COMMENTS

DNA Fingerprinting and Paternity Testing

INTRODUCTION

In 1977 an Illinois court convicted Gary Dotson of raping Cathleen Crowell. Six years after Dotson's imprisonment, Crowell recanted her testimony and stated that she lied about the rape, fearing that her boyfriend had impregnated her.[1] In 1983 and 1985 villagers in a small

[1] Sacramento Bee, Feb. 5, 1988, at A5, col. 1. Dotson was released on parole after

town in England were shocked by two separate murders of teenage girls. Police arrested a long-time area resident and claimed that he confessed during a taped interrogation. The police eventually dropped charges and were left without a suspect.[2] In a disputed paternity case, a North Carolina court declared a husband to be the father of a child born by his wife. The husband had undergone a successful vasectomy five years before the child's birth.[3]

The common element in these events is the issue of identity — the identity of the perpetrator of a crime or of a child's father.[4] The issue of identity particularly predominates paternity disputes. In these disputes the father's identity is the most critical issue.[5] To resolve this issue, courts increasingly rely on genetic marker tests such as blood

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officials discounted Crowell's admission. *Id.*, Aug. 17, 1988, at A14, col. 1. Dotson attempted to have DNA fingerprints created from the semen samples taken from Crowell, but preliminary reports indicated that the samples had degraded. Ingwerson, *DNA Fingerprints: When the Proof Is in the Genes*, CHRISTIAN SCI. MONITOR, Apr. 12, 1988, at 3, col. 1; Moss, *DNA — The New Fingerprints*, 74 A.B.A. J. 66, 68 (1988). However, Dotson's attorney later announced that tests had been performed that proved Dotson's innocence beyond a doubt. Sacramento Bee, Aug. 17, 1988, at A14, col. 1.

[2] Schmitz, *Murder on Black Pad*, S.F. Chronicle, Jan. 17, 1988, § Z (This World), at 14.

[3] *See* Cole v. Cole, 74 N.C. App. 247, 328 S.E.2d 446 (1985).

[4] For an example of when maternal identity is crucial, see Sirohi, *Woman in India Insists Hospital Sold Her Son*, Sacramento Bee, Feb. 12, 1988, at A14, col. 1. The newspaper reported that an Indian woman refused to leave a hospital maternity ward until the hospital returned her baby son. *Id.* She insisted that the staff switched infants. *Id.* The staff allegedly sold her baby boy to a childless couple and left her with a baby girl. *Id.*

[5] *See* Note, Cutchember v. Payne*: Approaching Perfection In Paternity Testing*, 34 CATH. U.L. REV. 227, 229 (1984-1985) ("[T]he most difficult issue . . . in paternity litigation is the actual proof . . . of paternity."). Parentage disputes have occurred throughout history. *See* U.S. DEP'T OF HEALTH AND HUMAN SERVICES, NAT'L INST. FOR CHILD SUPPORT ENFORCEMENT, ESSENTIALS FOR ATTORNEYS IN CHILD SUPPORT ENFORCEMENT app. B, at 365 [hereafter ESSENTIALS FOR ATTORNEYS] ("[T]he problem of disputed parentage and the search for ways to resolve it are not new."). Twelfth-century Japan resolved genealogical controversies by requiring the individual claiming a familial relationship to mix blood with the claimed relative. *Id.* If the respective drops of blood merged in a basin the relationship was declared valid. *Id.* In biblical times, King Solomon resolved a maternity dispute by proposing that the child be cut in half. Peterson, *A Few Things You Should Know About Paternity Tests (But Were Afraid to Ask)*, 22 SANTA CLARA L. REV. 667, 668 (1982). In modern times, disputed parentage more often concerns paternity. N. STEVENSON, GENEALOGICAL EVIDENCE: A GUIDE TO THE STANDARD OF PROOF RELATING TO PEDIGREES, ANCESTRY, HEIRSHIP AND FAMILY HISTORY 7 (1979). Proof of maternity is, of course, established by witness' attending the birth. *Id.* However, the maternity issue may arise when babies are switched at birth. *See* Sirohi, *supra* note 4, at A14, col. 1.

grouping tests.[6]

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[6] *See* Ellman & Kaye, *Probabilities and Proof: Can HLA and Blood Group Testing Prove Paternity?*, 54 N.Y.U. L. REV. 1131, 1135-36 (1979) (stating that "[although] blood test evidence . . . was not admitted at first . . . courts gradually became more confident of it"); *see also* Lake & Paulsen, *From Here To Paternity*, FAM. ADVOC., Summer 1985, at 41. Before the 1930s, medical testing for paternity was unknown. *See* Ellman & Kaye, *supra*, at 1135 ("Blood test evidence in paternity actions did not begin until the 1930's."). Historically, courts determined paternity on the basis of witness credibility, the mother and the alleged father's marital status, or by comparing the superficial appearance of the alleged father and the child for common characteristics. *See* CAL. EVID. CODE § 621 (West Supp. 1988) ("The issue of a wife cohabitating with her husband . . . is conclusively presumed to be a child of the marriage."). Arbitrators of early paternity cases would often compare "father" and child and decide whether they were similar. *See* Peterson, *supra* note 5, at 668. The comparison of father to child is still a common forensic device. *Id.*; *see also* Cole v. Cole, 74 N.C. App. 247, 328 S.E.2d 446 (1985). In *Cole*, the trial court asked the mother whether she saw any similarity between the baby and her husband. *Id.* at 249, 328 S.E.2d at 448. The trial court then asked the same questions of the husband. *Id.*, 328 S.E.2d at 448; *see* Ellman & Kaye, *supra*, at 1134 ("Perhaps in desperation, judges . . . permit exhibition of the child to the jurors, so that they may assess his resemblance to the defendant."). In many jurisdictions the defendant is allowed to introduce evidence that the mother had sexual relations with other males during the possible time of conception. *Id.*

Unfortunately, these methods of determining paternity lack reliability and accuracy. *See id.* The authors cite a Chicago study indicating that over half of defendants studied lied about whether they had intercourse with the mother. *Id.* Nearly half of the mothers lied when they denied having intercourse with more than one man during the possible conception period. *Id.*; *see also* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 365 (stating that "[blood tests] minimize[ ] the guesswork involved in determining the parentage" and "turn an essentially subjective determination into a far more objective and verifiable proceeding"). For an example of questionable factors used to determine paternity, see generally Annotation, *Bastardy Proceedings: Propriety of Exhibition of Child to Jury to Show Family Resemblance, or Lack of It, on Issue of Paternity*, 55 A.L.R.3d 1087, 1091 (1974) (stating that "it is perfectly permissible for jurors to infer paternity from a perceived resemblance between a child and its putative father"). In Berry v. Chaplin, 74 Cal. App. 2d 652, 169 P.2d 442 (1946) the court used a comparison between father and child to declare Charlie Chaplin the father of a child even though blood tests had excluded him. Peterson, *supra* note 5, at 668 n.3.

Since paternity is a biological act, the accurate determination of the father's identity requires testing of biological evidence of paternity. *See* County of El Dorado v. Schneider, 191 Cal. App. 3d 1263, 1275, 237 Cal. Rptr. 51, 58 (1987) (stating that blood tests are crucial for the accurate determination of paternity). *See generally* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 366 (indicating basis for genetic blood tests). The first available type of scientific evidence of paternity was the blood grouping test, introduced in the 1930s. *See id.* at 367 (stating that "at the beginning of this century, [the] discovery of the ABO blood group system provided the basis for paternity testing as we know it today"); Ellman & Kaye, *supra*, at 1135 (stating that "blood test evidence in paternity actions did not begin until the 1930s"); Note, *The Admissibility Of Electro-*

Blood grouping tests identify a physically discernible genetic characteristic, known as a genetic marker, present in the blood.[7] These tests are based on the laws of heredity which indicate that a child and father have a number of similar genetic markers.[8] If the child and alleged father possess different genetic markers, the alleged father cannot be the actual father.[9] Originally, proponents introduced the tests to show that a defendant was not the biological father.[10] As knowledge of blood genetics increased, though, modern courts accepted the use of blood tests and statistical analysis to establish paternity.[11]

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phoretic Methods Of Genetic Marker Bloodstain Typing Under The Frye *Standard*, 11 OKLA. CITY U.L. REV. 773, 775 (1986) (observing that knowledge of existence of blood groups stems from Landsteiner's discovery of ABO system at turn of century).

[7] *See* Lake & Paulsen, *supra* note 6, at 41; *see also* State v. Klindt, 389 N.W.2d 670, 671 (Iowa 1986). In *Klindt*, an expert testified that "[f]orensic serology is an identification process involving analysis of the genetic makeup of the blood and tissues." *Id.* The analysis notes the presence of enzymes in the blood, called phenotypes or genetic markers. *Id.*

[8] *See* Lake & Paulsen, *supra* note 6, at 41-42 (stating that "exclusion is a biological certainty").

[9] *See* Note, *supra* note 5, at 230 ("Most courts . . . allowed the use of blood grouping tests only to establish that a putative father was not the true parent of a child."); Annotation, *Admissibility and Weight of Blood-Grouping Tests in Disputed Paternity Cases*, 43 A.L.R.4th 579, 585 (1986) (stating that "red blood cell grouping tests . . . are admissible . . . for the purpose of establishing nonpaternity"). This conclusion is based upon the genetic principle that chromosomes from both father and mother combine randomly at fertilization. *See* Gaensslen, *When Blood is Their Argument: Use and Interpretation of Population Genetic Marker Frequency Data in Forensic Serology*, CRIME LABORATORY DIG., Oct. 1985, at 75. If genetic markers cannot indicate the presence of the alleged father's genetic contribution, the alleged father cannot be the actual father because all systems are inherited. *Id.* at 76. An alleged father is also known as a putative father. Neubaum, *Defense of Paternity Cases*, CASE & COM., July-Aug. 1987, at 38.

[10] Lake & Paulsen, *supra* note 6, at 41-42.

[11] *See* County of El Dorado v. Schneider, 191 Cal. App. 3d 1263, 1275 n.11, 237 Cal. Rptr. 51, 59 n.11 (1987) (stating that HLA and other blood test evidence may be properly used affirmatively to establish paternity); *In re* Lukas, 155 Ill. App. 3d 512, 516, 508 N.E.2d 368, 372 (1987) (citing expert that "blood test results cannot only exclude a man as the father but . . . can now be used to determine the probability that the man is . . . the father"); *see also* County of Fresno v. Superior Court, 92 Cal. App. 3d 133, 138, 154 Cal. Rptr. 660, 663 (1979); Cramer v. Morrison, 88 Cal. App. 3d 873, 883, 153 Cal. Rptr. 865, 871 (1979). *See generally* Annotation, *Admissibility, Weight and Sufficiency of Human Leukocyte Antigen (HLA) Tissue Typing Tests in Paternity Cases*, 37 A.L.R.4th 167 (1985). The affirmative use of blood tests to establish paternity is the result of rapid advances in medical testing for paternity during the past 25 years. *See* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 365 (stating that "tests of the paternal relationship have profited from the scientific advancements of the

However, a recent advance in genetic testing — DNA fingerprinting — makes even the most precise current blood tests obsolete. DNA fingerprinting more accurately establishes paternity because rather than identifying the biological father by the process of elimination,[12] DNA fingerprinting positively identifies the father.[13] The test achieves this result by creating individual-specific representations of the DNA configurations of the putative father, the mother, and the child.[14]

This Comment advocates that California use DNA fingerprinting to establish paternity. Part I compares DNA fingerprinting to current methods of proving paternity. Part II discusses the validity and reliability of DNA fingerprinting and its admissibility in California paternity suits. Part III sets forth two proposals which admit DNA fingerprint evidence. The Comment concludes that only by accepting DNA fingerprinting into evidence will courts conclusively link father and child.

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last 25 years"); Note, *supra* note 6, at 775 ("Since Landsteiner's discovery of the ABO system at the turn of the century, knowledge of the existence of blood groups has greatly expanded." (footnotes omitted)). *Compare* Carlyon v. Weeks, 387 So. 2d 465 (Fla. App. 1980) (court more willing to admit human leukocyte antigen test results than traditional blood grouping test results because of greater precision) *with* People v. Nichols, 341 Mich. 311, 312, 67 N.W.2d 230, 232 (1954) (finding that blood type evidence "had not the slightest probative value or tendency to prove defendant's paternity"). Beginning with the ABO red cell antigen test through to the human leukocyte antigen test, science's capacity to exclude falsely accused fathers has dramatically increased.

The ABO system classifies blood into one of four genetically inherited types: A, B, AB, and O. Lee, *Identification and Grouping of Bloodstains*, *in* FORENSIC SCI. HANDBOOK 267, 298 (R. Saferstein ed. 1982); Note, *supra* note 6, at 775 (citing Lee, *supra*); *see also* Note, *supra* note 5, at 233 ("[P]reventing the admission of statistically prejudicial evidence . . . is no longer an overwhelming policy interest."). Current blood tests purport to exclude up to 99% of falsely accused fathers when a combination of the tests is used. *See Cramer*, 88 Cal. App. 3d at 878, 153 Cal. Rptr. at 867 (stating that HLA test indicates approximately 98% probability of paternity); ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 365 ("[T]he possibility of excluding a falsely accused man is greater than 90 percent and is sometimes as high as 99 percent.").

[12] *See* Dodd, *DNA Fingerprinting in Matters of Family and Crime*, 26 MED. SCI. L. 5, 6 (1986); *see also* Lake & Paulsen, *supra* note 6, at 41 ("[N]o blood test can ever unequivocally determine paternity"); Note, *supra* note 5, at 230 (stating that blood test can only establish nonpaternity).

[13] *See* Dodd, *supra* note 12, at 6.

[14] *See infra* notes 44, 50-53 and accompanying text.

I. DNA FINGERPRINTING AND PROOF OF PATERNITY

A. The Current Genetic Marker Tests

Methods of proving paternity commonly accepted by courts use various blood tests and statistical analyses of the test results.[15] All blood tests for paternity stem from the same basic genetic principle: the biological father and the child share similar genetic markers.[16] However, none of the tests positively identify an individual as the actual father.[17] The basis of the tests' conclusion is always a negative premise. If the genetic markers in the alleged father and the child are dissimilar, the alleged father cannot be the actual father.[18] Thus, blood tests can conclusively establish only nonpaternity.[19]

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[15] Numerous articles describe the accepted methods of proving paternity. *See, e.g.*, Ellman & Kaye, *supra* note 6, at 1131; Lake & Paulsen, *supra* note 6, at 41; Peterson, *supra* note 5, at 667; *see also, e.g.*, ESSENTIALS FOR ATTORNEYS, *supra* note 5; Reisner & Bolk, *A Layman's Guide To The Use Of Blood Analysis In Paternity Testing*, 20 J. FAM. L. 657 (1982); Sussman & Gilja, *Blood Grouping Tests for Paternity and Nonpaternity*, 1981 N.Y. ST. J. MED. 343; Note, *supra* note 5, at 227. Current blood tests consist mainly of three types: red blood cell antigen, red blood cell enzyme and serum protein, and white cell antigen, also known as the human leukocyte antigen test (HLA). *See* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 367-69; Peterson, *supra* note 5, at 673-74.

[16] *See* People v. Brown, 40 Cal. 3d 512, 529, 726 P.2d 516, 523, 230 Cal. Rptr. 834, 841 (1985), *rev'd on other grounds*, 479 U.S. 538 (1987) (California Supreme Court stating that "traditional ABO testing is based on the immunological principle that each antigen type will react characteristically in combination with the others"); *see also* Lake & Paulsen, *supra* note 6, at 41.

[17] *See* Dodd, *supra* note 12, at 6.

[18] *See* Lake & Paulsen, *supra* note 6, at 42. If one or a combination of the tests show the presence of a genetic marker in the child but not in the defendant or the mother, the defendant is excluded as a possible father. *Id.* The defendant is also excluded if the child lacks a genetic marker necessary for the defendant to be the father. *Id.*; *see also*, Cole v. Cole, 74 N.C. App. 247, 250, 328 S.E.2d 446, 449 (1985) (stating that "while much progress has been made in the blood tests used in cases of disputed paternity, by expanding the number of antigens examined, the test's greatest value still lies primarily in excluding falsely accused fathers"). In California, blood test results that exclude the alleged father are conclusive proof of nonpaternity. *See, e.g.*, Dodd v. Henkel, 84 Cal. App. 3d 604, 148 Cal. Rptr. 780 (1978). However, due to the presence of mutant genes, many forensic geneticists believe that paternity exclusion should not rely on one genetic test. *See* Ota, Yonemura, Fukushima, Hasekura, Ishimoto, Mizutani & Yamada, *A Case of Paternity Testing Influenced by the Silent Allele of Rh Erythrocyte Groups*, 32 J. FORENSIC SCI. 1806, 1808 (1986) [hereafter Ota, *Silent Allele*]. Forensic geneticists believe that additional tests are necessary to detect the possibility of exceptional inheritance. *Id.*

[19] *See* Neubaum, *supra* note 9, at 38; *see also* Hodge v. Gould, 274 Cal. App. 2d 806, 109 Cal. Rptr. 245 (1969) (holding that no inference or presumption of paternity

However, blood test results that do not exclude the putative father are relevant to the paternity issue, since they narrow the class of possible fathers and thereby affect the balance of probabilities.[20] If the defendant is not excluded as a possible father, paternity experts compute a statistical analysis of the test results[21] using the numerous formulas that explain the significance of a nonexclusion.[22] Through the laws of probability, the expert can sometimes establish a particular probability that the defendant is the father.[23] This paternity figure that is based

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arises from fact that tests fail to exclude defendant).

