, supports the unmodified product rule. Courts have properly noted that the "ultimate results of DNA testing would become a matter of speculation without statistical evidence." Standards for Admission—Frye & Daubert.

Frye. Some courts admit an expert's DNA report, where the expert testifies that an accurate protocol was followed in collecting and processing the evidence. Population genetics theories utilized for these calculations have been debated. The scientist compares the accused's DNA to that represented in a laboratory database that contains samples from at least one hundred people of the same or similar race, calculating the frequency with which the subject's print is found in such a population. This calculation is supposed to determine the likelihood of identification. Prior to Daubert, all courts applied either the Frye standard, the Frye Plus standard, or the relevancy approach. Several states still apply the Frye test, holding that the RFLP technique is generally accepted by the appropriate scientific community. "[I]f a scientific technique has gained general acceptance in the relevant scientific community, then we will deem it presupmissively reliable and will generally admit the test results."

1.1 trillion Caucasians, and 1 in 466 billion Caucasians, given the level of acceptance of the product rule.; People v. Blasioli, 685 A.2d 151, 165-66 (Pa. Super. 1996) (1 in 10 billion probability based upon product rule is admissible).


107. Litton v. Litton, 624 So.2d 472, 475 (La. 2d Cir. 1993); cf., State v. Simien, 677 So.2d 1138 (La. 3d Cir. 1996); State in Interest of Braden v. Nash, 550 So.2d 866 (La. 2d Cir. 1989).


112. People v. Wilds, 37 Cal.Rptr.2d 351, 354 (Cal. App.), rev. granted & decision superseded, 39 Cal.Rptr.2d 406 (Cal. 1995) (RFLP DNA method admissible under the Kelly-Frye standard that allows admission of new scientific technique only after the method's reliability has been established); People v. Amundson, 41 Cal.Rptr.2d 127, rev. granted, (Cal. App. 1995) (PCR, RFLP, and statistical calculation of probabilities by the product rule are generally accepted by scientific community); People v. Wallace, 17 Cal.Rptr.2d 721 (1993); cf. People v. Venegas, 36 Cal.Rptr.2d 856, rev. granted (Cal. App. 1995) (appellate court reversed trial court's admission of DNA evi-
Evidence will not always be admitted, however. A Massachusetts court found that the testing laboratory had violated its own laboratory protocol in rendering their decision based on only one DNA probe, even though the parties involved were first degree relatives.113

**Daubert.**114 The U.S. Supreme Court, in *Daubert*, replaced the *Frye* “general acceptance” standard with one that requires a trial court to act as a “gatekeeper” to ensure that any and all scientific testimony or evidence admitted is not only relevant but reliable. The *Frye* standard had been superseded by Federal Rule of Evidence 702.115 The Court recognized the fundamental truth that science is a methodology, not a mass of knowledge.116 Courts must now focus on the scientific methodology utilized, rather than merely looking at the muster of scientists who support the evidence as under *Frye*.117 The reliability of scientific evidence is to be promoted by a requirement that there be a “valid scientific connection to the pertinent inquiry as a precondition to admissibility.”118 The court should examine this connection in light of a “preliminary assessment” by the trial court of whether the reasoning or methodology underlying the testimony is scientifically valid and properly can be applied to the facts.119

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116. Daubert, supra n. 115.
118. Daubert, supra n. 115, at 2795.
119. St. v. Foret, 628 So.2d 1116, 1122 (La. 1993), citing Daubert.
Daubert applies only to federal cases, although several states have adopted an identical approach.\textsuperscript{120}

\textbf{Federal Rule of Evidence 702} reads: “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. . . .” Several states have adopted identical or similar rules of evidence and apply the \textit{Daubert approach}.\textsuperscript{121} The U.S. Supreme Court, thus, thrust trial courts into the position of gatekeeper for proffers of scientific evidence; as screeners of its validity under Rule 702.\textsuperscript{122} \textit{Daubert} is concerned with determining the admissibility of testimony relating to “novel scientific knowledge and techniques” and whether an expert’s testimony will be helpful to the fact finder. \textit{Daubert} rejected the \textit{Frye Standard} as being inconsistent with the Federal Rules of Evidence.\textsuperscript{123} Rule 702 uses the terms “scientific” and “knowledge,” which require that “an inference or assertion . . . be derived by the scientific method. Proposed testimony must be supported by appropriate validation — i.e., ‘good grounds,’ based on what is known. In short, the requirement that an expert’s testimony pertain to ‘scientific knowledge’ establishes a standard of evidentiary reliability.”\textsuperscript{124} The test focuses on the relevancy of scientific evidence to the ultimate question [identification], the qualifications of the scientist testifying, whether the evidence presented will be more helpful than confusing to the trier of fact, and whether the possible prejudicial effects of the evidence will be outweighed by its probative value.\textsuperscript{125} The Louisiana Supreme Court held: “In considering whether scientific evidence is reliable, the trial court should consider the following factors . . .: (1) ‘Testability’ of the expert’s theory or technique; (2) whether the theory or technique has been subjected to peer review and publication; (3) the known or potential rate of error; and (3) whether the methodology is generally accepted in the scientific community.”\textsuperscript{126}

\textsuperscript{120} E.g., St. v. Foret, supra, n. 119, at 1123; La.R.Evid. 702; Tex.R.Crim.Evid. 702; Nations v. State, 944 S.W.2d 795, 796 (Tex. App. 1997); Ind.R.Evid. 702; Jervis v. State, 679 N.E.2d 875, 881 (Ind. 1997).