[20] *See, e.g.*, Plemel v. Walter, 303 Or. 262, 266, 735 P.2d 1209, 1212 (1987); *see also* Redman v. Thieret, 666 F. Supp. 148 (C.D. Ill. 1987) (criminal case in which court indicated that test results narrowed possible range of suspects that had same blood type as semen sample found in victim's car); ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 366 (stating that "scientific testing has transformed the paternity establishment process from a credibility contest to a conclusive, fact-oriented proceeding"); Annotation, *supra* note 9, at 587 (stating that "blood tests are the most powerful evidence . . . in a paternity case").

[21] Statistical computations include the probability of exclusion, the paternity index, the likelihood of paternity, and the probability of paternity. *See* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 373-75; Peterson, *supra* note 5, at 675-83. The probability of exclusion is the probability that a given test or combination of tests will exclude a falsely accused father. *See id.* at 677-78. The paternity index compares the alleged father's as opposed to a random man's chance of producing a child with a particular genetic marker. *See id.* at 684; Plemel v. Walter, 303 Or. 262, 269-70, 735 P.2d 1209, 1214 (1987); *see also* Walsh, Lawton, Buckleton, Seber & Woodfield, *Comments On The Use Of Blood Marker Frequency Data*, 32 FORENSIC SCI. INT'L 131, 132 (1986) [hereafter Walsh, *Comments*] ("[B]lood marker frequencies vary only between races and do not vary according to any other social factor."). The likelihood of paternity is a percentage derivation of the paternity index and indicates the likelihood that the tested individual as opposed to a random individual could be the father. *See Plemel*, 303 Or. at 271, 735 P.2d at 1214.

The probability of paternity is computed by using a mathematical expression known as Bayes Theorem. *See* Ellman & Kaye, *supra* note 6, at 1147-49. This Theorem determines the effect of blood test results upon nongenetic evidence and gives the probability that a defendant is the father. *See id.* For examples of the computation, see Peterson, *supra* note 5, at 681-82, 692-99.

[22] *See generally* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 371-76; Gaensslen, Bell & Lee, *Distributions of Genetic Markers in United States Population: II. Isoenzyme Systems*, 32 J. FORENSIC SCI. 1348 (1987) [hereafter Gaensslen, *Distributions II*]; Walsh, *Comments*, *supra* note 21, at 131; *see also* Gaensslen, *supra* note 9, at 78 (stating that "only by providing some information about . . . frequencies can the expert indicate the significance of the findings to the trier of fact").

[23] State v. Thompson, 503 A.2d 689 (Me. 1986) (expert testimony on probability of paternity was admissible in prosecution for gross sexual misconduct concerning whether defendant fathered child); *see also Plemel*, 303 Or. at 271, 735 P.2d at 1215. Normally, when the evidence only indicates a class of possibilities, one cannot ascertain the class size. Gaensslen, *supra* note 9, at 75 (stating that with most partial individualizations,

upon genetic marker frequencies is known as the probability of paternity.[24]

The probability of paternity compares the alleged father's chance of producing a child of similar genetic composition with a random man's chance.[25] The computation typically uses the frequency of a genetic marker in a population of males of similar ethnic origin as the alleged father.[26] The less frequently that the genetic characteristic is present in the relevant ethnic group, the more likely that the defendant produced

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"it is not possible to give any estimate of the degree to which the evidence item has been individualized"). However, with genetic markers, knowledge of the particular marker's frequency in a specific population allows an expert to estimate the size of the class and, in paternity cases, the possible fathers. *Id.*

[24] *See* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 375-76.

[25] *See* Peterson, *supra* note 5, at 690.

[26] *In re* Lukas, 155 Ill. App. 3d 512, 508 N.E.2d 368, 372 (1987). In *Lukas*, the expert used a paternity index to calculate the probability of paternity. *Id.* She defined the paternity index as the probability that an individual in question as opposed to a random individual is the father of a particular child. *Id.*; *see* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 375; Gaensslen, Bell & Lee, *Distributions of Genetic Markers in United States Populations: I. Blood Group and Secretor Systems*, 32 J. FORENSIC SCI. 1016 (1987) [hereafter Gaensslen, *Distributions I*]; *see also* Gaensslen, *supra* note 9, at 78 ("[T]he major racial groups in the U.S. population can be treated as genetically homogeneous."); Meighen, Smith, Angus & McClelland, *Population Frequencies of Carbonic Anhydrase II (CA II), Esterase (EsD), and Glyoxalase I (GLO) in the Metropolitan Birmingham, Alabama Area*, 31 J. FORENSIC SCI. 1366 (1986) (stating that genetic frequency data assist in establishing probability of random match between individual and tissue sample); Walsh, *Comments*, *supra* note 21, at 132 ("[B]lood marker frequencies vary only between races and do not vary according to any other social factor . . . [including] geographical location.").

However, one study indicates that the compiled frequencies for some racial groups in the United States may be erroneous. *See* Gaensslen, *Distributions II*, *supra* note 22, at 1350; *cf.* Gaensslen, Bell, & Lee, *Distributions of Genetic Markers in United States Populations: III. Serum Group Systems and Hemoglobin Variants*, 32 J. FORENSIC SCI. 1754, 1756 (1987) [hereafter Gaensslen, *Distributions III*] (stating that the majority of data fit expectations). Other scientists argue that mixed-race population frequencies are the correct data to use. *See* Walsh, *Comments*, *supra* note 21, at 131. They argue that since the racial origin of the blood sample is often unknown while the race of the defendant is known, the correct question should be, "What is the probability of choosing anyone at random as a suspect who has the same genetic markers [as the evidentiary sample]?" *Id.* at 132. The question asked when using discrete racial data is: "What is the probability of choosing someone of the same race as the suspect who has the same genetic markers [as the evidentiary sample]?" *Id.* The critics argue that since the racial origin of the sample is unknown, the latter question is irrelevant. *Id.* Others question the assumption that the frequencies do not vary according to geographical location, particularly when racial composition of the areas differ. *Id.*

the characteristic.[27] The greater the defendant's comparative chances of producing the characteristic, the greater the probability of paternity.[28]

Many commentators criticize the use of statistics to prove paternity.[29]

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[27] *See* Gaensslen, *Distributions I*, *supra* note 26, at 1016; *see also* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 375 (giving example of the calculations). Differences in the gene frequency values used in the calculations have significant effects on the outcomes. Gaensslen, *Distributions I*, *supra* note 26, at 1054.

[28] *See* Gaensslen, *Distributions III*, *supra* note 26, at 1754. *See generally* Ellman & Kaye, *supra* note 6, at 1131.

[29] *See* Jaffe, *Comment on the Judicial Use of HLA Paternity Test Results and Other Statistical Evidence: A Response to Terasaki*, 17 J. FAM. L. 457 (1978-1979). The criticisms focus on several areas. Some critics feel that juries may misinterpret the probability of paternity figure, based upon nonexclusion, as evidence of positive paternity identification. *See* State v. Kim, 398 N.W.2d 544 (Minn. 1987) (court arguing that jury might use statistical population frequency evidence as probability measure of defendant's guilt or innocence); Ellman & Kaye, *supra* note 6, at 1140-41 (citing California case in which court erroneously believed that probability of paternity equaled 100% minus genetic frequency in population); *see also* Aiken, *Some Fallacies in the Computation of Paternity Probabilities*, 36 AM. J. HUM. GENETICS 904, 905 (1984); Jonakait, *When Blood Is Their Argument: Probabilities In Criminal Cases, Genetic Markers, And Once Again, Bayes Theorem*, 1983 U. ILL. L. REV. 369, 398 (stating that "normally one does not weigh each piece of evidence alone"); Kaye, *The Admissibility of "Probability Evidence" in Criminal Trials — Part II*, 27 JURIMETRICS J. 160, 167-68 (1987); *cf.* Gaensslen, *supra* note 9, at 80 (observing that probabilities computed from population frequency data have a significant potential to mislead).

The California Legislature has endorsed the paternity index by prescribing a statutory presumption of paternity when the paternity index is 100 or more. *See* CAL. EVID. CODE § 895.5 (West Supp. 1988). However, a person could be 1000 times more likely than a random individual to be guilty but still be more likely innocent than guilty. Finkelstein & Fairley, *A Bayesian Approach To Identification Evidence*, 83 HARV. L. REV. 489, 502 (1970) (stating that "the jury's function is not to compare a defendant with a person selected randomly but to weigh the probability of the defendant's guilt against the probability that anyone else was responsible.").

In addition, the probability does not measure the putative father's actual probability of paternity but only compares the putative father's to a random man's chance of fathering a child. Plemel v. Walter, 303 Or. 262, 269, 735 P.2d 1209, 1213 (1987). The paternity index measures the chances of producing any child with a particular characteristic such as blue eyes — not the chances of producing the child in question. *Id.* at 269-70, 735 P.2d at 1214; *see also* Ellman & Kaye, *supra* note 6, at 1146. Thus, critics argue that the statistic is only indirectly and circumstantially relevant to the issue of whether the defendant fathered a particular child.

While the prior criticisms attack conclusions reached by statistical analysis in proving paternity, the final criticism attacks the methodology of the computations. Specifically, writers attack the use of Bayes Theorem to compute the probability of paternity. *See* Cole v. Cole, 74 N.C. App. 247, 328 S.E.2d 446, 449 (1985) (stating that critics have focused on assumptions made in calculation); Terasaki, *Resolution by HLA Testing of 1000 Paternity Cases Not Excluded by ABO Testing*, 16 J. FAM. L. 543, 548-49 (1977-1978) (indicating some assumptions made in calculations); *see also* Ellman &

Despite the validity of these criticisms, the tests were formerly the best

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Kaye, *supra* note 6, at 1150; Jonakait, *supra*, at 403. Bayes Theorem is a mathematical expression that derives a posterior probability by computing the effect of newly discovered evidence on already known evidence. *See* Ellman & Kaye, *supra* note 6, at 1147-48.

In paternity testing, the analysis requires an initial assessment of the relevant nongenetic evidence to establish an opinion about the prior probability of paternity. *See Cole*, 74 N.C. App. at 251, 328 S.E.2d at 450 (stating that "when a laboratory uses Bayes Theorem to calculate a probability of paternity it must first calculate a 'prior probability of paternity,' *i.e.*, a probability that the alleged father is the true father, based on information other than that gotten from the blood test"). The nongenetic evidence normally includes a showing that the defendant engaged in sexual relations with the mother during the possible time of conception. *See* Florence v. Roberts, 233 Va. 297, 355 S.E.2d 316, 317 (1987) (listing evidence of paternity). It might also include evidence that the mother engaged in sexual relations with more than one man during the relevant time period. The paternity expert applies Bayes Theorem to determine the effect of the genetic marker test results upon the prior opinion of paternity. *Cole*, 74 N.C. App. at 251, 328 S.E.2d at 450 ("[T]he Bayes Theorem calculates a final probability only by applying new statistical information to the prior probability").

However, in most cases, the expert is not aware of the nongenetic evidence introduced at trial. *See id.* (stating that prior probability used by experts "usually has no connection to the case at hand"). In some cases, the figure represents the "previous success of the laboratory at excluding falsely accused fathers." *Id.* In many other cases, the expert commonly assumes a prior probability of 50%, *i.e.*, a 50% chance that the defendant is the father. *Id.* Reisner & Bolk, *supra* note 15, at 673-74; *see also* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 374 (stating that most often used calculation is assumption of 50% chance defendant is the father). The assumptions made in the calculations also affect the result. *Cole*, 74 N.C. App. at 250, 328 S.E.2d at 449. The calculation assumes that all possible fathers are unrelated. *Id.* However, if the alleged father and the biological father are related, the genetic marker profiles are likely to be similar. *Id.* The HLA technique's discoverer states that the probability of paternity calculation cannot be used when potential fathers are related. Terasaki, *supra*, at 549. A second assumption is that all possible fathers are fertile. *Cole*, 74 N.C. App. at 250, 328 S.E.2d at 449.

The 50% assumption assures a positive paternity finding whenever the blood tests do not exclude the defendant. *See id.* at 250-51, 328 S.E.2d at 449-50 (stating that calculations made without awareness of evidence that the putative father is not fertile are highly likely to overestimate substantially the probability of paternity); Ellman & Kaye, *supra* note 6, at 1149-52 (stating that the estimation of prior probability should take circumstances of the case into account); *see also Cole*, 74 N.C. App. at 151, 328 S.E.2d at 450 (stating that when fifty percent figure used as prior probability and defendant not excluded by blood tests, "Bayes Theorem ensures that . . . the blood test results only improve upon the 50% prior probability of paternity"). For discussion of prior probability use at trial, see Jaffe, *Prior Probability — A Black Hole in the Mathematicians' View of the Sufficiency and Weight of Evidence*, 9 CARDOZO L. REV. 967 (1988); Jaffe, *Of Probativity and Probability: Statistics, Scientific Evidence, and the Calculus of Chance at Trial*, 46 U. PITT. L. REV. 925 (1985).

method of determining paternity.[30] Since the plaintiff's burden of proof in a civil action is the lax preponderance of evidence standard,[31] courts do not require more accurate proof of paternity.[32] Further, the blood tests and statistical analysis have obvious probative value in determining paternity.[33]

However, while genetic marker testing performed in conjunction with statistical analysis may have sufficed to resolve the paternity issue in the past, courts need a more accurate and efficient method to determine paternity. This need is becoming more acute, given the rapid increase in illegitimate births in the United States over the past twenty

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[30] *See* Ellman & Kaye, *supra* note 6, at 1161 ("[A]dvancing medical technology has produced tests which . . . resolve paternity disputes with more accuracy than . . . traditional evidentiary techniques are likely to obtain."); *see also* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 365.

[31] *See* County of El Dorado v. Schneider, 191 Cal. App. 3d 1263, 1271, 237 Cal. Rptr. 51, 56 (1987) (stating that "paternity actions are essentially civil in nature where no direct penal consequences attach to a finding of paternity"); State v. Erickson, 363 N.W.2d 859 (Minn. App. 1985) (holding that danger of statistical evidence undermining presumption of innocence not applicable to civil paternity action); *see also Schneider*, 191 Cal. App. 3d at 1271 n.7, 237 Cal. Rptr. at 56 n.7 (stating that "burden of proof in a paternity action is by a preponderance of the evidence."); *cf.* Neubaum, *supra* note 9, at 38 ("[E]stablishment of paternity creates the obligation to support the child, and in default of the obligation, to face imprisonment."); Note, *supra* note 5, at 229 ("[T]he burden of proof . . . varies according to whether the proceeding is criminal or civil in nature.").

[32] *See* Note, *supra* note 5, at 229 ("[T]he plaintiff must demonstrate by a preponderance of the admissible evidence that the defendant is the actual father").

[33] *See Cole*, 74 N.C. App. at 251, 328 S.E. at 450 ("[T]he probability of paternity is generally probative . . . where it is 90%, or as some have suggested 95%."); Annotation, *supra* note 9, at 587 ("Blood tests are the most powerful evidence . . . in a paternity case."); *see also Joint AMA-ABA Guidelines: Present Status Of Serologic Testing in Problems of Disputed Parentage*, 10 FAM. L.Q. 247, 262 table IV (1976-1977). Blood tests are extremely useful in narrowing the field of possible suspects not only in paternity cases but also in other cases involving more serious criminal activity. *See* Evans v. State, 256 Ga. 10, 342 S.E.2d 684 (1986) (finding that serological expert's description of data base compilation permitted testifying about population statistics related to genetic markers of blood discovered in murder victim's car and house and in defendant's blood); Shaw v. State, 179 Ga. App. 807, 348 S.E.2d 132 (1986) (holding that testimony by state forensic serologist that only 11.59% of population had blood which matched stain found on incriminating items was admissible); People v. Demming, 116 A.D.2d 886, 498 N.Y.S.2d 203 (App. Div. 1986) (finding evidentiary hearing on probative value of blood analysis not required when murder victim's blood type was rare and when blood stains on trousers found at defendant's residence were identical to victim's blood type); State v. Nicholas, 34 Wash. App. 775, 663 P.2d 1356 (1983) (holding blood test results admissible even though results indicated that defendant was only within 60% of the population that could have committed the crime).

years.[34] Before DNA fingerprinting, courts had no alternative to the exclusionary blood tests and statistical inferences.[35] That is no longer the case.

B. The New DNA Test

DNA fingerprinting basically detects and codifies the presence of deoxyribonucleic acid (DNA) in human tissue cells.[36] The test looks directly at an individual's genetic composition, DNA.[37] DNA is the genetic code of cellular development[38] and is unique for each individual.[39]

While each individual's DNA is unique, a child inherits half of her

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[34] *See* Walker, *Guidelines for Reporting Estimates of Probability of Paternity, reprinted in* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 391; *see also* Note, *supra* note 5, at 227 ("[M]uch of the case law has resulted from paternity disputes to recover support payments for the child."). Illegitimate births are over 15.5 percent of total births. Krause, *Forcing Fathers To Be Financially Responsible*, FAM. ADVOC., Summer 1982, at 13, 17; *see also* N. STEVENSON, *supra* note 5, at 2 ("[F]or societal reasons, the law demands that all children have a father as illegitimacy causes legal complications and is an expense to the government and taxpayers."). Society's concern with the legitimacy of the child was expressed early on by the English maxim that if the husband was within the four seas of England, the husband was presumed the father of any child borne by his wife. *Id.* This presumption remains today in California Evidence Code § 621 (West 1966) which states that "notwithstanding any other provision of law, the issue of a wife cohabitating with her husband, who is not impotent, is conclusively presumed to be legitimate." *Id.*; *see generally* Stevenson, *supra* note 5, at 4-6 for historical references to proof of legitimacy. The federal government reflects this concern for paternity determination by requiring that state governments actively "pursue cases on behalf of mothers receiving Aid to Families with Dependent Children." Peterson, *supra* note 5, at 668.

[35] *See supra* notes 6-11 and accompanying text.

[36] *See* Ellman & Kaye, *supra* note 6, at 1138 n.37; Gorner, *Gene Fingerprints: U.S. Courts Accept "Sure-Fire" ID Test*, ARIZ. REPUBLIC, March 13, 1988, § AA, at 2; Kelly, Rankin & Wink, *Method and Applications of DNA Fingerprinting: A Guide for the Non-Scientist*, 1987 CRIM. L. REV. 105 [hereafter Kelly, *Method and Applications*].

[37] *See* Ellman & Kaye, *supra* note 6, at 1138 n.37; Gorner, *supra* note 36, at 2; Kelly, *Method and Applications*, *supra* note 36, at 108; Lecture by Charles Ogletree to National Association of Criminal Defense Lawyers Annual Convention in Boston, Mass., (Aug. 12, 1988) [hereafter Ogletree].

[38] *See* Kelly, *Method and Applications*, *supra* note 36, at 105-06 ("[T]he human blueprint is carried in discrete packets of information known as chromosomes, and the material of which they are made is called DNA."); *see also* Hicks, *DNA Profiling, A Tool for Law Enforcement*, F.B.I. L. ENFORCEMENT BULL., Aug. 1988, at 2.

[39] CRIM. PRAC. MANUAL, Sept. 19, 1987, at 427; Hicks, *supra* note 38, at 2; Kelly, *Method and Applications*, *supra* note 36, at 106.

DNA from her mother and the other half from her father.[40] If a test can link the parts of DNA to the separate contributing parents, identification of the father simply involves comparing the unknown (the putative father's DNA configuration) to the known (the actual father's DNA contribution to the child).[41] The comparison positively identifies the father in much the same way as hand fingerprint analysis identifies an individual's fingerprint.[42]

For paternity testing, DNA fingerprinting identifies[43] the parental

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[40] *See* Dodd, *When Blood Is Their Argument*, 20 MED. SCI. L. 231, 232 (1980); Ellman & Kaye, *supra* note 6, at 1135; Jeffreys, Wilson & Thein, *Hypervariable "Minisatellite" Regions in Human DNA*, 314 NATURE 67, 71 (1985) [hereafter Jeffreys, *Minisatellite*]; Lake & Paulsen, *supra* note 6, at 42; Peterson, *supra* note 5, at 670; *see also* Lemmon & Murphy, *The Evidentiary Use of the HLA Blood Test in Virginia*, 19 U. RICH. L. REV. 235, 238 n.13 (1985) (stating that "for every inherited characteristic, a person has one gene or haplotype from the father and one gene from the mother"). Each cell is created by the "parental" cell division into two cells. *See* A. MOENSSENS, F. INBAU & J. STARRS, SCIENTIFIC EVIDENCE IN CRIMINAL CASES 356 (3d ed. 1986) [hereafter A. MOENSSENS]. Upon cell division, the DNA is carried in long threadlike bodies called chromosomes. *Id.* The DNA in each cell is in the configuration of double strands. *See id.* A human cell contains 46 chromosomes, 23 of which are contributed by each parent. *Id.*; ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 366. The 46 chromosomes can be arranged into 23 pairs. *Id.*; Kelly, *Method and Applications*, *supra* note 36, at 106. The ovum and the sperm, each containing 23 single chromosomes, combine at fertilization to produce the total of 46. *Id.*

[41] A. MOENSSENS, *supra* note 40, at 357. The polymorphisms in each individual's DNA are compared to each other. *Id.* For a similar criminal case application, see Kanter, Baird, Shaler & Balazs, *Analysis of Restriction Fragment Length Polymorphisms in Deoxyribonucleic Acid (DNA) Recovered from Dried Bloodstains*, 31 J. FORENSIC SCI. 403, 404 (1986) [hereafter Kanter, *Analysis*].

[42] *See* Kelly, *Method and Applications*, *supra* note 36, at 108 ("DNA fingerprinting produces a band pattern as unique in its way as a normal fingerprint but from which in addition information relating to the parental origin can be derived.").

[43] *Id.* Specifically, the test uses radioactive probes to identify particular sequences of nucleotides, the basic components of DNA. *See* A. MOENSSENS, *supra* note 40, at 358; Guisti, Baird, Pasquale, Balazs & Glassberg, *Applications of Deoxyribonucleic Acid (DNA) Polymorphisms to the Analysis of DNA Recovered from Sperm*, 31 J. FORENSIC SCI. 409 (1986) [hereafter Guisti, *Applications*]; Thompson & Ford, *DNA Typing*, TRIAL, Sept. 1988, at 56, 58-59. The order in which the nucleotides occur in the DNA provides the information required to regulate the construction of the human body. *See* A. MOENSSENS, *supra* note 40, at 356-57; Kelly, *Method and Applications*, *supra* note 36, at 106; Altman, *New DNA Test Offers Biological "Fingerprints" for Crime Fight*, N.Y. Times, Feb. 4, 1986, § Y, at 19, 23. The order of these sequences is unique for each individual. *See* Gill, Jeffreys & Werrett, *Forensic Application of DNA Fingerprints*, 318 NATURE 577 (1985) [hereafter Gill, *Forensic Application*]; Hicks, *supra* note 38, at 2; Kelly, *Method and Applications*, *supra* note 36, at 107; *see also* Sensabaugh, *Forensic Biology — Is Recombinant DNA Technology in Its Future?*, 31 J. FORENSIC SCI. 393, 394 (1986) ("[D]ifferences among individuals are expressed as re-

contributions to the child's DNA by comparing the child and parental

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striction fragment length polymorphisms."). The DNA is present in cells in the form of a double chainlike structure. *See* A. MOENSSENS, *supra* note 40, at 356; Gorner, *supra* note 36, at 2; Thompson & Ford, *supra*, at 58. The two strands fit together like a zipper. *Id.* This characteristic occurs because of the chemical makeup of the nucleotides. *See* A. MOENSSENS, *supra* note 40, at 356. Certain molecules in the nucleotide bond only with certain other molecules. *Id.* A sequential arrangement of the molecules on one chain results in a corresponding sequence appearing on the second chain. *Id.* The DNA has sections in which the sequences of nucleotides repeat. *See* Kelly, *Method and Applications*, *supra* note 36, at 107. The repetitious sections occur randomly throughout the length of the chain. *Id.* at 108.

The initial step in the test is to chemically fragment the DNA double chain, also known as the double helix. *See* Hicks, *supra* note 38, at 2; Kanter, *Analysis*, *supra* note 41, at 403; Moss, *supra* note 1, at 69; Sensabaugh, *supra*, at 393; Thompson, *DNA's Troubled Debut*, CAL. LAW., June 1988, at 36, 40; *Reports and Proposals*, CRIM. L. REP., Sept. 23, 1987, at 2472; *see also* A. MOENSSENS, *supra* note 40, at 356 ("DNA is a double helix in which two chains of nucleotides . . . are held together by hydrogen bonds . . . between pairs of centrally located bases."). The methods of detecting polymorphisms in DNA rely on restriction endonucleases, enzymes that break the DNA chain in specific areas. Hicks, *supra* note 38, at 2; Kanter, *Analysis*, *supra* note 41, at 403. Restriction enzymes occur in certain bacteria. *See* Kelly, *Method and Applications*, *supra* note 36, at 107. These enzymes are used to break human DNA into different-sized fragments which are then separated from each other by a process called gel electrophoresis. *Id.*; Hicks, *supra* note 38, at 2. Electrophoresis is a method of separating molecules through the use of an electric field. *See* A. MOENSSENS, *supra* note 40, at 335; Hicks, *supra* note 38, at 2. With DNA fingerprinting, the fragments pass through passages in an agarous gel surface. A. MOENSSENS, *supra* note 40, at 357; Hicks, *supra* note 38, at 2. One end of the surface is a negatively charged pole, and the other end is a positively charged pole. A. MOENSSENS, *supra* note 40, at 357. The fragments will normally be attracted to the positively charged pole since DNA carries a negative charge. *Id.* The different sized fragments will separate as they travel because of differing weights, resulting in an arrangement of DNA fragments along parallel lines. *Id.* at 357-58; *see also* Note, *supra* note 6, at 777-78.

High molecular weight fragments are important because the smaller fragments are unable to generate the signal in the radioactive bands normally observed after the fragments are recombined. *See* Gill, *Forensic Application*, *supra*, at 577 (stating that DNA fingerprints can only be obtained from high molecular weight DNA); *see also* Guisti, *Applications*, *supra*, at 412-13; Kanter, *Analysis*, *supra* note 41, at 405. Many of the fragments contain the repeated sequences. *See* Kelly, *Method and Applications*, *supra* note 36, at 107. The fragments will combine to reform the DNA double helix only at the site of the repeated sequences. *See* A. MOENSSENS, *supra* note 40, at 358; *see also* Guisti, *Applications*, *supra*, at 415 (stating that "the DNA has to be cleaved at specific sites . . . so that the resulting fragments can migrate to discrete regions of the gel").

After separating the fragments, the analyst labels the fragments containing the sequences with radioactive probes. *See* Kelly, *Method and Applications*, *supra* note 36, at 107; Moss, *supra* note 1, at 69; Sensabaugh, *supra*, at 393-94; *Reports and Proposals*, CRIM L. REP., Sept. 23, 1987, at 2472. The DNA fragments are transferred to a nylon membrane by use of a blotting technique. Kanter, *Analysis*, *supra* note 41, at

representations of the DNA.[44] The representations are similar in appearance to the UPC bar code on the side of a grocery package.[45] (See Figure 1.)

Since each parent contributes half the child's chromosomes[46] and DNA characteristics,[47] the child's "bar prints" are a composite of the parents' "bar prints."[48] However, the child's bar print is unique.[49] On comparison of the child's and mother's DNA fingerprints, approximately half the bars on the child's print should match bars on the mother's print.[50] The remaining bars on the child's print are compared with bars on the putative father's print.[51] If the man is the biological

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404. The radioactive probes are then placed in contact with the membrane. *Id.* at 404-05. The fragments are recombined and the repeating sequences reform the double helix. *See* Kelly, *Method and Applications*, *supra* note 36, at 108. The analyst places X-ray film in contact with the test surface and the radioactivity causes an image of bands representing the sequences to appear on the film. *See id.* at 107; Moss, *supra* note 1, at 69.

[44] Jeffreys, Wilson & Thein, *Individual-Specific "Fingerprints" of Human DNA*, 316 NATURE 76, 78 (1985) [hereafter Jeffreys, *Individual-Specific "Fingerprints"*] (stating that "paternal fragments can be identified by comparison of the mother's and offspring's DNA fingerprints"); *see also* A. MOENSSENS, *supra* note 40, at 358.

[45] *See* Altman, *supra* note 43, at 23; Kelly, *Method and Applications*, *supra* note 36, at 108; Moss, *supra* note 1, at 69; Ogletree, *supra* note 37; *Reports and Proposals*, *supra* note 43, at 2472; Thompson, *supra* note 43, at 40. Commercial laboratories use different methods of DNA analysis. *See* Moss, *supra* note 1, at 69. One uses a "single locus" test that analyzes only one restriction site. *Id.* This test is easier to perform than the "multi-locus" test but cannot identify an individual with as much certainty as other methods. *Id.* The "multi-locus" test examines many restriction sites and achieves much greater certainty in the identification. *Id.* Greater certainty can be achieved with a "single locus" test through repeated analysis. *Id.*

[46] *See* Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 78.

[47] *Id.*

[48] *Id.*; *see* Jeffreys, *Minisatellite*, *supra* note 40, at 71 (stating that "all fragments in offspring can be traced back to one or the other parent"); *see also* Frank, *Sleuths Hail New Aid: "DNA Fingerprinting"*, S.F. Sunday Examiner & Chronicle, Feb. 28, 1988, at Business 3, col. 1; Maidment, *DNA Fingerprinting*, 136 NEW L.J. 326 (1986).

[49] *See* Jeffreys, *Minisatellite*, *supra* note 40, at 71 (stating that "pairs of parental fragments can be identified which segregate independently in the offspring"); *see also* CRIM. PRAC. MANUAL, *supra* note 39, at 427; Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 316; *News Notes*, 13 FAM. L. REP. 1567, 1568 (1987).

[50] *See* Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 78; *Reports and Proposals*, *supra* note 43, at 2472. Some of the bars will be common between mother and father and therefore cannot be used as evidence of the putative father's paternity. *See* Jeffreys, Brookfield & Semeonoff, *Positive Identification of an Immigration Test-Case Using Human DNA Fingerprints*, 317 NATURE 818, 819 (1985) [hereafter Jeffreys, *Immigration*].

[51] *See* CRIM. PRAC. MANUAL, *supra* note 39, at 427; Jeffreys, *Immigration*, *supra*

father, virtually all remaining bars of the child's print will match bars of the father's print.[52] If the man is not the father, very few bars match.[53]

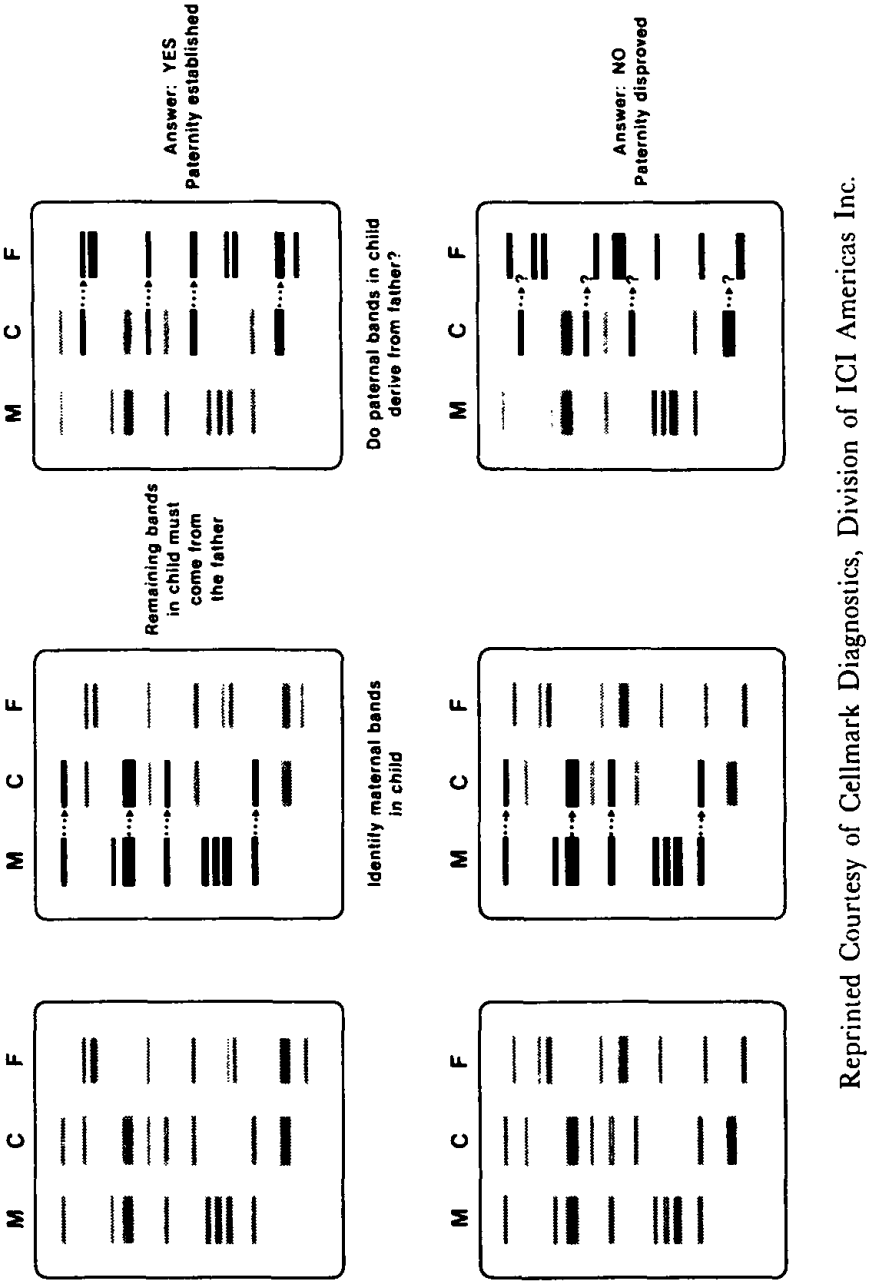

Figure 1
Analysis of DNA Fingerprints in Paternity Testing
Reprinted Courtesy of Cellmark Diagnostics, Division of ICI Americas Inc.

note 50, at 819; Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 77; *News Notes*, *supra* note 49, at 1568.