\textsuperscript{121} E.g., The Louisiana Supreme Court embraced \textit{Daubert} in 1994. St. v. Foret, 628 So.2d 1116, 1123 (La. 1993) (holding also that it applied retroactively); State v. Quatrevingt, 670 So.2d 197 (La. 1996). Louisiana Evidence Code article 702 is virtually identical to the federal rule. See also, Tex. Rule of Crim. Evid. 702; see also, Mitchell v. Kentucky, 908 S.W.2d 100 (Ky. 1995).

\textsuperscript{122} Daubert, supra n. 115.

\textsuperscript{123} Daubert v. Merrell Dow, supra n. 114; Giannelli, \textit{Forensic Science} supra n. 110, at 433.

\textsuperscript{124} Daubert, supra n. 114; Giannelli, supra n. 110, at 433.


\textsuperscript{126} Id., citing Daubert, 113 S.Ct. at 2796-97.
evidence should be admitted in proceedings whenever the trial court, after balancing the probative value of the evidence against its prejudicial effect, determines that “the evidence is reliable and will aid in a decision.” The Court reiterated:

... Daubert goes further... in that it sets forth clearer guidelines for determining the reliability of scientific evidence in its consideration of the probative value aspect of the balancing test... The similarity between La.Code Evid. art. 702 and its federal counterpart, ..., persuaded this Court to adopt Daubert's requirement that, in order to be admissible under... art. 702, scientific evidence must rise to a threshold level of reliability.

Many argue that the Daubert criteria should include peer review of the expert's work, publication, rate of error, testability, and that the decision to admit evidence should include consideration of the scientific community's acceptance of the expert, his theory and methodology. State statutes apply the Daubert approach, like Louisiana R.S. 15:441.1, which provides: “[E]vidence of [DNA] profiles, genetic markers of the blood, and secretor status of the saliva offered to establish the identity of the offender of any crime is relevant as proof in conformity with the Louisiana Code of Evidence.” The Louisiana Legislature intended DNA evidence to be admissible absent a showing that the particular evidence is unreliable.

A federal trial court must also apply Federal Rule of Evidence 104(a). This requires the court to assess the validity of the methodology underlying scientific expert testimony. The U.S. Supreme Court, in Daubert, listed several factors to assist the court in this determination, including: (1) empirical testing; (2) whether a theory or technique has been subjected to peer review and publication (relevant, but not dispositive); (3) the technique's "known or potential rate of error"; (4) the "existence and maintenance of standards controlling the technique's operation" as an indicia of trustworthiness; (5) "general acceptance" as an important criterion, although not dispositive.:

[6] presence of safeguards in the characteristics of the technique, [7] analogy to other scientific techniques whose results are admissible, [8] the extent to which the technique has been accepted by scientists in the field involved, [8] the nature and breadth of the inference adduced, [9] the clarity

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127. Quatrevign, supra 121, citing Foret, n. 119, at 1123, citing State v. Cantanese, 368 So.2d 975, 978-79, 983 (La. 1979).
128. Id., citing Foret, supra n. 119, at 1123.
130. Id.
131. Daubert, supra n. 115; Giannelli, Forensic Science, supra n. 110, at 434.
and simplicity with which the technique can be described
and its results explained, [10] the extent to which the basic
data are verifiable by the court and the jury, [11] the avail-
ability of other experts to test and evaluate the technique,
[12] the probative significance of the evidence in the circum-
stances of the case, and [13] the care with which the tech-
nique was employed.132

Some Outstanding Daubert Issues, include: Whether there
are cases that defy the ability of fact finders to understand133 Even if
fact finders can finally learn enough to understand such complex
problems, do the time and cost exceed the value obtained?134 Could
resources be better used elsewhere? Who should decide whether they
could better be used elsewhere? Where should they be used? Who de-
cides that? How can fact finders decide which of two “experts” is cor-
rect, without actually understanding what the experts understand?
Under Evidence Rule 702, the issue is whether the given “scientific
knowledge” is helpful to the fact finder. That, of course, does not de-
termine what is meant by “scientific knowledge.”135 Professor Ronald
Allen has written:

[T]he most regrettable aspect of Daubert is that the Court
seemed quite unaware of the implications of admitting data
without a basis for believing that the data can be under-
stood. By doing so, it seems to be putting its stamp of ap-
proval on undeliberative and nonrational legal decision
making, which I think to be the antithesis of the law’s aspi-
rations. Jurors or judges who cannot understand the reason-
ing of a witness can only accept or reject the witness’
conclusions, but neither acceptance nor rejection will occur
rationally. The choice will not be made because a fact finder
understands the reasoning and sees either its cogency or its
flaws; it will be made for some other reason. And the set of
“some other reasons” is, from the point of view of the law’s
aspirations, filled with unsavory characters.136

Types of Statutes on Admitting DNA Evidence. Many states
have promulgated statutes allowing DNA evidence to be admitted at
trial.137 Alaska, for example, allows DNA profile evidence to prove or
disprove “any relevant fact,” if the court finds that the technique un-