[52] *See* CRIM. PRAC. MANUAL, *supra* note 39, at 427-28; Jeffreys, *Immigration*, *supra* note 50, at 819; *News Notes*, *supra* note 49, at 1568.

[53] *See* CRIM. PRAC. MANUAL, *supra* note 39, at 428; Jeffreys, *Immigration*, *supra* note 50, at 819; *News Notes*, *supra* note 49, at 1568.

C. The Advantages of DNA Fingerprinting

DNA fingerprinting offers marked practical advantages over genetic marker tests in paternity cases. First, unlike other forensic tools, DNA fingerprinting is not limited to analysis of one particular type of fluid or tissue: it examines a molecule common to every nucleated cell in the human body.[54] Thus, virtually any body cell containing DNA yields a

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[54] *Reports and Proposals*, *supra* note 43, at 2472; *see also* Ogletree, *supra* note 37 (stating that "a person's genetic markers are the same whether the DNA comes from blood, semen or tissue"). In the last few decades, forensic scientists have made significant advancements in developing tests of identification. *See* Gaensslen, *Distributions I*, *supra* note 26, at 1016; Gaensslen, Lee, Pagliaro, Bremser & Carroll-Reho, *Evaluation of Antisera for Bloodstain Grouping II. Ss, Kell, Duffy, Kidd, and Gm/Km*, 30 J. FORENSIC SCI. 655, 655-56 (1985) [hereafter Gaensslen, *Evaluation of Antisera II*]; Sensabaugh, *supra* note 43, at 393. The analysis of hair, blood, sperm, fingerprints, urine, saliva — virtually any form of human tissue or secretion — can yield information leading directly to the identification of the source. *See* Carracedo, Prieto, Concheiro & Estefania, *Isoelectric Focusing Patterns of Some Mammalian Keratins*, 32 J. FORENSIC SCI. 93 (1986); Kido, Komatsu, Ose & Oya, *Fucosidase Phenotyping In Human Tissues, Dental Pulps and Hair Roots*, 33 FORENSIC SCI. INT'L 53 (1987) [hereafter Kido, *Fucosidase Phenotyping*]; Murch & Budowle, *Applications of Isoelectric Focusing in Forensic Serology*, 31 J. FORENSIC SCI. 869, 873 (1986); Tyler, Kirby, Wood, Vernon & Ferris, *Human Blood Stain Identification and Sex Determination in Dried Blood Stains Using Recombinant DNA Techniques*, 31 FORENSIC SCI. INT'L 267 (1986) [hereafter Tyler, *Recombinant*]. Blood is the tissue probably richest in genetic markers, which characteristic has made it a major object of human genetic study and has also resulted in the explosive growth of forensic serology in the past 25 years. *See* Gaensslen, *supra* note 9, at 76.

For examples of various techniques used in the analysis of blood for identification purposes, see Alsawaf & Tu, *Isotachophoretic Analysis of Bloodstains: Differentiation of Human, Menstrual, Bovine, and Ovine Bloods*, 30 J. FORENSIC SCI. 922 (1985); Bar & Biedermann, *Agarose Gel Electrophoresis of Human Erythrocyte Glutamic-Pyruvic Transaminase (GPT EC 2.6.1.2.)*, 33 FORENSIC SCI. INT'L 69 (1987); Budowle, Murch, Davidson, Gambel & Kearney, *Subtyping Phosphoglucomutase-1 in Semen Stains and Bloodstains: A Report on the Method*, 31 J. FORENSIC SCI. 1341 (1986) [hereafter Budowle, *Subtyping*]; Gaensslen, *Evaluation of Antisera II*, *supra*, at 655; Gaensslen, Lee, Pagliaro & Bremser, *Evaluation of Antisera for Bloodstain Grouping I, ABH, MN, and Rh*, 30 J. FORENSIC SCI. 632 (1985) [hereafter Gaensslen, *Evaluation of Antisera I*]; Mudd, *A Microplate Method for Reverse ABO Typing of Bloodstains*, 31 J. FORENSIC SCI. 418 (1986); Murch, Gambel & Kearney, *A Double Origin Electrophoretic Method for the Simultaneous Separation of Adenosine Deaminase, Adenylate Kinase, and Carbonic Anhydrase II*, 31 J. FORENSIC SCI. 1349 (1986); Nelson, Westwood & Werrett, *A Comparison of the Sensitivity of Typing Group-Specific Component (Gc) and the Phosphoglucomutase (PGM) Locus in Control and Casework Bloodstains by Three Isoelectric Focusing Methods*, 32 FORENSIC SCI. INT'L 121 (1986) [hereafter Nelson, *Comparison*]; Oya, Kido, Ose & Komatsu, *C6 Phenotyping in Sera and Bloodstains by Isoelectric Focusing Followed by Electroim-*

munoblotting, 33 FORENSIC SCI. INT'L 61 (1987); Scott & Budowle, *Transferrin Subtyping of Human Bloodstains*, 28 FORENSIC SCI. INT'L 269 (1985); Tyler, *Recombinant*, *supra*, at 267; Wraxall & Stolorow, *The Simultaneous Separation of the Enzymes Glyoxalase I, Esterase D, and Phosphoglucomutase*, 31 J. FORENSIC SCI. 1439 (1986).

For articles indicating advances in traditional fingerprinting, see Almog, *Reagents for Chemical Development of Latent Fingerprints: Vicinal Triketones — Their Reaction with Amino Acids and with Latent Fingerprints on Paper*, 32 J. FORENSIC SCI. 1565 (1987); Almog, Hirshfeld & Klug, *Reagents for the Chemical Development of Latent Fingerprints: Synthesis and Properties of Some Ninhydrin Analogues*, 27 J. FORENSIC SCI. 912 (1982); Everse & Menzel, *Sensitivity Enhancement of Ninhydrin-Treated Latent Fingerprints by Enzymes and Metal Salts*, 32 J. FORENSIC SCI. 446 (1986); Harper, Clare, Heaps, Brennan & Hussain, *A Bacteriological Technique for the Development of Latent Fingerprints*, 33 FORENSIC SCI. INT'L 209 (1987); Kobus, Stoilovic & Warrener, *A Simple Luminescent Post-Ninhydrin Treatment for the Improved Visualization of Fingerprints on Documents in Cases Where Ninhydrin Alone Gives Poor Results*, 22 FORENSIC SCI. INT'L 161 (1983); Lambourne, *The Use of Fingerprints in Identification*, 19 MED. SCI. L. 217 (1979); Menzel, *Comparison of Argon-Ion, Copper-Vapor, and Frequency-Doubled Neodymium: Yttrium Aluminum Garnet (Nd:YAG) Lasers for Latent Fingerprint Development*, 30 J. FORENSIC SCI. 383 (1985); Menzel & Almog, *Latent Fingerprint Development by Frequency-Doubled Neodymium: Yttrium Aluminum Garnet (Nd:YAG) Laser: Benzo(f) Ninhydrin*, 30 J. FORENSIC SCI. 371 (1985); *see also* Laskowski & Kyle, *Barefoot Impressions — A Preliminary Study of Identification Characteristics and Population Frequency of Their Morphological Features*, 33 J. FORENSIC SCI. 378 (1988) (stating that "friction edge minutiae patterns are so unique that they identify individuality to a particular person no matter how large the population data base").

For examples of footprint evidence see Laskowski, *An Improved Technique for the Visualization of Footprint Impressions in the Insoles of Athletic Shoes*, 32 J. FORENSIC SCI. 1075 (1987); Laskowski & Kyle, *supra*, at 378. Criminalists have used footprint identification evidence for some time. *Id.* at 379. In a case reported in 1888, successful identification of the criminal resulted from analysis of footprints. *Id.* In 1938 the Supreme Judicial Court of Massachusetts upheld a bloodstained footprint comparison. *Id.*

For information on sperm testing, see Budowle, *Subtyping*, *supra*, at 1341; Murch & Budowle, *supra*, at 873; Stubbings & Newall, *An Evaluation of Gamma-Glutamyl Transpeptidase (GGT) and p30 Determinations for the Identification of Semen on Postcoital Vaginal Swabs*, 30 J. FORENSIC SCI. 604 (1985).

For information on urine testing, see Chase, *ABO Typing Studies on Liquid Urines*, 31 J. FORENSIC SCI. 881 (1986). For information on saliva testing, see Caeiro, Boan & Carracedo, *A Simplified Procedure For Simultaneous Detection of Salivary Proteins and Its Application in Paternity Testing*, 33 FORENSIC SCI. INT'L 47 (1987).

In State v. Klindt, 389 N.W.2d 670 (Iowa 1986), a forensic serologist identified a detached torso as probably belonging to a missing woman. *Id.* at 672. The expert identified specific genetic markers present in the torso and then analyzed blood samples from the missing woman's parents. *Id.* at 671. The genetic markers in the torso were similar to genetic markers in the parent's blood. *Id.* at 672. Using a genetic marker population data bank, she concluded that the parents were 107.8 times more likely than

DNA fingerprint, including blood, semen, skin, and hair.[55] In addition, while existing blood tests require a series of tests to establish each genetic marker and to increase the probability of excluding a falsely accused father,[56] DNA fingerprinting requires only one test to establish

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a random couple to have produced a child with the genetic markers found in the torso. *Id.* This case is similar to cases that use the probability of paternity statistic since the testing did not specifically identify the torso as definitely belonging to the missing woman. *Id.* at 674. The test only indicated the probability that the torso was the missing woman's versus another random missing woman's. *Id.*

An important factor in most of these tests is the presence of DNA in human tissue cells. *See* Sensabaugh, *supra* note 43, at 393; Tyler, *Recombinant*, *supra*, at 267.

[55] *See* A. MOENSSENS, *supra* note 40, at 356. For an analysis of DNA fingerprinting using blood, semen, and hair, see Gill, *Forensic Application*, *supra* note 43, at 577.

[56] Existing blood tests examine genetic markers that represent inherited genetic characteristics. *See supra* note 16 and accompanying text. A genetic characteristic such as blue eyes is obviously present in more than one individual, and many males who are not the biological father of a child at issue will possess the same genetic markers. *See* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 366. In a case involving genetic marker testing in a criminal context, blood samples found at the scene of a double homicide were analyzed for ten genetic markers. Gaensslen, *supra* note 9, at 80. The blood analysis matched blood samples from a defendant who admitted his presence at the scene on various occasions but denied involvement with the crime. *Id.* The calculated probability that the crime scene blood sample was someone other than the defendant was 0.3 to 0.6 percent. *Id.* Fortunately for the defendant, however, shoeprint evidence tended to exclude him. *Id.* As a result, additional genetic marker systems were analyzed and the results confirmed exclusion. *Id.* Without the fortuitous shoeprint, the probability evidence from the first group of genetic markers would have been admitted as strong circumstantial evidence of the defendant's guilt. *Id.*

In the context of paternity, blood tests that examine genetic markers can identify only a class of possible fathers who share the genetic characteristic. *See* Jonakait, *supra* note 29, at 388 (stating that "blood analysis . . . merely indicates that the defendant is a member of a restricted subclass"); Neubaum, *supra* note 9, at 38 (stating that "statistically, three to four percent of the general male population will have blood characteristics consistent with those of the actual father"). The class could easily be comprised of millions of men. *See* Ellman & Kaye, *supra* note 6, at 1141; Peterson, *supra* note 5, at 680. As the tests analyze more genetic markers, the pool of possible fathers becomes correspondingly smaller. *See* Ellman & Kaye, *supra* note 6, at 1140 & n.50; Note, *supra* note 5, at 256; *see also* Gaensslen, *supra* note 9, at 75 (discussing the partial individualization achieved by genetic marker testing). However, even genetic marker testing that excludes 95% of falsely accused fathers will still leave thousands of possible fathers in a city the size of Los Angeles. *See id.* at 80 (stating that "even relatively low values for combinations of genetic marker system types still represent a substantial number of people"); *see also* Ellman & Kaye, *supra* note 6, at 1141. If a series of genetic marker tests has an overall capability of excluding all but one falsely accused father in 1000, the results still leave 50 possible fathers in a geographical area with a population of 50,000 males, assuming that the biological father resides in the area. *See* Dodd, *supra* note 40, at 233. Genetic marker tests cannot single out the actual biologi-

positive proof of paternity.[57]

A second advantage of DNA fingerprinting is that when a putative parent is unavailable for testing, relatives of the child can give DNA fingerprints.[58] In a recent English case, a Ghanian boy was refused entry into Great Britain.[59] The authorities were not satisfied that the woman claiming him as her son was his mother.[60] Neither the father nor any of the mother's sisters were available for analysis.[61] Analysts determined the parental contribution to the child's DNA by comparing the alleged mother's DNA fingerprint with those of her three undisputed children.[62] Bars present in the children's prints but not in the mother's print were similar and represented a common paternal contribution to the children's DNA.[63] The disputed child's bar print also

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cal father. *Id.* at 232; Kelly, *Method and Applications*, *supra* note 36, at 105; Lake & Paulsen, *supra* note 6, at 41-42; Maidment, *supra* note 48, at 326; Peterson, *supra* note 5, at 684; Note, *supra* note 5, at 230; *see also* Jonakait, *supra* note 29, at 384-86 (giving hypothetical example of genetic marker testing and validity in murder context).

Contrasted with the educated guess of existing blood tests, DNA fingerprinting both excludes falsely accused fathers and positively identifies the actual father. *See* Maidment, *supra* note 48, at 326. The superior identification capabilities of DNA fingerprinting stem from several characteristics of DNA. First, DNA present in a particular individual does not vary from cell to cell. *See* Thompson & Ford, *supra* note 43, at 58; Nat'l. L.J., Jan. 18, 1988, at 42, col. 1; *Reports and Proposals*, *supra* note 43, at 2472. Each cell contains identical DNA molecules with identical genetic codes in exactly the same configuration. *See* Thompson & Ford, *supra* note 43, at 58. Second, with the exception of identical twins, the DNA molecules and configurations of any two individuals are always dissimilar. *See* Gorner, *supra* note 36, at 2; Kelly, *Method and Applications*, *supra* note 36, at 108; Maidment, *supra* note 48, at 326. The differences in individual makeup is because of the presence of polymorphisms or slight variations in the genetic code. Jeffreys, *Minisatellite*, *supra* note 40, at 67. Kelly, *Method and Applications*, *supra* note 36, at 106-08; Sensabaugh, *supra* note 43, at 394. Specifically, polymorphisms are variations in the sequences of nucleotides. *See* A. MOENSSENS, *supra* note 40, at 357; Jeffreys, *Minisatellite*, *supra* note 40, at 67. The uniqueness of these variations is the key to the use of DNA fingerprinting as a superior, viable alternative to the blood test and statistical approaches. *See* Kelly, *Method and Applications*, *supra* note 36, at 107-08.

[57] *See* Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 78.

[58] *See* Jeffreys, *Immigration*, *supra* note 50, at 818. Genetic marker testing other than DNA fingerprinting is inappropriate for paternity testing when the mother is unavailable for testing. *See* Dodd, *supra* note 40, at 237.

[59] *See* Jeffreys, *Immigration*, *supra* note 50, at 818.

[60] *Id.* The authorities suspected that the woman was, in fact, the boy's aunt. *Id.*; Kelly, *Method and Applications*, *supra* note 36, at 109.

[61] Jeffreys, *Immigration*, *supra* note 50, at 818. Additionally, while the mother was positive about her maternity, she was unsure as to paternity. *Id.*

[62] *Id.*

[63] *Id.* at 818-19.

matched the paternal contribution, indicating a common father.[64] The remaining bars on all the children's prints corresponded to the mother's bar print.[65] The test established common maternity.[66]

A third advantage of DNA fingerprinting is that it allows children to be tested much earlier than current blood tests allow. Current blood tests generally require that a child be at least six months old before an accurate analysis is possible.[67] The reason for this age minimum is that the blood antigens for genetic marker analysis do not appear in detectable amounts in the body until the child is three to six months old.[68] In contrast, the DNA configuration of a child can immediately be detected upon birth.[69]

A fourth advantage is that the test usually takes less time to determine results than other methods.[70] Current testing for paternity requires a series of tests, each requiring separate analysis.[71] The result is often a delay of thirty days or more while the court awaits the results.[72] By comparison, DNA fingerprinting takes from one to three weeks to complete.[73] The difference in time required for analysis is important since each year approximately one-quarter of a million paternity disputes clog the court systems.[74]

Fifth, when confronted with evidence positively identifying the de-

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[64] *Id.* at 819. The question of common paternity was simplified in this case since "the father did not transmit any bands solely to [the child in question]." *Id.* The authors indicate that about one-sixteenth of inherited paternal bands are child-specific. *Id.* While this increases the odds of a chance match, the increase is insignificant. *Id.*

[65] *Id.*

[66] *See id.*; Kelly, *Method and Applications*, *supra* note 36, at 109.

[67] *See* Lake & Paulsen, *supra* note 6, at 42.

[68] *Id.* at 43.

[69] *See* Gorner, *supra* note 36, at 2 (stating that DNA remains stable throughout an individual's lifetime); Schmitz, *supra* note 2, at 14 (describing a case in which investigators linked a mother to an abandoned newborn baby).

[70] *See Reports and Proposals*, *supra* note 43, at 2472.

[71] *See* Ellman & Kaye, *supra* note 6, at 1161; Gill, *Forensic Application*, *supra* note 43, at 577; Lake & Paulsen, *supra* note 6, at 41-42; Lemmon & Murphy, *supra* note 40, at 239; Wraxall & Stolorow, *supra* note 54, at 1440. Many state statutes limit the analysis of genetic markers to only one set of tests. *See* Lake & Paulsen, *supra* note 6, at 42.

[72] CRIM. PRAC. MANUAL, *supra* note 39, at 428.

[73] *See id.*; Frank, *supra* note 48, at 3. The test procedures usually take approximately four days; the bulk of the remaining time is spent waiting for chemical reactions and the production of photographs. *See* Altman, *supra* note 43, at 23.

[74] LIFECODES CORP., DNA-PRINT[TM] IDENTIFICATION TEST 12 (1986) [information booklet by private laboratory engaged in DNA fingerprint testing].

fendant as the father, many defendants forego contesting the issue.[75] Conversely, if the DNA fingerprint indicates that the defendant is not the father, plaintiffs' attorneys will presumably withdraw the allegations. The test could save courts considerable time as more paternity issues are quickly resolved without the time and expense of trial.

DNA fingerprinting is particularly advantageous because the test does not require subjective judgments by analysts.[76] Either the bar codes match exactly, or only a few bars match.[77] In many other tests of identification, analysts must subjectively decide whether the raw test data indicates a match.[78] Even in a traditional fingerprint analysis, for example, samples that an expert declares a match have both similar points and apparently dissimilar points.[79] The expert must subjectively

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[75] *See* Ingwerson, *supra* note 1, at 4 (stating that suspects are pleading guilty in criminal cases when result is inculpatory, or charges are dropped when results are exculpatory); *see also* Hicks, *supra* note 38, at 5. A spokesman for a commercial laboratory performing the analysis indicates that in the rape cases with which they have been involved, most defendants pled guilty after DNA fingerprints identified them as the rapist. *See* Moss, *supra* note 1, at 67. A prosecutor who has used DNA fingerprinting in a rape case agrees with this finding, as does Professor George Sensabaugh of the University of California at Berkeley School of Public Health. *Id.* at 70.

[76] *See Reports and Proposals*, *supra* note 43, at 2472. In cases when DNA has degraded, no bands are produced, thus eliminating false readings. *See* Gill, *Forensic Application*, *supra* note 43, at 578; Kanter, *Analysis*, *supra* note 41, at 407; Guisti, *Applications*, *supra* note 43, at 415. *But see* Thompson & Ford, *supra* note 43, at 63-64 (giving examples of possible DNA fingerprint misinterpretation).

[77] *See supra* notes 41-42 and accompanying text. The only exception occurs when a mutant gene is present. *See* CRIM. PRAC. MANUAL, *supra* note 39, at 428; Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 78; Jeffreys, *Minisatellite*, *supra* note 40, at 71. The genetic marker tests also result in false exclusions with the presence of suppressor genes, amorphic genes, or mutant genes. *See* Ota, *Silent Allele*, *supra* note 18, at 1806. The presence of a mutant gene in the DNA fingerprint test is revealed by a single bar dissimilarity but a repetition of the test with examination of another part of the chain should reveal an exact match. CRIM. PRAC. MANUAL, *supra* note 39, at 428.

[78] For examples of problems existing with some of the current genetic marker tests, see Gaensslen, *Evaluation of Antisera II*, *supra* note 54, at 657; Wolson & Stuver, *Simultaneous Electrophoretic Determination of Phosphoglucomutase Subtypes, Adenosine Deaminase, Erythrocyte Acid Phosphatase, and Adenylate Kinase Enzyme Phenotypes*, 30 J. FORENSIC SCI. 904, 904-05 (1985).

[79] Fingerprint examination involves the evaluation and identification of friction ridge detail from surfaces of the hands. NAT'L COLLEGE OF DISTRICT ATTORNEYS, ADVANCES IN LATENT PRINT EXAMINATION — A 1987 UPDATE, Nov. 10, 1987 (seminar). Prints are also analyzed from the plantar surfaces of the feet. *Id.* The science of fingerprinting is based on the principle that friction-skin individual characteristics are permanent throughout one's life and that the unit relationship of individual characteristics is unique to each person. *Id.*; *see also* Maugh, *Genetic Fingerprinting Joins Crime*

evaluate when a dissimilarity is sufficiently explained to permit reliability of a declared match.[80] Two different fingerprint experts could conceivably have different opinions about the same set of fingerprints.[81]

Finally, the test has several miscellaneous advantages. The cost of the process is comparable to other methods of proving paternity.[82] DNA fingerprinting also requires only a small sample for analysis.[83] In addition, since DNA is a much more stable molecule than the genetic markers used in current blood tests,[84] older samples of DNA are often still

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War, L.A. Times, Jan. 7, 1988, § 1, at 3 (noting that odds two individuals' traditional fingerprints will be identical are about one in 64,000,000,000). However, variations in the processes of fingerprint recording, deposition, and development may lead to misclassification of a fingerprint characteristic and therefore, a false exclusion or inclusion. *See* Stoney & Thornton, *A Critical Analysis of Quantitative Fingerprint Individuality Models*, 31 J. FORENSIC SCI. 1187, 1193 (1986).

[80] CRIM. PRAC. MANUAL, *supra* note 39, at 428. In 1973 the International Association for Identification announced that "no valid basis exists at present for requiring that a predetermined minimum of friction ridge characteristics must be present in two impressions in order to establish positive identification." Lambourne, *Fingerprint Standards*, 24 MED. SCI. L. 227 (1984).

[81] *See* CRIM. PRAC. MANUAL, *supra* note 39, at 428; Lambourne, *supra* note 80, at 229. The variation in analysis is particularly true when experts from different countries analyze the prints. *Id.* However, with recent technological advances, many large police departments are using computers to scan, analyze, and classify fingerprints, theoretically injecting a certain consistency into the analysis. *See* Kurre, *On-Line Exchange of Fingerprint Identification Data*, F.B.I. L. ENFORCEMENT BULL., Dec. 1987, at 14; *Fingerprint Technology*, TRIAL, July 1987, at 96.

[82] The cost of DNA fingerprinting varies from $400-800, depending upon which commercial laboratory is used and how many samples are required for analysis. *See* Frank, *supra* note 48, at 3; Lohr, *For Crime Detection, "Genetic Fingerprinting"*, N.Y. Times, Nov. 30, 1987, § Y, at 5; Moss, *supra* note 1, at 68; *Reports and Proposals*, *supra* note 43, at 2472. In contrast, the most precise genetic marker test, the HLA test, is expensive because necessary reagents are rare. *See* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 369.

[83] *See* Gill, *Forensic Application*, *supra* note 43, at 578 (stating that sufficient DNA for a "fingerprint" can be extracted from one drop of blood); Moss, *supra* note 1, at 66 (stating that "a . . . spot of blood about the size of a quarter, a . . . spot of semen the size of a nickel, a few hairs, or a small patch of skin tissue" can yield a DNA fingerprint); *Reports and Proposals*, *supra* note 43, at 2472 (stating that "only a small amount of tissue is necessary — one or two drops of blood, ten hair roots, or a trace of semen"); *see also* Kelly, *Method and Applications*, *supra* note 36, at 110. In criminal cases involving forensic evidentiary samples found at the scene of a crime, the necessary sample size is critical since, if an insufficient amount is available for independent testing, the defendant may be denied due process rights. Altman, *supra* note 43, at 23 (quoting George Sensabaugh, forensic scientist at the University of California at Berkeley). If the test only requires a small sample, criminologists may be able to solve crimes they are now unable to. *Id.*; *see also* Wolson & Stuver, *supra* note 78, at 905.

[84] *See* Kanter, *Analysis*, *supra* note 41, at 407; Gaensslen, *Evaluation of Antisera I*,

viable for testing.[85]

However, the first and foremost advantage of DNA fingerprinting in paternity disputes remains that it is the only test that can single out the actual father.[86] The test avoids the qualitative and quantitative drawbacks to current methods of proving paternity.[87] While current methods go far in excluding all falsely accused fathers, the tests cannot pinpoint the actual father.[88] Consequently, the use of DNA fingerprinting

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supra note 54, at 651; Lomhoff, *By Their DNA, So Shall Ye Know Them*, CALIF. LAW., Feb. 1987, at 8; *see also* Altman, *supra* note 43, at 23 (stating that many tests are unreliable when the sample is more than 30-days old); Lake & Paulsen, *supra* note 6, at 42 (stating that "the longer the delay in testing, the greater the likelihood of inaccurate results"). However, new techniques may increase the capacity to detect genetic markers in aged samples. *See* Gaensslen, *Evaluation of Antisera II*, *supra* note 54, at 660, 667 (discussing the finding of some genetic markers in six- and 11-month-old bloodstains); Nelson, *Comparison*, *supra* note 54, at 125 (discussing the successful typing of stains ranging from 39- to 207-days-old). Moreover, the presence of foreign material and bacteria can give erroneous readings with many genetic marker tests. *See* Budowle, *Subtyping*, *supra* note 54, at 1346; Dodd, *supra* note 12, at 5; Gill, *Forensic Application*, *supra* note 43, at 577; Kanter, *Analysis*, *supra* note 41, at 407. HLA testing requires live cells, therefore, the test must be performed within 24 hours after blood is drawn. Lake & Paulsen, *supra* note 6, at 42. The sample cannot be refrigerated. *Id.*; *see also* Wilkerson, *Test May End 10-Year Rape Dispute*, N.Y. Times, Feb. 7, 1988, at 46 (the test's inventor stated that oldest DNA he had tested was five-years-old). Other scientists have successfully performed DNA analysis on three-year-old samples. *See* Kanter, *Analysis*, *supra* note 41, at 407; *see also* Sensabaugh, *supra* note 43, at 395 (noting the recovery of DNA fragments from one-hundred-year-old dry skin).

[85] Genetic marker analysis is difficult with aged and dried specimens, but DNA is still detectable in these situations. *See* Budowle, *Subtyping*, *supra* note 54, at 1346; Moss, *supra* note 1, at 66; Perry, Bass, Riggsby & Serotkin, *Autodegradation of DNA in Human Rib-Bone and its Relationship to the Time Interval Since Death*, 33 J. FORENSIC SCI. 144 (1988); *Reports and Proposals*, *supra* note 43, at 2472. DNA has been found in Egyptian mummies. *See* Gill, *Forensic Application*, *supra* note 43, at 577; Gorner, *supra* note 36, at 1. The sample's age is irrelevant, but the conditions of storage, such as moisture, light, and temperature, do matter. Gorner, *supra* note 36, at 1; Sensabaugh, *supra* note 43, at 395; *see also* Gill, *Forensic Application*, *supra* note 43, at 577 (finding that DNA isolated from ancient material such as mummies was only low molecular weight DNA).

In a recent Kentucky paternity suit, DNA fingerprint evidence refuted allegations of paternity for a deceased man. *See* Lomhoff, *supra* note 84, at 8. The test analyzed blood taken nine months earlier during an autopsy. *Id.* The sample was too old for conventional genetic marker tests. *Id.* The British scientists who developed the test used a four-year-old bloodstain and weeks-old semen samples in a pilot study to determine the effects of aging samples on test results. *See* Altman, *supra* note 43, at 23.

[86] *See supra* notes 51-53 and accompanying text.

[87] *See supra* notes 56-57 and accompanying text.

[88] *See supra* note 56 and accompanying text; *see also Nova: The Search for the Disappeared* (WGBH-TV Boston, Mass., television broadcast, Oct. 14, 1986) (tran-

should increase the accuracy, reliability, and efficiency of courts' paternity findings.

II. DNA FINGERPRINTING: VALIDITY, RELIABILITY, AND ADMISSIBILITY

A. Validity and Reliability

Since forensic scientists accept the underlying theory of DNA fingerprinting — the individuality of DNA[89] — the only issue is whether the current DNA test accurately detects the uniqueness. This section discusses the validity of DNA fingerprinting as a reliable test of identity and its admissibility in California paternity disputes.

Some commentators caution that, to date, insufficient proof exists that DNA fingerprinting distinguishes the individuality of each person's DNA.[90] Proponents of the test counter that the probability of two individuals, other than identical twins, having identical fingerprints approaches zero, particularly when DNA analysis is verified.[91] Critics at-

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script on file with *U.C. Davis Law Review*) (stating that with genetic marker tests such as HLA, maternal and paternal gene types cannot be distinguished).

[89] Scientists generally accept the individuality of a person's DNA configuration as stemming from variations in restriction fragment length polymorphisms. *See* Sensabaugh, *supra* note 43, at 394. Empirical studies have established the existence of variable polymorphisms in DNA. *See* Cooper & Clayton, *DNA Polymorphisms and the Study of Disease Associations*, 78 HUM. GENETICS 299 (1988). For an overview of generally accepted DNA theory, see J. WATSON, THE MOLECULAR BIOLOGY OF THE GENE (1987).

[90] Critics argue that DNA fingerprinting is not proven to show complete individualization, *i.e.*, a genetic marker uniquely specific to each individual. *See* Gaensslen, *supra* note 9, at 75. Only complete individualization absolutely demonstrates that known and unknown samples share a common origin. *Id.* Most forensic evidence testing is capable of partial individualization; *i.e.*, the item of evidence belongs to a restricted subclass within the overall class. *Id.* The evidence is partially individualized when some but not all members of the overall class can be excluded as a source of common origin. *Id.*

[91] *See* Gill, *Forensic Application*, *supra* note 43, at 579; Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 76 table 1; *see also* Dodd, *supra* note 12, at 5 (indicating that "the probability of a chance match is calculated to be 3×10^{-11}, less with multi-probes"); Kelly, *Method and Applications*, *supra* note 36, at 108 (stating that "the only possible confusion lies in the case of identical twins who will share many DNA characteristics"). The degree of precision varies with the type of probe used. *See* Thompson & Ford, *supra* note 43, at 62-63; *see also* Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 77 (stating that the chance of two individuals having identical fingerprints is increased if the individuals are related "to a maximum for parental offspring and sibs").

The calculation of the probability of a chance match assumes that each band is independent of each other. *See* Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44,

tack the probability figure by stating that the probability cannot be established with certainty unless all living individuals are tested.[92] However, a verification of that magnitude is impossible[93] and has never been required as a condition for the acceptance of any other identity test — even traditional fingerprinting.[94]

Scientists and critics also argue that DNA fingerprinting must undergo extensive population studies before the scientific community can accept the test as a valid indicator of identity.[95] However, the tech-

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at 77. The assumption of independence is based upon empirical evidence that polymorphisms are inherited as Mendelian traits and therefore can be used as genetic markers. *See* Guisti, *Applications*, *supra* note 43, at 409-10. A population frequency for a particular band is calculated by using an established statistical data base in conjunction with the Hardy-Weinberg equilibria formula. Andrews v. State, No. 87-2166 slip op. (5th D. Ct. App. Fla. Oct. 20, 1988) (WESTLAW, Allstates library, FL-CS file).