132. Daubert, supra n. 115, quoted and discussed in 3 J. Weinstein & M. Berger
133. Allen, “Expertise & the Daubert Decision,” 84 J. Crim. L. & Crim. 1157,
134. Id.
135. Id. at 1158-59, 1169.
136. Id. at 1174–75.
137. See discussion of some in Smith & Gordon, Admission of DNA Evidence,
supra, n. 115, at 2487-88.
derlying the evidence is sufficiently valid.\textsuperscript{138} Indiana and Minnesota allow admission even without expert testimony.\textsuperscript{139} Delaware admits RFLP evidence to "prove or disprove the identity of any person. . . ."\textsuperscript{140} Some require that, prior to admission, there be a showing that the laboratory used "proper procedures," although this often goes to weight, not admissibility.\textsuperscript{141} Some require that the testing laboratory be "accredited."\textsuperscript{142}

The Washington Supreme Court recently held that the methodology underlying RFLP typing is generally accepted by the scientific community and admissible under Frye. It also held that the statistical evidence of genetic profile frequency probabilities must be presented to the trier of fact. It approved the ceiling principle (modified, or "interim," ceiling principle).\textsuperscript{143} In September 1996, the Washington Supreme Court described the "product" or "multiplication" rule:

Briefly restated, the product rule (or "multiplication rule") as applied in RFLP typing means that the probability of a genetic profile occurring in the population is the product of the probabilities of each individual allele's occurrence in the population. Validity of the rule depends upon whether the individual alleles are actually statistically independent. Two assumptions underlie use of the product rule when calculating genetic profile frequencies: linkage equilibrium, which means that the alleles at different loci are inherited independent of each other, and Hardy-Weinberg equilibrium, which means that one allele at a locus is not predictive of the other allele at that locus (one allele is inherited from the mother, the other from the father). Hardy-Weinberg equilibrium depends upon an assumption of a large population in which there is random mating. . . The Committee reported in 1992 that substantial controversy arose about the adequacy of population databases used to calculate frequency estimates and about the role of racial and ethnic ori-

\textsuperscript{138} Alaska Stat § 12.45.035(a) (1996).
\textsuperscript{141} Smith & Gordon, supra n. 115, at 2487. See discussion of weight v. admissibility, supra. See, e.g., Washington v. Kalakosky, 852 P.2d 1064, 1073 (Wash. 1993), and authority cited infra.
\textsuperscript{143} State v. Copeland, 922 P.2d 1304 (Wash. 1996). For more on the "ceiling principle," see infra and State v. Jones, 1996 WL 528838 (Wash. en banc, 1995). However, while the court approved the ceiling principle, it has not foreclosed use of other statistical models provided they are accepted in the scientific community. State v. Buckner, supra n. 71.
gin in the frequency estimation. . . Potential problems could result from "genetic drift" resulting in small populations having distinct genetic differences, too small a database, lack of randomness of the samples, and most importantly, lack of a truly mixed population such that each locus is in Hardy-Weinberg equilibrium as well as linkage equilibrium. . . .¹⁴⁴


In the early days of DNA testing, fairly large trace samples were required, and the process was limited to analyzing blood and semen.¹⁴⁵ Recent developments, however, have made it possible to test minute samples of blood, semen, hair follicles, saliva, or skin tissue possible.¹⁴⁶ Courts in both the civil and criminal arenas have rushed to embrace this valuable new technology.¹⁴⁷ The embrace is occasionally overdone. A New York court stated, "[DNA testing] constitute(s) the single greatest advance in the 'search for truth,' and the goal of convicting the guilty and acquitting the innocent, since the advent of cross-examination."¹⁴⁸ Experts sometimes claim that DNA testing is infallible. It is not infallible, nor failsafe,¹⁴⁹ yet courts and experts claim that it is. "[I]t is technically impossible to make a false/positive identification."¹⁵⁰ And, "[t]here is no way to get a false positive with this technology."¹⁵¹ "The accuracy rate is 100%."¹⁵² A transcript in a Texas case reads:

"Q: Now, you're telling us that you can only get a result or no result; is that correct?

¹⁴⁴ State v. Copeland, id. (some citations omitted).
¹⁴⁷ Thames, supra n. 145, at 554-57.
¹⁵⁰ Jones v. State, 569 So.2d 1234 (Fla. 1990); quoted by Koehler, id., at 23 & n. 4.
¹⁵¹ Kelly v. State, 792 S.W.2d 579 (Tex. App. 1990); cited and quoted in Koehler, supra n. 149, at 23, n. 5.
¹⁵² State v. Davis, 814 S.W.2d 593 (Mo. 1991) (transcript, at 82); cited in, Koehler, supra n. 149, at 23, n. 8. See, also, additional authority in Professor Koehler's article, "Error & Exaggeration," supra this note especially in nn. 8 and 9.
A: That’s correct.
Q: And you couldn’t get a false positive?
A: There’s nothing like a false positive in this, no.
Q: How about if you use the wrong sample?
A: If you use the wrong sample?
Q: (Nods head).
A: You either get a result, or you don’t get a result. There’s no false positives.”

Such extravagant claims are extremely misleading and should be reversible error. The cumulation of procedural errors makes the possibility of error in identification increase. Procedural errors are documented in both laboratory proficiency tests and in actual casework. When astounding claims of probability are admitted, the risk is obvious. Some of these are: “the probability of selecting an unrelated individual of the population from the same race . . . who had a genetic profile matching [defendant] was one in ten billion.”

The combination of blind respect for science, the tendency of a judge or jury to be overwhelmed by very complex scientific, mathematical, or statistical evidence, astronomical claims of “probability,” the tendency to want to make science a talisman make the risk of error significant and deadly. Moreover, it is misleading to suggest, as some experts do, that DNA testing “identifies” a person. This inaccurately describes what the testing does and what the statistics mean. If the population base is such that the percentage actually could include some 50,000 potential persons, the potentiality of confusion is great. To claim that testing can produce a 99.9% or higher percent “probability” of “identification” is misleading. What does the statistical percentage really mean? What is the population base and what is its impact on the potentiality of fatherhood? Are counsel and the trier of fact capable of understanding the complexities of the mathematical information? If not can they apply any appropriate value to the probabilistic evidence?

As we’ve seen, DNA evidence, when admitted, often holds an aura of virtual certainty.\textsuperscript{157} Nevertheless, as in any form of scientific analysis, the testing procedure is rife with potentiality for error. Although a match reported by a laboratory may be suggestive of a true match, it is not the same as a true match. The opportunity for error occurs at each stage of the procedure and concerns about misrepresentation or misinterpretation increase as the stages of the process cumulate; each phase is part of a cumulative chain of inferences.\textsuperscript{158} Even as the inferences drawn from each phase cumulate, so do the opportunities for error.\textsuperscript{159} Failure to follow proper procedure at any stage makes error more likely at that stage and the potential cumulates over the chain of stages and the inferences drawn therefrom.\textsuperscript{160} Professor Koehler explains that many experts, judges, and attorneys, “not only fail to see the cumulative nature of the problems that can occur when moving along the inferential chain, but they frequently confuse the probabilistic estimates that are reached at one state with estimates of the others. . . [T]he resulting misrepresentation and misinterpretation of these estimates lead to exaggerated expressions about the strength and implications of DNA evidence.”\textsuperscript{161}

The trier of fact, of course, decides whether the state has met its burden of proving identity beyond a reasonable doubt.\textsuperscript{162} DNA evidence is to be presented and used with and like other evidence. DNA evidence, alone, should not be sufficient.\textsuperscript{163} Judge Gerald Sheindlin, one of the more expert judges about DNA,\textsuperscript{164} has argued that:\textsuperscript{165}

[while fully capable of understanding the scientific process used to generate the evidence, the trial lawyers and judge were confused and in awe of the analysis of complicated concepts such as Hardy-Weinberg equilibrium, linkage equilibrium, Wahlund principle, sub-populations, population drift, the Gaussian Curve and other mind boggling statistical complexities used to explain the significance of a match, and de-

\textsuperscript{157} See, e.g., People v. Fishback, supra n. 149 (DNA testing is “failsafe”); Missouri v. Davis, 814 S.W.2d 593 (Mo. 1991) (claiming 100% accuracy); Andrews v. State, 533 So.2d 841, 890 (Fla. App. 1988), aff’d 542 So.2d 1332 (1989).
\textsuperscript{158} Koehler, supra n. 149.
\textsuperscript{159} Id.
\textsuperscript{160} Id.
\textsuperscript{161} Koehler, supra n. 149, at 22.
\textsuperscript{162} See, Litton v. Litton, supra n. 107, at 474.
\textsuperscript{163} Cr. Leiter v. Scott, 854 N.E.2d 742 (Ind. 1995).
\textsuperscript{164} Judge Gerald Sheindlin is a New York City criminal court judge, who also sits on the State Supreme Court. He is an expert on DNA evidence, has written two books on the subject, and has been a lecturer on that topic for the FBI. He may be most well-known for his decision in the famous People v. Castro case, supra n. 44. See, Goldstein, “At Ease With Tough, High-Profile Cases,” 216 N.Y. L.J. 1, col 3, (9/24/96).
\textsuperscript{165} Sheindlin, “DNA: Is the Presentation of Statistical Evidence Necessary?,” 214 N.Y. L.J. 1 (1995) (footnotes in this quote are Judge Sheindlin’s).
ferred to the population geneticist and statistician. [It is potentially harmful to allow] experts to invade the trial with their language rather than insist that the time honored use of our legal language, used with success and understanding from time immemorial, be the method by which expert opinion is presented. . . \textsuperscript{166} Assume that four DNA tests were conducted examining four different sections of chromosomes\textsuperscript{167} and a computerized match is observed between the DNA sample left at the crime scene and the defendant's DNA.\textsuperscript{168} Then the four separate DNA matches are compared to four separate databases consisting of a large number of randomly chosen people whose DNA was previously profiled.\textsuperscript{169}

Thereafter, for example, if two bands are observed, one at 10KB and another at 5KB (10,000 and 5,000 base pairs long), in both the defendant and the random persons tested in the database, and out of 500 people tested only one other person had the same length DNA at both areas of the chromosome, then the opinion is rendered that the odds of a random person having this band is 1 in 500. Then the match for the next chromosome is compared to a database for that chromosome.

Assuming there are 1,000 people in this database, and there are two matches at these different lengths of DNA, then again it can be said that the odds that anyone else having this band is 2 in 1,000 or 1 in 500. This process continues until the other two matches are compared and their odds are computed. These figures are then multiplied, one with the other (i.e. 500 x 500 x 350 x 400),\textsuperscript{170} producing fantastic numbers which is the foundation for the opinion that sets forth the odds of randomly finding anyone else in the relevant population (i.e. Black, Caucasian, etc.) with the same unique DNA pattern over the four chromosomes tested.