In *Andrews*, the defendant argued that the data base used to determine population frequencies was too small to give valid conclusions. *Id.* The appellate court pointed to expert testimony that, generally, as the data base expands, the probabilities do not change. *Id.* Additionally, the court cited the American Association of Blood Banks for the premise that a data base of two to five hundred samples was adequate for valid statistical analysis of population frequencies. *Id.*; *see also* Gaensslen, *supra* note 9, at 77 (stating that a sample size of several hundred randomly selected individuals is sufficient).

[92] Sensabaugh, *supra* note 43, at 395. The testing of every individual would yield a probability of approximately 1 in 4,000,000,000. *See* Note, *supra* note 6, at 777 n.25. However, for civil and criminal law applications, a "practical" or partial individualization yielding a probability of approximately 1 in 100,000 to 1 in 1,000,000 is sufficient. *Id.*

[93] *See* Gaensslen, *supra* note 9, at 77 (indicating that it is "impossible in practice to test an entire population").

[94] *See* Lambourne, *supra* note 80, at 227 (stating that fingerprinting is "practically" infallible, meaning a presumption of individuality exists because no instance of disproving the theory has been recorded). Some commentators note that paternity probabilities themselves have never been subject to empirical validation. *See* Aicken, *Reservations About the Paternity Probability*, *reprinted in* ESSENTIALS FOR ATTORNEYS, *supra* note 5, at 387; *see also* Walker, *supra* note 34, at 393.

[95] *See* Dodd, *supra* note 12, at 7; Moss, *supra* note 1, at 69. Professor George Sensabaugh of the University of California at Berkeley School of Public Health calls for additional independent studies, but he believes that the results will verify the method rather than disprove it. Moss, *supra* note 1, at 69; *see also* Sensabaugh, *supra* note 43, at 394.

A population study with a sample size of 100 to several hundred persons is sufficient. *See* Gaensslen, *supra* note 9, at 77. The sample must be randomly selected from the population it represents because the greater the extent to which the sample is a random representation of the population, the closer the values derived from the testing will match possible values derived from testing the entire population. *Id.* The sample size affects the potential randomness of the sample. *Id.* A larger sample generally has a

nique's inventors have repeatedly confirmed the discriminatory power of DNA fingerprinting.[96] Other independent studies confirm their conclusion.[97] Moreover, a number of experts in the field have given their support to DNA fingerprinting.[98] In contrast, test opponents have not

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better chance of being truly random than a smaller sample. *Id.* FBI researchers and scientists at the University of California at Davis are presently conducting studies to establish the reliability of DNA fingerprinting for identity purposes. *See* Hicks, *supra* note 38, at 2-3; Moss, *supra* note 1, at 69. The FBI is also investigating the effect of environmental factors such as heat, moisture, and bacteria on DNA specimens. *Id.* Additionally, the FBI is conducting technical training programs to instruct state and local crime laboratories in the use of DNA analysis. Hicks, *supra* note 38, at 2-3.

[96] *See* Gill, *Forensic Application*, *supra* note 43, at 577; Jeffreys, *Minisatellite*, *supra* note 40, at 67; Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 76; Jeffreys, *Immigration*, *supra* note 50, at 818; *see also* A. MOENSSENS, *supra* note 40, at 359 (stating that research has validated the claims).

One study of DNA fingerprinting's use to determine paternity concluded that the test could exclude greater than 99% of falsely accused fathers. *See* Baird, Wexler, Clyne, Meade, Ratzlaff, Smalls, Benn, Glassberg & Balazs, *The Application of DNA-Print for the Estimation of Paternity*, in ADVANCES IN FORENSIC HAEMOGENETICS 2 (1987) [hereafter Baird, *DNA-Print*]. A genetic marker frequency for Restriction Fragment Length Polymorphisms was used as the basis for statistical analysis. *Id.* A second study of more than 170 forensic samples concluded that the chance of two individuals having identical fingerprints is greater than 10,000,000,000 to 1. Lecture by Michael Baird, Laboratory Manager, Lifecodes Corp., to National College of District Attorneys, 1987; *see also* Gaensslen, *supra* note 9, at 77 (indicating that a sample size over 100 is usually sufficient for population studies).

[97] One of these studies used 700 individuals as subjects. *See* Thompson, *supra* note 43, at 44. Commercial labs have also run thousands of tests over the years, and the results verify proponents' claims. *Id.* However, the companies refuse to disclose the tests results, claiming that the information is proprietary. *Id.* The refusal to disclose the results has led Law Professor Edward Imwinkelried of the University of California at Davis to question whether any adequate explanation of the calculations of a chance match exist. *See* Ingwerson, *supra* note 1, at 4. *But see* Jeffreys, *Individual-Specific "Fingerprints"*, *supra* note 44, at 77 (explaining that the basis of the calculation is the empirical observation that the particular bands are independent of one another).

[98] David Housman, Professor of Biology at the Massachusetts Institute of Technology, states that DNA fingerprinting technology is as certain as the law of gravity. *See* Moss, *supra* note 1, at 69-70. James Starrs, Professor of Law and Forensic Sciences at George Washington University, indicates that DNA fingerprint analysis is a great deal more accurate than the traditional genetic marker tests. *Id.* at 66. Starr also believes that "DNA analysis will be to the end of the 20th century what fingerprinting was to the 19th." *See* S.F. Chronicle, Jan. 17, 1988, § Z (This World), at 17. George Sensabaugh, testing DNA samples for the effects of environmental factors and chemical changes at the University of California at Berkeley, indicates that, to this point, his research reveals no false identifications or results. *See* Moss, *supra* note 1, at 70. Sensabaugh is "pretty much convinced [of its accuracy]." Lomhoff, *supra* note 84, at 9. Wilma Bias, Director of Immunogenetics Laboratories at the Johns Hopkins Univer-

disputed the test's validity and reliability in scientific circles.[99] Additionally, no commercial company currently marketing DNA fingerprint testing has reported any failure to replicate results of the technique's originators.[100] Critics may discount the significance of commercial enterprises to disprove the method because of the enterprises' possible conflict of interest, but the fact that no independent studies disprove the method is significant.[101]

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sity, states that the technology "will revolutionize forensic science." *See* Frank, *supra* note 48, at 3. Peter Gill, an English forensic scientist for the Home Office Forensic Science Service, states that the technique "will revolutionize forensic biology." Lomhoff, *supra* note 84, at 8-9. John Hayward, an independent consultant who worked for eighteen years as a forensic scientist for the British Government, states that "it is an enormous breakthrough in the field of forensic science." *See* Lohr, *supra* note 82, at 5. Other scientists have also enthusiastically endorsed DNA fingerprint analysis, including Dr. Gilbert Corrigan of the Veterans Administration Hospital in St. Louis, and James Kearney, a forensic science specialist at the FBI lab in Washington. *See* Altman, *supra* note 43, at 23.

[99] *See infra* note 121 and accompanying text (observing defense attorneys unable to find any experts to testify against DNA fingerprint evidence). Researchers at the FBI crime laboratory indicate that the major problems are to determine which test or combination of tests is most applicable to law enforcement and to develop consistent standards and reference bases to facilitate investigation. *See* Hicks, *supra* note 38, at 4; Johnson, *DNA "Fingerprinting" Tests Becoming a Factor in Courts*, N.Y. Times, Feb. 7, 1988, at 1, 46.

[100] DNA fingerprint testing is currently marketed in the United States by three companies, each having developed their own method of testing. Commercial laboratories claim that their research indicates that DNA fingerprinting has an ability to identify individuals equal to that of traditional fingerprints. *See* Moss, *supra* note 1, at 66. The discriminatory power stated by one commercial lab is 1 in 30,000,000,000. *Id.* Edward Blake of Forensic Science Associates in Emeryville, California, believes that the procedure "is generally accepted by unbiased molecular biology scientists [because] this technology has not been cooked up by cops in lab coats who want to throw accused individuals in jail." *Id.* at 69.

[101] Studies reported in scientific literature most often involve new findings or methods that are reported for use by the scientific community. *See* Note, *supra* note 6, at 787. Other scientists then attempt to duplicate the results in their own research. *Id.* However, unless results cannot be duplicated, subsequent studies of a particular method are often not reported. *Id.* A successful duplication of results is more likely to be discussed at seminars and gatherings of interested scientists. *Id.* at 786. For example, Michael Baird, affiliated with Lifecodes Corporation, a commercial lab, reported to the Eleventh International Congress for Forensic Haemogenetics that probes were used to identify DNA present in three-year-old bloodstains. *See* Dodd, *supra* note 12, at 6. The study also successfully matched DNA fingerprints of sperm taken from female volunteers after sexual activity to DNA fingerprints from the male partner's sperm. *Id.* Thus, the published scientific literature undoubtedly does not document all the research validating the reliability of DNA fingerprinting. *See* Note, *supra* note 6, at 787. However, the literature would, in all likelihood, document studies challenging

Critics also argue that with the highly complicated DNA fingerprinting process, inadequately trained laboratory personnel and careless techniques create a grave danger of misidentification if proponents introduce DNA fingerprinting as positive and certain proof of identity.[102] Since the test is new, few laboratory analysts have the expertise required to perform the tests.[103] However, these concerns do not reflect the efficacy of DNA fingerprinting as a tool for identity. Moreover, these concerns are equally applicable to any sophisticated technique[104] requiring trained personnel for analysis.[105] Many accepted blood tests require procedures as complex as any required in DNA fingerprinting.[106]

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its validity as an identification method. *Id.* To date, the latter are nonexistent.

[102] *See* Thompson & Ford, *supra* note 43, at 63-64. Poorly trained personnel and sloppy techniques are a major problem in forensic laboratories, regardless of the particular test performed. *See* Grunbaum, *Problems Inherent in the Analysis of Rape Evidence — State of the Art*, FORUM, Sept.-Oct. 1986, at 30; Maugh, *supra* note 79, at 3.

[103] *See* Beroldingen & Sensabaugh, *Forensic DNA Analysis*, 12 TIELINE 27, 36 (1986) (stating that DNA fingerprinting procedure is time-consuming and somewhat tricky); Lomhoff, *supra* note 84, at 9 (stating that lab technicians will need careful training before the test can be used on large scale).

[104] The normal procedure to ascertain proper technique is to cross-examine the analyst about qualifications and the specifics of the procedure used. *See* CAL. EVID. CODE § 893 (West 1966). Under the statute, the experts called to testify "shall be subject to cross-examination by the parties." *Id.* DNA fingerprint analysts should be subjected to the same process. For this reason, attorneys should familiarize themselves with the general principles involved in this technique. In addition, unlike many tests, DNA fingerprinting minimizes analysts' subjective interpretations of raw data. *See supra* notes 76-78 and accompanying text. Many of the genetic marker tests require subjective determinations both as to procedures and results. *See* Gaensslen, *Evaluation of Antisera I*, *supra* note 54, at 649-50; Mudd, *supra* note 54, at 421-23; *see also* Thornton, Guarino, Rios & Cashman, *Enhancement of the Luminol Test by Means of Light Amplification*, 31 J. FORENSIC SCI. 254 (1986) (indicating that amplification of light sources during experimental procedures may affect conclusions as to quality and quantity of reactions); Wraxall & Stolorow, *supra* note 54, at 1443-44 (indicating common problems associated with some testing procedures).

[105] *See* Peterson, *supra* note 5, at 675 (discussing HLA testing). Questions about lab proficiency extends beyond genetic marker testing. *See* Caudill & Boone, *Crisis in Drug Testing: Results of CDC Blind Study*, 253 J. A.M.A. 2382 (1985); *see also* Grunbaum, *supra* note 102, at 30 (summarizing results of various lab proficiency tests indicating many laboratories have unacceptably high error rate in performance of simple tests).

[106] For examples of the complexity of some of the tests, see Budowle, *Subtyping*, *supra* note 54, at 1346; Budowle & Allen, *Electrophoresis Reliability I: The Contaminant Issue*, 32 J. FORENSIC SCI. 1537 (1987); Davies, *The Appearance and Grouping of Mixtures of Semen and Vaginal Material*, 22 MED. SCI. L. 21 (1982); Gaensslen, *Evaluation of Antisera II*, *supra* note 54, at 657; *see also* Stubbings, *supra* note 54, at

B. Admissibility

Many foreign courts accept the test's validity as a test of identity. In England, where the use of DNA fingerprinting for identity purposes began, the first reported case was the disputed maternity immigration case noted earlier.[107] In the case of the two murdered English girls,[108] DNA fingerprinting established that the same individual committed both crimes.[109] It also established that the original suspect who had confessed did not commit the crimes.[110] After DNA fingerprinting all males in the surrounding area, police identified a second suspect who was convicted and sentenced to life in prison.[111] The test has been applied in a number of English criminal and civil cases, including paternity cases.[112]

In the United States, no jurisdiction has denied the admission of DNA fingerprints when the proponent sought to introduce the results.[113] In 1987 a Florida state trial court became the first court to admit prosecution DNA fingerprinting testimony in a rape case.[114] In

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613 (identifying problems inherent in the analysis of postcoital vaginal swabs). One limitation on the possibility of getting a false positive identification with DNA fingerprinting is that the test yields no results if the sample has been contaminated or has been degraded. *See* Thompson, *supra* note 43, at 43.

[107] *See* Jeffreys, *Immigration*, *supra* note 50, at 818; *see also* Maugh, *supra* note 79, at 28 (stating that the first uses of DNA fingerprint evidence were in English immigration cases).

[108] *See* Schmitz, *supra* note 2, at 14.

[109] Gill & Werrett, *Exclusion of a Man Charged With Murder By DNA Fingerprints*, 35 FORENSIC SCI. INT'L 145, 146 (1987).

[110] *Id.*; Kelly, *Method and Applications*, *supra* note 36, at 109; Lohr, *supra* note 82, at 5.

[111] Schmitz, *supra* note 2, at 17. In another English case, a defendant was convicted of rape through DNA fingerprinting evidence presented at trial. Lohr, *supra* note 82, at 5. The test identified the defendant as the donor of semen stains found on the victim's clothing. *Id.* In an English paternity case, another defendant was accused of unlawful sex with a fourteen-year-old female. CELLMARK DIAGNOSTICS, INC., INFORMATION SHEET (publication by private laboratory engaged in DNA analysis). DNA fingerprinting indicated that the defendant fathered the child born as a result of the intercourse, and the defendant was convicted. *Id.*

[112] CRIM. PRAC. MANUAL, *supra* note 39, at 428. English officials have proposed that DNA fingerprint evidence be routinely used in immigration cases in which a familial relationship is contested. *See* Lomhoff, *supra* note 84, at 9. Douglas Hurd, the British Home Secretary, recently announced that the Government's seven forensic laboratories all will use DNA fingerprint analysis. *See* Lohr, *supra* note 82, at 5.

[113] *See* Maugh, *supra* note 79, at 28 (quoting Cecil Hider, Manager, California Criminalistics Institute).

[114] *See* Johnson, *supra* note 99, at 46; Nat'l L.J., *supra* note 56, at 42 (citing State

that case, a blood test indicated only that the defendant and the rapist were among a group of males with similar blood type.[115] The size of the group was approximately one-third of all males.[116] There were no witnesses to the rape.[117] The victim could not identify the defendant as the rapist because the rape occurred in a dark room, and the rapist whispered.[118] Furthermore, the defendant had an alibi, and his fingerprints were found only on the outside of a window screen.[119] However, DNA fingerprinting indicated an exact match between the defendant and the semen sample taken from the victim's vagina.[120] Two experts testified of the validity of DNA fingerprinting, and the defense could not find an expert to refute the validity.[121] The defendant was convicted.[122] The defendant has appealed, challenging the admission of the DNA fingerprint evidence.[123]

Trial courts in Oklahoma, New York, Virginia, Pennsylvania, and North Carolina have also admitted DNA fingerprint evidence in cases involving murder, robbery, sexual battery, and paternity.[124] In a Vir-

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v. Andrews, No. CR87-1400 (9th Jud. Cir. Fla., Oct. 20, 1987)).

[115] *See* Nat'l L.J., *supra* note 56, at 42.

[116] *Id.*

[117] *Id.*

[118] *Id.*

[119] *Id.*

[120] *Id.*; Johnson, *supra* note 99, at 46.