\textsuperscript{166} Id.
\textsuperscript{167} There are currently 12 different probes developed to inspect nine different sections of chromosomes. Presently, six probes are the maximum actually utilized to examine portions of nine chromosomes using the RFLP technique. In PCR, there are approximately nine different probes that are utilized to examine the genes on about 10 different chromosomes or sections thereof.
\textsuperscript{168} In these discussions, it is assumed that the DNA tests were performed correctly and with integrity. Whether a "false positive" can be generated by DNA tests, depends upon the definition assigned to "false positive." If the definition asks whether there can be a "false positive" if the actual testing system fails, then there is little likelihood that there can be a "false positive." If the definition asks if human error or design can cause a "false positive," the answer, as in any science, is obviously yes.
\textsuperscript{169} The FBI database consists of Black, Hispanic, Southeastern Hispanic, Southwestern Hispanic, Caucasian and Asian populations.
\textsuperscript{170} This is the "product rule."
In the example supplied, assuming a Caucasian defendant, the expert would render the opinion that the odds of finding a random person in the Caucasian population with the same genetic pattern is 1 in 35 billion. There are, however, only about 5-6 billion people on earth.\textsuperscript{171} Controversy over matching continues. Professor Thames explains that the bands produced by the DNA testing process do not fall on a single point but appear across a spectrum of points. "A value is given by determining where the darkest point occurs. This can be done by 'eyeball' or relegated to a computer.\textsuperscript{172} The FBI uses a computer, but the analyst may override the computer's placement of the marker; but no record is kept of the override.\textsuperscript{173} There has been no standard for declaring matches.\textsuperscript{174} If all this occurs and no record is kept, chance for error abounds with no opportunity to prove it.

\textit{Controversy—the Use of DNA Statistical Evidence and Human Error.} As we have shown, DNA testing, while very valuable, is no panacea. Prosecutors have felt [traditionally] that it is their courtroom ally.\textsuperscript{175} Serious problems arise. Professor Thames continues:

\ldots [c]ontroversy exists in the conversion of matching into probabilities. In New York \textit{v.} Castro,\textsuperscript{176} an expert from Lifecodes Laboratories cited the probabilities of a random match as one in 100,000,000 while the defense expert, using Life Codes' published procedures, calculated the odds as one in 74 and, using the FBI methodology, as one in 24.\textsuperscript{177} The National Research Council attempted to resolve this problem in its 1992 report\textsuperscript{178} proposing a "modified ceiling" approach.\textsuperscript{179} The major element of this method seems to involve assigning a minimum interim ceiling frequency of ten percent on any individual locus.\textsuperscript{180} In State \textit{v.} Cauthorn, the Washington Supreme Court adopted this position stating, "Although we lack the scientific expertise to either assess or explain the methodology, its adoption by the (NRC) Committee indicates that sufficient acceptance within the

\textsuperscript{171} Id.
\textsuperscript{172} Id., at 556.
\textsuperscript{173} Id.
\textsuperscript{175} Sherman, "DNA Unraveling," 15 \textit{The National Law Journal}, p. 1, col. 1, Feb. 1, 1993 (noting that there appears to have been a dramatic shift toward defense counsel in the vigorous tug-of-war with prosecutors regarding this evidence).
\textsuperscript{176} People \textit{v.} Castro, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (Sup. Ct. 1989).
\textsuperscript{177} Hoeffel, supra n. 175, at 482 (citing the expert's report in the case).
\textsuperscript{178} National Research Council, DNA Technology in Forensic Science (1992) (cited in Minnesota \textit{v.} Alt, 504 N.W.2d 38, 43 (1993)).
\textsuperscript{179} Minn. \textit{v.} Alt, 504 N.W.2d at 50.
\textsuperscript{180} Id.
scientific community has been achieved to satisfy Frye in appropriate circumstances."^{181}

**National Research Council (NRC) 1992 & 1996 Reports.** Several states have followed the recommendations of these reports, prepared by the prestigious National Research Council (NRC). Based on the more rigorous aspects of the 1992 Report, several courts refused to admit DNA evidence containing the dramatic statistics shown by the FBI and commercial laboratories.^{182} The 1992 approach, included what is often called the "ceiling principle."^{183} The 1992 Report recommended that random samples of 100 persons from each of 15–20 populations, which represent groups relatively homogeneous genetically, be taken. Researchers are then advised to take the "ceiling frequency," either the largest frequency in any of the referenced groups or populations or 5%, whichever is larger.^{184}

**The NRC 1996 Report.** This Report has been criticized for, among other things, accepting lower standards,^{185} for having paid insufficient attention to serious problems relating to interpretation of DNA test results, for acquiescing to less rigorous interpretive standards than were called for in the 1992 NRC Report, and for assuming unrealistically, that retesting criminal defendants will rectify laboratory errors.^{186} These problems are critical, given the reality and prevalence of poor scientific practice in interpreting DNA test results!^{187} Another difficulty is that the 1996 Report fails to focus on evidential weight, causing tangentiality in terms of what is important at trial, and causing misunderstanding.^{188} It provided that evidence adduced using the product rule be admissible. It accepted that data from different ethnic groups within the major races imply that both the ceiling principle and the modified ceiling principle are unnecessary.^{189} Courts have accepted

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181. Thames, supra n. 145.
182. Sherman, supra n. 175.
186. Id.
189. National Research Council, The Evaluation of Forensic DNA Evidence 5 (1996 NRC Report) (repudiating ceiling principles: "sufficient data have been gathered to establish that neither ceiling principle is needed . . . [and that] this is true a fortiori for the direct counting method. . .").
the 1996 Report’s, approval of the product rule as the “statistical best estimate” of genotype frequencies.\textsuperscript{190}

The report did recognize that “this new technology burst on the scene so rapidly that there are essentially no standards and no regulation disturbing prospect since the largest potential source of error lies in poor laboratory practice.”\textsuperscript{191} The 1992 Report had urged Congress to promulgate legislation requiring accreditation of all DNA typing laboratories, and that DNA evidence be admitted, only if the laboratory has been accredited. It recommended that the Department of Health and Human Services, in consultation with the Department of Justice be charged with the task of setting up the accreditation and regulatory program.\textsuperscript{192} It also recommended that a National Committee Forensic DNA Typing be established, and be housed in the National Institutes of Health or the National Institute of Standards and Technology, to obviate expensive courtroom fights. This Committee is to evaluate new approaches to DNA Testing and matching, to oversee blood sample collection for the population studies, and to advise the courts on statistical questions.\textsuperscript{193}

Recently, two of the opposing scientists in the famous quarrel over population statistics appear to have reconciled their differences, or at least called a truce, in a published paper. They said that their argument was more academic than real and that both the conservative ceiling principles and the liberal product rule should be admissible.\textsuperscript{194} Others still wonder. Judge Sheindlin, for example:

“\textit{[a]re conservative numbers as mischievous a legal approach as the presentation of ridiculous astronomical numbers generated by the product rule?}”\textsuperscript{195} Does either approach have any meaningful relationship to the truth we are seeking in the trial of a criminal case? Does the presentation of these odds even come close to the truth that is being sought? Does evidence of negative odds tend to distract the jury? Do they tend to confuse the real issue? In order to resolve the issue, we must be sensitive to the real questions being presented at

\begin{itemize}
\item \textsuperscript{191} Roberts, “DNA Fingerprinting: Academy Reports,” 256 Science 300, 301 (April 17, 1992).
\item \textsuperscript{192} Id.
\item \textsuperscript{193} Id.
\item \textsuperscript{194} Lander & Budowle, “DNA Fingerprinting Dispute Laid to Rest,” 371 Nature 736 (1994); see, Sheindlin, supra n. 165.
\item \textsuperscript{195} In California v. Soto, 30 Cal.App.4th 340 (1994), the court noted the opinion of Dr. Kenneth Kidd, director of the Yale University DNA laboratory and an executive of the Human Genome Project, that the product rule is as accurate as any determination can possibly be: “Although the greater the database the greater the certainty of the estimate, any difference in estimates over one in a million becomes pragmatically meaningless.” See, Sheindlin, supra n. 165.
\end{itemize}
the trial, to wit: (1) what is the relevance of the disputed evidence to the defendant on trial? (2) What is the relationship of DNA evidence to the ultimate question of whether the guilt of the defendant has been established beyond a reasonable doubt?\(^{196}\)

Some courts have held that "if an estimated rarity of a DNA profile was not arrived at in a scientifically generally accepted manner, and so was inadmissible, then so too was the fact of a match."\(^{197}\) The ceiling principle is criticized,\(^{198}\) as being an unscientific guess at the best method of overcompensating for the problems of substructuring. On the other hand, precisely for that reason, some courts, in Frye jurisdictions hold that statistical testimony based on the modified ceiling principle is admissible even though testimony based on the traditional computation technique is inadmissible, because the ceiling principle generally understates the probability of a random match.\(^{199}\) But,

"the FBI has not found a four probe match between a defendant and a random person in over 7.5 million DNA tests performed. The National Research Council of the National Academy of Sciences in its report of 1992 entitled "DNA Technology in Forensic Science" [notes] that it would be an extremely rare event to find two people with the same genetic profile over three or four chromosomes. Hence, is it appropriate to tell the jury the odds of a match when we know that information is not true? Do we do it in serology? fingerprinting? ballistics? Hair comparisons? . . . "\(^{200}\)

Important issues have been raised about DNA identification. We have noted the tendency for fact finders to allow their fact-finding role to be usurped by "expert," scientists, mathematicians, or statisticians. Judge Sheindlin notes further that, "now that we [some of us] have become comfortable with our understanding of this fascinating science, would we not return to time honored legal method of presenting expert opinions . . . DNA profiling is [not] as clear as supermarket bar codes. [It is not true that] if the tests are not performed correctly absolutely no result will be obtained, [it is also not true that], where tests are performed correctly a perfectly clear picture is obtained."\(^{201}\) Finally, "[i]f DNA tests are not performed properly, you cannot distin-

\(^{196}\) Sheindlin, supra n. 165.
\(^{197}\) This is the so-called "no state, no match" rule. Wright, "DNA Evidence: Where We've Been, Where We Are, and Where We Are Going," 10 Me. B. J. 206, 208 (July 1995), and authority cited in fn. 35, which includes: People v. Wilds, 37 Cal. Rptr. 351, 354 (Cal. App.), rev. granted, 39 Cal. Rptr. 2d 406 (Cal. 1995); People v. Wallace, 17 Cal.Rptr. 2d 721, 726, n.3 (Cal.App.1993).
\(^{198}\) E.g., Wright, supra n. 197, at 208–13.
\(^{199}\) Imwinkelried letter, supra.
\(^{200}\) Id.
\(^{201}\) Scheindlin, supra n. 165, at text of fn. 28.
guish one person from another, statistically or otherwise."²⁰² Yet courts continue to make decisions based on faulty expert opinion.²⁰³

**Has the controversy really ended?**²⁰⁴ The 1996 NRC Report is commendable in many respects, but is seriously flawed in others. It fails to pay adequate attention to interpretation errors and acquires to less rigorous interpretive standards. Unfortunately, it supports the use of random match probabilities independent of plausible error rates.²⁰⁵ Following it will often cause the probative value of DNA test results to be overstated.²⁰⁶ The tendency of judges and juries to be overwhelmed by scientific and mathematical evidence creates a serious risk.