[121] *See* Moss, *supra* note 1, at 66; *see also* Gorner, *supra* note 36, at 2 (David Houseman and Dr. Michael Baird, Director of Forensics for the Lifecodes Corporation, testified as experts for the technology). Dr. Houseman testified that DNA analysis was used in his laboratory at the Massachusetts Institute of Technology on a daily basis. State v. Andrews, No. CR87-1400 (9th Jud. Cir. Fla., Oct. 20, 1987). In addition, Houseman testified that at a meeting of the American Society for Human Genetics the previous month, several hundred scientific presentations using DNA variant analysis were made. *Id.* Dr. Baird indicated that other independent university laboratories were using the same technology, following essentially the same protocol as was used in this case. *Id.*

[122] Gorner, *supra* note 36, at 1; Johnson, *supra* note 99, at 46.

[123] *See* Moss, *supra* note 1, at 68. The admissibility of DNA fingerprint evidence was upheld by the first appellate court to decide the issue. Andrews v. State, No. 87-2166 slip op. (5th Dist. Ct. App. Fla., Oct. 20, 1988) (WESTLAW, Allstates library, FL-CS file). The court used a relevancy standard in its decision but additionally required that "the party seeking to introduce expert testimony first establish that the subject can support an expert opinion with a reasonable degree of reliability." *Id.* The court found DNA fingerprint evidence reliable both in its reliance on accepted scientific principles and in the procedures and techniques involved in test performance. *Id.*

[124] *See* Ingwerson, *supra* note 1, at 4; Thompson, *supra* note 43, at 42. For a description of some of these cases, see Moss, *supra* note 1, at 68. A Virginia trial judge ruled in a juvenile court case that DNA fingerprinting was admissible on the issue of

ginia capital case, a jury accepted DNA fingerprint evidence that linked the defendant to the rape and strangulation of a woman and convicted the defendant.[125] In a Washington case, police used DNA fingerprinting to identify a rapist when the victim suffered from Alzheimer's Disease and was unaware of the rape.[126] Oklahoma police used DNA fingerprinting to link a woman to a dead newborn baby found in a garbage can.[127] The latter two cases illustrate the potential capability of DNA fingerprinting as an investigatory tool when other evidence has identified a suspect.[128]

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paternity. Lomhoff, *supra* note 84, at 9. In a New York murder trial, DNA fingerprint evidence was presented to show that a bloodstain on a knife was the victim's. *See* Johnson, *supra* note 99, at 46; Thompson & Ford, *supra* note 43, at 57. In New York, a special commission has been appointed to review DNA fingerprinting procedures. Moss, *supra* note 1, at 70.

[125] Ogletree, *supra* note 37. In this case, four experts testified that DNA fingerprinting was both reliable and widely used in laboratories throughout the world. Commonwealth v. Spencer, No. CR88-131 through CR88-133 (Arlington Cty. Cir. Ct., Virginia July 6, 1988).

[126] *See* Maugh, *supra* note 79, at 3. Legislators in Washington have introduced legislation establishing panels of experts to recommend testing techniques for DNA fingerprinting. *See* Moss, *supra* note 1, at 70.

[127] *See* S.F. Chronicle, *supra* note 98, at 17. In a few jurisdictions, legislators have proposed bills calling for genetic typing of convicted sex offenders as a condition of parole. Hicks, *supra* note 38, at 3.

[128] The use of DNA fingerprinting is particularly helpful in rape cases, since application of traditional genetic marker tests to semen samples is limited. Genetic marker tests rely on the secretion of antigens found in blood and semen. *See* Moss, *supra* note 1, at 66. However, some individuals are non-secretors, and analysis through the genetic marker systems is limited for those individuals. *Id.* Approximately 20% of the population does not secrete the proteins. *See* Lomhoff, *supra* note 84, at 8. In rape case analysis the presence of particular antigens may have come from vaginal secretions mixed with semen, thus masking a true rapist's characteristic as a nonsecretor. *See* Grunbaum, *supra* note 102, at 32; Kelly, *Method and Applications*, *supra* note 36, at 110; *see also* Dodd, *supra* note 12, at 5 (noting that "the origin of any markers present is . . . [nearly] impossible to trace"). DNA fingerprinting, in contrast, does not rely on antigens for analysis. Kelly, *Method and Applications*, *supra* note 36, at 110. DNA fingerprinting can also facilitate the identification of fire, flood, and crash victims. CELLMARK DIAGNOSTICS, INC., *supra* note 111; Hicks, *supra* note 38, at 3. In addition, the test may be used to identify children in long-term kidnapping cases and for pedigree determinations of animals. A child is identified through a comparison of DNA fingerprints of the child and the alleged parents. *See* Moss, *supra* note 1, at 66. Genetic marker tests can also identify missing children. In Argentina, scientists used HLA testing of grandparents to identify children kidnapped during a repressive military regime. *See Nova: The Search for the Disappeared*, *supra* note 88. The parents had often been killed by the military, and their children were either sold or placed with childless military couples. *Id.* Grandpaternity testing is an extension of current paternity testing and

C. Admissibility in California

Despite the evident advantages of DNA fingerprinting, the test may presently be inadmissible in California paternity trials. California follows the *Kelly-Frye* standard for admission of scientific evidence.[129] This standard requires that the proponent of evidence derived from a new scientific technique establish "the general acceptance of the technique by the relevant scientific community."[130] The California Supreme Court thus imposed a higher standard of admissibility for scientific evidence than for other evidence, fearing that unsophisticated jurors would be overwhelmed by the scientific "mystique."[131] The court felt that a restrictive position on the admission of scientific evidence minimizes this

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calculates the probability that a child inherited the genetic marker from grandparents rather than by chance. *Id.*; *In re* Lukas, 155 Ill. App. 3d 512, 508 N.E.2d 368, 372 (1987). For an application of DNA analysis in the context of the diagnosis of predisposition to disease, see Cox, Woo & Mansfield, *DNA Restriction Fragments Associated with Antitrypsin Indicate a Single Origin for Deficiency Allele PI Z*, 316 NATURE 79 (1985).

[129] Grunbaum, *supra* note 102, at 30.

[130] *See* Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923) (denying admissibility of systolic blood pressure data as evidence of untruthfulness).

[131] People v. Kelly, 17 Cal. 3d 24, 31-32, 549 P.2d 1240, 1245, 130 Cal. Rptr. 144, 149 (1976). However, empirical studies indicate that juries may not be misled by scientific evidence any more than judges. *See* Imwinkelried, *The Standard for Admitting Scientific Evidence: A Critique From the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 563 (1982-83). Two instances in which the scientific "mystique" has apparently misled factfinders are the use of expert testimony in psychology and psychiatry and the use of polygraphs. *See* Greenberg, *Science's Infallibility Debunked*, Sacramento Bee, July 11, 1988, at B11, col. 3. Courts particularly rely on psychologists and psychiatrists for testimony to determine guilt or innocence, child custody, monetary awards, and other issues. *See id.* However, evidence indicates that "in screening for brain damage, professional psychologists performed no better than office secretaries," and that "in predicting violence, the experts are wrong at least twice as often as they are correct." *Id.* This tendency in the case of psychological and psychiatric testimony to rely upon apparently unfounded scientific testimony is not limited to "unsophisticated jurors." *Id.* Psychologists and psychiatrists are routinely relied on by courts, governmental agencies, and private firms to assess the mental status of individuals. *Id.*

Juries may misinterpret genetic marker frequency evidence both in criminal cases and in paternity disputes. *See* State v. Kim, 398 N.W.2d 544 (Minn. 1987); Jonakait, *supra* note 29, at 390; Peterson, *supra* note 5, at 684. To date, however, no court has cautioned the jury as to the limited probative value of genetic marker frequencies. Jonakait, *supra* note 29, at 390. While the California Supreme Court noted the dangers of using statistics to prove criminal guilt in People v. Collins, 68 Cal. 2d 319, 438 P.2d 33, 66 Cal. Rptr. 497 (1968), that concern has not been applied to proof of paternity. *See* Ellman & Kaye, *supra* note 6, at 1132; Peterson, *supra* note 5, at 676.

danger.[132]

Many law enforcement officials in California feel that proponents of DNA fingerprinting will be unable to establish general acceptance by the scientific community within the immediate future.[133] However, the

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[132] *Kelly*, 17 Cal. 3d at 31, 549 P.2d at 1245, 130 Cal. Rptr. at 149. California courts use three criteria to determine the general acceptance of a new scientific technique: 1) published scientific and legal writings on the subject; 2) qualified expert testimony; and 3) judicial decisions on the issue from other jurisdictions. Note, *supra* note 6, at 782. Unless a proponent can show at least one of these elements, the evidence is inadmissible. *Kelly*, 17 Cal. 3d 24, 549 P.2d 1240, 130 Cal. Rptr. 144 (stating that in the case before the court, the proponent met none of the tests). California courts also require a showing that the procedures used in the particular test are reliable. *Id.* at 30, 549 P.2d at 1244, 130 Cal. Rptr. at 148.

The lack of appellate decisions and legal writings preclude showing the general acceptance of DNA fingerprinting to satisfy the first or third criteria. Proponents of DNA fingerprinting are limited to expert testimony to establish general acceptance. When DNA fingerprinting has been admitted in United States courts, expert testimony has established reliability. *See supra* note 121 and accompanying text.

[133] *See* Thompson, *supra* note 43, at 44. One of the reasons indicated by the officials for this belief is that credible expert witnesses for the technique are scarce. *Id.* California Attorney General John Van De Kamp believes that only a handful of DNA researchers are working in forensics and of those, "almost none are law enforcement personnel." *Id.* Most are attached to private laboratories, whom Van De Kamp sees as partial. *Id.* However, the *Kelly* court indicated that the impartiality of law enforcement personnel may also be suspect. *See Kelly*, 17 Cal. 3d at 39, 549 P.2d at 1250, 130 Cal. Rptr. at 154.

Attorney General Van De Kamp has urged a more intense legal scrutiny of the technology because of its "devastating" effects on criminal trials. Address by John Van De Kamp, Attorney General of California, to California Criminalistics Institute, Seminar on DNA Identification, Los Angeles, Cal., Jan. 7, 1988. Van De Kamp believes that DNA fingerprinting is not yet generally accepted in the scientific community. *Id.* Despite this stance, Van De Kamp has called for the creation of a statewide data bank of DNA fingerprints. *See* Moss, *supra* note 1, at 70.

Some law enforcement officials in California disagree strongly with Van De Kamp's conclusions. *See* Thompson, *supra* note 43, at 40. However, at a 1987 meeting of the American Society of Crime Laboratory Directors, only one-third of the directors polled believed that DNA fingerprint evidence was ready to be introduced at trials. Address by John Van De Kamp, *supra*. Because of fears that a premature attempt by prosecutors to introduce DNA fingerprint evidence will result in a precedent-setting denial of admissibility in criminal trials, Van De Kamp has ordered the California Bureau of Forensic Services not to use the technology in any form. *Id.* This policy will continue until he is satisfied that the technology meets the *Kelly-Frye* standard. *Id.*

However, the Attorney General may be forced to decide sooner than that. In a recent rape case, the defendant had DNA fingerprints taken from three semen samples recovered from the victim. Thompson, *supra* note 43, at 40. Comparison of the prints from the samples and the defendant's DNA fingerprint indicates that the defendant is not the culprit. *Id.* at 36. Yet the victim has positively identified the defendant as her assailant.

future of the *Kelly-Frye* standard may itself be in doubt. The new conservative majority on the California Supreme Court has indicated a willingness to examine scientific evidence under a more relaxed standard.[134] The Truth-in-Evidence amendment to the California Constitution,[135] commanding that relevant evidence not be excluded in California criminal trials,[136] may also lead to the demise of the standard.[137]

In the interim, *Kelly-Frye* remains the standard for admissibility of scientific evidence in California. While courts are less likely to rule against admission of DNA test results in paternity suits than in criminal trials,[138] the fear of an adverse *Kelly-Frye* decision has apparently precluded proponents from introducing DNA fingerprinting in paternity suits. To date, proponents of the test have not introduced DNA fingerprint evidence in any California paternity suits.[139] The failure to use this evidence to prove or disprove paternity means that the most relevant evidence on the issue of paternity is withheld from the factfinder.[140]

Id. The prosecutor in the case is now faced with the choice of accepting the test results and dropping the charges or of going to trial based on the victim's identification and attempt to have the DNA fingerprints ruled inadmissible under *Kelly-Frye*. *Id.* at 40. If the prosecutor chooses the former, the victim in the case will feel she has been further victimized. *Id.* If the prosecutor chooses the latter course and is successful, she may also succeed in keeping DNA fingerprint evidence out of California courts for years. *Id.*

The reluctance of prosecutors to use DNA fingerprinting evidence in criminal cases because of *Kelly-Frye* allows defendants to take advantage of new technology with no risk. *See id.* at 42 (quoting Edward Blake, a forensic serologist) (stating that "prosecutors are leaving virgin territory for the defense to exploit at no risk to the defense"). If the test proves inculpatory, the defendant can withhold the results. *Id.* If the test is exculpatory the defendant can present the results and ask for a dismissal. *Id.*

[134] *See* People v. Reilly, 196 Cal. App. 3d 1127, 242 Cal. Rptr. 496 (1987). The California Supreme Court refused to review a lower court ruling that the process of electrophoresis was generally accepted by the scientific community and admissible in evidence. *Id.*

[135] CAL. CONST. art. 1, § 28(d).

[136] The article mandates the admission of evidence in criminal trials unless the United States Supreme Court has held otherwise. *See* People v. Neer, 177 Cal. App. 3d 991, 223 Cal. Rptr. 555 (1986).

[137] *See* E. HEAFY, CALIFORNIA TRIAL OBJECTIONS § 20.8, at 178-79 (2d ed. 1984) (suggesting the Truth-in-Evidence amendment overturned *Kelly-Frye* standard in California criminal cases); *see also* Uelman, *Proposition 8 Causes Uncertainty Over Vast Areas of Criminal Law*, CAL. LAW., July-Aug. 1982, at 45.

[138] *See supra* notes 31-32 and accompanying text.

[139] *See* Maugh, *supra* note 79, at 28; Thompson, *supra* note 43, at 40.

[140] *See supra* notes 36-38 and accompanying text; *see also* Cramer v. Morrison, 88 Cal. App. 3d 873, 885, 153 Cal. Rptr. 865, 872 (1979) ("[R]ather than relying on [extraordinarily flimsy evidence] . . . the law should not ignore readily obtainable ge-

The failure to use DNA fingerprinting evidence is particularly distressing because the test may be admissible in California paternity suits under current California statutes. While the California Legislature has not yet considered a statute to admit DNA fingerprinting, the test may arguably be admissible under current statutes that specify appropriate evidence to prove paternity. These statutes admit genetic marker tests[141] and require that the tests show the probability of paternity.[142] The DNA fingerprint test has been used as a basis for calculating the statistical probability of paternity[143] and could thus satisfy this requirement.[144] Presumably, the statutes take precedence over the *Kelly-Frye*

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netic evidence that can provide a precise and objective basis for deciding such an important question as the paternity of a child.").

[141] *See, e.g.*, CAL. EVID. CODE § 892 (West Supp. 1988) (requiring court ordered blood tests in civil actions involving paternity); *Id.* § 893 (West 1966) (authorizing tests performed by court-appointed experts); *Id.* § 895 (West Supp. 1988) (founding determination of paternity on all the evidence); *Id.* § 895.5 (West Supp. 1988) (imposing rebuttable presumption of paternity with paternity index of 100 or more).

CAL. EVID. CODE § 892 allows the court to make a paternity finding adverse to the defendant when he refuses to undergo the blood tests. *Id.* § 892 (West Supp. 1988). Section 895, amended in 1986, provides that if the blood tests indicate the probability of paternity, the paternity issue is resolved on all the evidence, including the blood tests. *Id.* § 895 (West Supp. 1988). The key statute is section 895.5, added in 1986. That statute shifts the burden of proof to the putative father when the genetic marker blood tests and statistical analysis yield a paternity index of 100 or more. *See id.* § 895.5 (West Supp. 1988). The statute defines genetic markers as "separate identifiable genes or complexes of genes." *Id.* By this definition, DNA fingerprint evidence is admissible as a genetic marker test. *See supra* notes 40-41 and accompanying text; *see also* Baird, *DNA-Print*, *supra* note 96, at 2.

[142] *See* County of El Dorado v. Schneider, 191 Cal. App. 3d 1263, 1276 n.11, 237 Cal. Rptr. 51, 59 n.11 (1987) (stating that under California Evidence Code § 895, blood tests are used affirmatively to show the probability of paternity). However, since all blood tests commonly used cannot prove actual paternity, none are tests that show "probability of paternity." *See supra* note 19 and accompanying text. Only when the statistical significance of the failure to exclude is computed does a probability of paternity exist. *See supra* notes 21-23 and accompanying text.

[143] *See* Baird, *DNA-Print*, *supra* note 96, at 2.