The Supreme Court of Washington reported that it has. It notes that some scientific literature supported the view that there were statistically significant deviations from Hardy-Weinberg equilibrium, indicating the presence of genetically distinct subgroups in Caucasian, African-American, and Hispanic groups.²⁰⁷ However, other literature has disputed early conclusions that the possibility of substructuring in major population groups was statistically significant.²⁰⁸

We have seen that a number of courts had concluded that in light of the scientific disagreement, there was a lack of general acceptance of use of the product rule to estimate genetic profile frequencies, and accordingly such calculations were not admissible.²⁰⁹ The Washington Supreme Court, no doubt influenced by the 1996 NRC Report, reversed its earlier decision that use of product rule for this purpose was not generally accepted because of concerns that substructuring in human populations undercut certain assumptions underlying use of the rule. Its prior decision was heavily influenced by the recognition that there was a significant dispute among the scientists.²¹⁰ The evidence today, the literature, and the case law from other jurisdictions shows that use of the product rule now has sufficient general

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²⁰². Id., at fn. 28.
²⁰³. Id., citing People v. Fishback, supra n. 149 (DNA testing is "failsafe"); Missouri v. Davis, 814 S.W.2d 593 (Mo. 1991) (claiming an accuracy rate is 100%); Andrews v. State, 533 So.2d 841, 890 (Fla. App. 1988), aff'd 542 So.2d 1332 (1989).
²⁰⁶. Id.
²⁰⁹. See, Cauthron, 120 Wash.2d at 905, 846 P.2d 502 (citing authority).
²¹⁰. State v. Copeland, supra n. 204.
acceptance that it is admissible under Frye\textsuperscript{211} for calculating statistical frequencies of genetic profiles from RFLP typing results. The Washington Supreme Court held that the trial court did not err, holding:

\[ \text{[t]his process of multiplication, . . . the "product rule," is valid if each band (or bin) is independent of the others. . . . [T]he frequencies of independent events may be multiplied to determine the frequency of their simultaneous occurrence is a universally accepted principle of statistics. [A]lthough various experts have raised theoretical objections to the use of the product rule with RFLP data, those experts who have analyzed the data agree that there is no evidence of dependence between the alleles, defined as fixed bins, used by the FBI. . . .[T]estimony, published work, and analysis performed . . . prove that independence between alleles defined as fixed bins is a valid assumption. The defense presented no evidence that the assumption of independence was invalid. Our review is de novo and we are do not defer to the trial court's finding that the product rule is generally accepted. However, we have extensively reviewed the Frye hearing . . ., and we reach the same conclusion as the trial court did. Although at one time a significant dispute existed among qualified scientists, from the present vantage point we are able to say that . . . [it] was short-lived. . . . [A]dditional empirical studies have been conducted, the FBI has collected data from around the world, and one of the most vociferous opponents of use of the product rule has joined with an FBI scientist in declaring that the DNA wars are over.}\textsuperscript{212}

The FBI study concluded: 1) that there are sufficient population data available to determine whether:

"forensically significant differences might occur when using different population databases; 2) that subdivision, either by ethnic group or by U.S. geographic region, within a major population group does not substantially affect forensic estimates of the likelihood of occurrence of a DNA profile; 3) that estimates of the likelihood of occurrence of a DNA profile using major population group databases (e.g., Caucasian, Black, and Hispanic) provide a greater range of frequencies than would estimates from subgroups of a major population category; therefore, the estimate of the likelihood of occurrence of a DNA profile derived by the current practice of employing the multiplication rule and using general population

\textsuperscript{211} Washington continues to apply the Frye test, discussed below. State v. Copeland, supra n. 204.

\textsuperscript{212} State v. Copeland, supra n. 204, at 1318.
databases for allele frequencies is reliable, valid, and meaningful, without forensically significant consequences; and 4) that the data do not support the need for alternate procedures, such as the ceiling principle approach. . . .213

In 1994, Eric Lander co-authored an article with the FBI’s Bruce Budowle, declaring “[t]he DNA fingerprinting wars are over,”214 and calling the ceiling principle “unabashedly conservative.”215 They stated: “[s]ome of the statistical power was sacrificed to neutralize all possible worries about population substructure.”216 They also wrote, however, that the 1992 NRC Report, “failed to state clearly enough that the ceiling principle was intended as an ultra-conservative calculation, which did not bar experts from providing their own ‘best estimates’ based on the product rule.”217 The FBI’s population surveys “yielded a remarkable database for examining allele frequency variation among ethnic groups. Reassuringly, the observed variation is modest for the loci used in forensic analysis and random matches are quite rare, supporting the notion that the FBI’s implementation of the product rule is a reasonable best estimate.”218 Courts have begun to take notice of the FBI’s worldwide study, the numerous empirical studies reported, and the Lander & Budowle article, and have recognized that the significant challenges to use of the product rule have been sufficiently resolved.219 Unanimity, of course, does not exist on this point and controversy has not been eliminated. In fact, the NRC 1996 Report repudiated the ceiling principles, but