[144] In County of Sonoma v. Grant, 187 Cal. App. 3d 1439, 232 Cal. Rptr. 471 (1986), the court stated that section 895 "permits all blood tests . . . and probability of paternity percentages to be admitted on the issue of paternity, subject to the restrictions of Evidence Code section 352." *Id.* at 1447. Genetic markers are defined in the statute as "separate identifiable genes or complexes of genes generally isolated as a result of blood typing." CAL. EVID. CODE § 895.5(b)(1) (West Supp. 1988). DNA fingerprinting should presumably qualify under this definition because it identifies the source of genetic markers which result in blood group or protein variance. *See* Beroldingen & Sensabaugh, *supra* note 103, at 27 (stating that "genetic polymorphisms . . . have usually been detected as blood groups or protein variants[, but] . . . the ultimate source

standard,[145] and therefore, the evidence would be admissible.[146]

III. Proposal for Admitting DNA Fingerprinting in California Paternity Suits

A. Statutory Proposal

To facilitate the use of DNA fingerprinting in California paternity suits, the California Legislature should adopt the following statute as part of the California Evidence Code:

> a) If a court finds that the results of DNA fingerprint testing indicate that a putative father is the actual father of a child at issue, the court shall impose a rebuttable presumption of paternity. This presumption may be rebutted by a preponderance of the evidence. Evidence admissible in rebuttal of the presumption of paternity may include nongenetic evidence of paternity, evidence of unreliable test results, and genetic test results indicating nonpaternity.
>
> b) Notwithstanding subsection (a), DNA fingerprint test results are inadmissible in evidence as proof of paternity unless the test is performed by an expert and forensic laboratory qualified in genetic analysis and in the performance and analysis of DNA fingerprint testing under standards established by the California Association of Crime Laboratory Directors.[147] Qualifications of both the expert and the forensic laboratory shall be established prior to the admission of test results. In addition, the proponent of the test results must establish that the test and analysis were performed under established methods of analysis in accordance with guidelines established by the California Association of Crime Laboratory Directors.[148]
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> c) As used in this section, "DNA fingerprint testing" means that test which visualizes and identifies individual variations in the genetic code through the use of multi-locus probes applied to Restriction Fragment Length Polymorphisms.

The proposed statute places DNA fingerprinting on the same footing as genetic marker tests such as the ABO and HLA. The statute paral-

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of genetic variation is DNA").

[145] *See* Lemmon & Murphy, *supra* note 40, at 244 n.46 (indicating that broad interpretation of similar Virginia statute eliminated need to lay foundation for admissibility under *Frye*); *see also* E. Imwinkelried, R. Wydick & J. Hogan, California Evidentiary Foundations 104 (1988) [hereafter E. Imwinkelried].

[146] *See* E. Imwinkelried, supra note 145, at 104 (stating that statute eliminates need for proof of general acceptance of genetic markers).

[147] *See* Position Paper, California Association of Crime Laboratory Directors Position on DNA Typing of Forensic Samples, presented to California Criminalistics Institute Seminar on DNA Identification, Los Angeles, Cal., Jan. 7, 1988 (hereafter *Position Paper*).

[148] *Id.*

lels California Section 895.5 of the California Evidence Code[149] in applying the results of genetic analysis as positive proof of paternity. While both statutes create a presumption of paternity when the tests indicate paternity, the proposed statute states that the defendant may rebut the presumption through further genetic testing and other nongenetic evidence.

As a further safeguard, the statute emphasizes the importance of establishing the reliability and accuracy of test results. For admission of the test results, the proponent must show both the reliability of the method used to obtain the raw data and the ability of the analyst to interpret the data. The requirements may initially limit the use of DNA fingerprint evidence in paternity suits since scientists knowledgeable in the field of DNA fingerprinting are relatively uncommon.[150] However, with the diffusion of knowledge of the technique to more scientists, the limitation would eventually become a nonfactor.

While proponents must show the reliability of a particular test performance, the proposed statute assumes the underlying validity of DNA fingerprinting as positive proof of paternity. This assumption is based upon the significant studies validating the method[151] and the lack of contrary evidence.[152] The statute acknowledges the test's validity by placing the burden of proof on the defendant to show nonpaternity when DNA fingerprinting indicates paternity. By making the presumption rebuttable, the statute avoids placing the decisionmaking process in total reliance upon the test results.

The statute attempts to narrow the possibly broad definition of "DNA fingerprinting" by stating specific characteristics of the test. While DNA analysis encompasses more than one test,[153] the more intricate methods, such as those used by the technique's inventors,[154] supply

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[149] CAL. EVID. CODE § 895.5 (West Supp. 1988).

[150] *See supra* note 133 and accompanying text (indicating California law enforcement officials' belief that credible experts for the technique are scarce).

[151] *See supra* notes 96-97 and accompanying text.

[152] *See supra* notes 99-101, 121 and accompanying text. Proponents could establish reliability by following proposed standards for DNA polymorphism tests as recommended by the AABB Parentage Committee in the California Association of Crime Laboratory Directors Position Paper on DNA Typing of Forensic Samples. *See Position Paper, supra* note 147, at 2. Among the specific guidelines proposed are the use of controls during the electrophoresis process, DNA fingerprint interpretation by two or more individuals, the computation of the paternity index as a function of allele frequency databases for DNA probes, and confirmatory testing by an independent laboratory. *Id.*

[153] *See* Moss, *supra* note 1, at 69.

[154] *Id.*

the most precise results.[155]

B. Changing the Standard for Admission of Scientific Evidence

As an alternative approach to a statutory solution to the admissibility of DNA fingerprint evidence in California paternity disputes, California courts should consider changing the standard for the admission of scientific evidence in general, and DNA fingerprint evidence in particular. While the *Frye* standard is the standard for the majority of jurisdictions in the United States, the application of the standard creates numerous problems for proponents of scientific evidence.[156] In reaction to the drawbacks of the *Kelly-Frye* standard, some jurisdictions treat scientific evidence similarly to other evidence and simply inquire as to its logical relevance.[157] While this approach allows the admission of most relevant scientific evidence, it fails to account for the possibility of an unreliable or experimental technique.[158] To overcome this problem, the standard for the admission of scientific evidence in California should encompass a two-part test. The first part should focus on the relevance of the evidence, while the second part would determine the method's reliability.[159]

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[155] *See* Thompson & Ford, *supra* note 43, at 62-63 (noting that degree of precision varies with type of probe used).

[156] Note, *supra* note 6, at 779-80.

[157] *See* People v. Brown, 297 Or. 404, 411, 687 P.2d 751, 758 (1984) ("[T]he principal alternative approach to the *Frye* test is to treat scientific evidence in the same way that other evidence is treated."). Many of these jurisdictions weigh the probative value of the evidence against the probative dangers. *See* Moss, *supra* note 1, at 68. Other jurisdictions only require one qualified expert to vouch for the reliability of the test. Note, *supra* note 6, at 780.

Critics have attacked the *Kelly-Frye* rule since its inception. *See* Gianelli, *The Admissibility of Novel Scientific Evidence:* Frye v. United States, *A Half-Century Later*, 80 COLUM. L. REV. 1197, 1206 n.59 (1980); Note, *supra* note 6, at 779. They criticize both the deprivation of relevant evidence as a result of the standard and the standard's vague nature. *See* State v. Klindt, 389 N.W.2d 670, 672 (Iowa 1986) (stating "if reliability is shown, we need not await approval by the scientific community"); A. MOENSSENS, *supra* note 40, at 6 (stating that "general acceptance under *Frye* does not necessarily result in reliability of the test used"); *see also* Note, *supra* note 6, at 780.

[158] In a conference and workshop on the *Frye* standard sponsored by the National Conference of Lawyers and Scientists, all participants agreed that a "relevancy" test such as that in Federal Rule of Evidence § 401 should not replace the *Frye* standard. *See* A. MOENSSEN, *supra* note 40, at 12.

[159] *See* Millar, *Entering the Twilight Zone of* Kelly-Frye, paper presented at California Criminalistics Institute Seminar on DNA Identification, Los Angeles, Cal., Jan. 7, 1988.

1. Relevance

The relevance part of the test would treat scientific evidence similarly to other types of evidence. Under current California law, evidence is presumptively admissible even though it is only slightly relevant to the disputed fact.[160] However, all relevant evidence is not admissible. Under Section 352 of the California Evidence Code, relevant evidence is excluded if considerations such as undue time consumption, prejudice, confusion of the issues, and danger of misleading the jury substantially outweigh the probative value of the evidence.[161]

Under a balancing test of section 352, a court considering whether to admit evidence based on DNA fingerprinting admissibility would first determine the probative value of the evidence.[162] Since DNA fingerprint test results are very relevant to paternity,[163] the most likely conclusion is that the test is highly probative.[164] The court would then weigh the countervailing dangers.[165] In its determination, the court might even incorporate the degree of general acceptance as one of the test's factors.[166]

Assuming that the novelty of a technique correspondingly increases the probative danger of the evidence, the judge may exclude some novel research techniques as highly speculative and the results as too prejudicial.[167] However, this exclusion should rarely be invoked since excessive use of this remedy would reinstate the *Kelly-Frye* standard.[168]

A more palatable solution would be to admit the evidence and to give

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[160] *See* CAL. EVID. CODE § 210 (West 1966) (stating that evidence is relevant when it has "any tendency in reason to prove or disprove any disputed fact that is of consequence to the determination of the action").

[161] *Id.* § 352.

[162] The proponent of the evidence has the burden of showing its probative value. *See* E. IMWINKELRIED, *supra* note 145, at 49. The proponent "must establish that the object is what the proponent claims it to be." *Id.*

[163] DNA fingerprinting is the only scientific method that consistently and positively identifies the father. *See* Kelly, *Method and Applications*, *supra* note 36, at 105.

[164] *See* CAL. EVID. CODE § 210 (West 1966).

[165] *See supra* note 161 and accompanying text.

[166] In People v. Brown, 297 Or. 404, 687 P.2d 751 (1984), the court used the *Frye* standard as one of several factors to be considered in the analysis of reliability. *Id.* at 412, 687 P.2d at 759.

[167] *See* People v. Kelly, 17 Cal. 3d 24, 32, 549 P.2d 1240, 1245, 130 Cal. Rptr. 144, 149 (1976) (discussing danger of misleading jury through "impressive credentials" that obscure "experimental nature" of the technique). Novelty should not render a scientific technique inadmissible per se because "every new development must have a first day in court." *See* Note, *supra* note 5, at 254 (citing Phillips v. Jackson, 615 P.2d 1228, 1234 (Utah 1980)).

[168] *See supra* note 132 and accompanying text.

a cautionary instruction to the jury.[169] A method similar to this is used in Great Britain. In English jury trials, the magistrate, when turning the case over to the jury for deliberation, may comment on the credibility of the evidence presented at trial.[170] This safeguard allows the courts to admit evidence derived from new scientific techniques and minimizes fear that the jury will attach too much weight to the evidence.[171] Adopting a similar approach in California paternity trials will allow the relevance aspect of the admissibility test to address concerns underlying *Kelly-Frye*. This approach also fulfills the factfinder's need for relevant evidence of paternity.[172]

2. Reliability

While the admissibility test's first step deals with prejudicial effects of scientific evidence upon jurors, the second aspect addresses the reliability of the method. Determining reliability should use all relevant factors that indicate whether DNA fingerprinting is reliable.[173] The relevant factors may include, for example, the technique's general acceptance, statistical studies performed to validate the technique, the existence of explanatory writings, the objectivity of the analyst's interpretation, and the analyst's qualifications.[174] With a new technique such as DNA fingerprinting, the proponent of the evidence should have the burden of proof to prove reliability.[175] In addition, the court could

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[169] The *Kelly* court conceded that one alternative to the *Frye* approach is to allow the trial court discretion to admit the evidence but to lessen the weight of the evidence upon a finding of questionable reliability. *Kelly*, 17 Cal. 3d at 31, 549 P.2d at 1244, 131 Cal. Rptr. at 148.

[170] *See* Silverman, *The Trial Judge: Pilot, Participant or Umpire*, 11 ALBERTA L. REV. 40, 52-53 (1973) (citing Regina v. Pavlukoff, 10 W.W.R.(N.S.) 26 (B.C.C.A.) (1953-54)) (stating that a Magistrate may express opinions on the credibility of a witness to jury); *see also* Peiris, *Corroboration in Judicial Proceedings: English, South African and Sri Lankan Law on the Testimony of Accomplices Compared*, 30 INT'L & COMP. L.Q. 682, 715 (1981).

[171] Silverman, *supra* note 170, at 53.

[172] *See supra* notes 51-53 and accompanying text. The results of DNA fingerprint testing become direct evidence of paternity, replacing the circumstantial evidence of genetic marker tests. *See* Aicken, *supra* note 94, at 385; Gaensslen, *supra* note 9, at 80.

[173] *See* People v. Brown, 297 Or. 404, 412, 687 P.2d 751, 759 (1984) (stating that "the existence or nonexistence of factors may all enter into the court's . . . decision . . . but need not necessarily do so").

[174] *Id.*

[175] The burden should not differ greatly from the burden a proponent of any evidence is subject to in proposing the admission of evidence. *See* E. IMWINKELRIED, *supra* note 145, at 49. For proposed criteria of reliability, see Beroldingen & Sen-

invoke the rarely used power to appoint a court expert to determine the reliability of DNA fingerprinting evidence.[176]

Under the two-part test, DNA fingerprinting could be judged on its scientific merits, not on the number of its adherents.[177] Since a failure to show the DNA technique's reliability under one circumstance (such as the technique's general acceptance) is not fatal if other circumstances (such as statistical studies and objectivity of analyst interpretation) indicate reliability, the novelty of the test does not end the inquiry.[178]

The willingness by courts to examine and to admit new scientific techniques such as DNA fingerprinting is particularly important because scientific advances occur rapidly.[179] By imposing a time-lag between actual reliability and general acceptance, the *Kelly-Frye* standard precludes the admission of most advanced scientific techniques.[180] By the time a test is generally accepted, an improved method is often already available.[181] In contrast, if the relevance-reliability standard is adopted, the scientific breakthrough of DNA fingerprinting will help courts achieve significantly more accurate paternity findings.[182]

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sabaugh, *supra* note 103, at 40; *Position Paper*, *supra* note 147, at 2.

[176] The *Kelly* court indicated that this procedure could be used to insure a fair and objective hearing on the test's reliability. People v. Kelly, 17 Cal. 3d 24, 37-38, 549 P.2d 1240, 1249, 130 Cal. Rptr. 144, 153 (1976); *see* CAL. EVID. CODE § 730 (West Supp. 1988) (giving courts discretion, on their own motion or parties' motion, to appoint an expert to assist in determining facts at issue); *see also* Weinstock, *Expert Opinion and Reform in Anglo-American, Continental, and Israeli Adjudication*, 10 HASTINGS INT'L & COMP. L. REV. 9, 22 (1986). U.S. courts sparingly use the power to appoint experts because they believe that the power conflicts with an adversarial system of justice. *Id.* at 33.

[177] *Kelly*, 17 Cal. 3d 24, 540 P.2d 1240, 130 Cal. Rptr. 144 (emphasizing that standard requires a minimal number of experts to vouch for a technique's validity).

[178] *See supra* note 173 and accompanying text.

[179] *See supra* note 54 and accompanying text.

[180] *Kelly*, 17 Cal. 3d at 32, 540 P.2d at 1245, 130 Cal. Rptr. at 149 (stating that *Frye* was deliberately intended to retard the admission of evidence based on new scientific principles).

[181] The HLA test that vastly exceeds the accuracy of previous blood tests has only recently been admissible as proof of paternity. *See* Lemmon & Murphy, *supra* note 40, at 251-54. Now a superior technique for establishing paternity faces the same battle. However, as the court in Cramer v. Morrison, 88 Cal. App. 3d 873, 153 Cal. Rptr. 865 (1979) stated "we are not aware of any public policy which would require exclusion of highly probative scientific evidence on the issue of paternity . . . [a]ll the policy considerations advanced by California commentators and case law argue for broad inclusion of such evidence in paternity proceedings." *Id.* at 885, 153 Cal. Rptr. at 872.

[182] DNA fingerprints exceed the efficiency of conventional systems because of its definitive answer to the paternity issue. *See* Dodd, *supra* note 12, at 6. When DNA fingerprint evidence is used on a large scale in paternity testing, then perhaps the old

CONCLUSION

Due to the lack of a definitive paternity test, California courts utilize genetic marker tests that prove paternity by the process of elimination. DNA fingerprinting can simplify paternity determinations because it is the only test that positively indicates paternity. The California Legislature should create a new statute specifically allowing the introduction of DNA fingerprinting to prove paternity. Alternatively, California courts should adopt a relevance-reliability standard for the admission of DNA fingerprint evidence, since currently accepted methods of proving paternity are of limited utility. While the current genetic marker tests have served their purpose, it is time for the courts to determine who is the father, rather than who is not.

Ronald J. Richards

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adage that maternity is a matter of fact while paternity is a matter of opinion will no longer hold. *See* Dodd, *supra* note 40, at 231.