213. State v. Copeland, supra n. 204, citing FBI study, at page 2. The Court also noted that other studies have similarly concluded that differences of allelic distribution is not forensically significant. E.g., Budowle et al., “The Assessment of Frequency Estimates of Hae III-generated VNTR Profiles in Various Reference Databases,” 39 J. of Forensic Sciences 319 (Jan. 1994); Budowle et al., “Evaluation of Hinf I-generated VNTR Profile Frequencies Determined Using Various Ethnic Databases,” 39 J. of Forensic Sciences 988 (July 1994); Shui Tse Chow et al., “The Development of DNA Profiling Database in an HAE III Based RFLP System for Chinese, Malays, and Indians in Singapore,” 38 J. of Forensic Sciences 874 (July 1993). Also, extensive literature in peer reviewed journals indicates that substructuring does not have much impact on DNA population frequency estimates. See People v. Marlow, 41 Cal.Rptr.2d 5, 33 (citing a number of articles, including several submitted as exhibits in Copeland’s Frye hearing), review granted, 43 Cal.Rptr.2d 679, 899 P.2d 65 (1995) (California rules provide that once review is granted, an opinion may not be cited as legal authority).


216. State v. Copeland, supra n. 204 citing Lander & Budowle, DNA Fingerprinting, supra n. 214, at 735.

217. Copeland, supra n. 204, quoting Lander & Budowle, DNA Fingerprinting, supra n. 204, at 737 (Lander was a member of the Committee).

218. State v. Copeland, supra, n. 204, citing Lander & Budowle, DNA Fingerprinting, supra n. 204, at 738.

accepted the product rule. The Washington Supreme Court held that it does not require unanimity among scientists before finding general acceptance in the relevant scientific community, holding that “use of the product rule in establishing statistical probabilities of a genetic profile frequency in the human population is generally accepted within the relevant scientific community and that a significant dispute no longer exists on this matter.”

Conclusion—Major Problems Persist

Evidence—The Need for Corroboration: Although DNA testing is more reliable than other tests, it ought to be well-corroborated. Most states have mandated that DNA or other scientific testing not be the sole factor in determining identity. Rather, it should be but one factor to be weighed against the totality of the circumstances. Although scientific testing ought to be utilized and admitted to trial, serious doubt even exists that “any expert—no matter how skilled in biochemistry or biostatistics —can correctly testify to any quantified probability of identity.” The need for corroboration stems from several factors, including difficulties with gathering, storing, and testing process and in the extreme difficulty in presenting the scientific and statistical evidence in a manner that allows it clearly and correctly to be understood.

State Evidentiary Law & Procedure: Chain of Evidence.
The chain of evidence method of identification is a widely recognized approach in both civil and criminal cases. State laws generally provide that, the chain of custody of blood or tissue samples may be established by affidavit if verified documentation of the chain of custody is submitted with the expert’s report and if such documentation was made at or near the time of the chain of custody and was made in the course of regularly conducted business activity. This requires testimony of those who are in the chain of custody. Courts generally do not allow the identity and authenticity of an exhibit to be established by a single witness. This is because several people have usually handled the specimen before, during, and after its analysis. Blood and tissue specimens, of course, should be handled with utmost care and all persons who have had access to them should be able to identify them and to testify that their custody and condition have been unchanged while in their custody. Gaps or gaffs in the chain provide opportunity for attacking the validity of the test results. Many states, however, hold that the decision as to the chain of custody is a matter within the discretion of the trial judge and will not be over-

220. State v. Copeland, supra n. 204.
222. See, Blakesley, Louisiana Family Law Ch. 6, Scientific Testing (Michie 1992) (Supp. 1996); Blakesley, Scientific Testing & Proof of Paternity, supra n. *.
turned unless there is clear error or an abuse of discretion,\textsuperscript{223} and accept a "reasonable assurance of the identity of the sample."\textsuperscript{224} Here follows an example of trial testimony regarding chain of custody of a blood sample: "... [T]he blood was drawn by a phlebotomist and not by the witness testifying. The witness, Dr. Hubbard, testified as follows:

Q. Do your records reflect the dates upon which those tests (DNA) were conducted, and in whose presence they may have been conducted, and under what types of conditions and policy?

A. Which would you like for me to answer first? I can explain to you the normal operating procedure. The blood is drawn in the hospital laboratory, not by me, it's drawn by a phlebotomist, who are people who are specifically trained to draw blood. After the blood is drawn, there are various documents that have to be signed to maintain chain of possession of the blood. An authorization to do the testing is given by individuals involved in the case. Their phlebotomy or the blood being drawn is witnessed, and the witnesses sign as to who they are. Individuals participating in the case are photographed, identified using a picture ID usually, or mutual identification. They are fingerprinted and they are photographed. Once the blood is drawn, the participants, if they are able, initial the blood tubes, if they are able. I mean if it's a minor, then one of the guardians initial the blood tubes. Then they are sealed in a sample—in a tamper evident sample package, it's not tamper proof. And once the blood samples are sealed in that tamper evident bag, along with the documentation, then participants in the test initial the seal, and then they are taken to my laboratory, and then I, or one of my technologists, opens the bag and the tests will proceed from there.\textsuperscript{225}

\textsuperscript{223} E.g., State v. Brown, 238 A.2d 482 (N.J. Super. 1968); Patterson v. State, 160 S.E.2d 815 (Ga. 1968); Shell v. Law, supra n. 221.

\textsuperscript{224} See, State v. Simien, 677 So.2d 1138 (La. 3d Cir. 1996); Patterson v. State, id.; Shell v. Law, supra n. 221.

\textsuperscript{225} From Shell v. Law, supra n. 221.