



Court of Appeals of New York.
The PEOPLE of the State of New York, Respondent,
v.
George WESLEY, Appellant.

March 29, 1994.

The People moved for order to extract blood and take hair samples from defendant indicted on charges of murder in the second degree, rape in the first degree, attempted sodomy in the first degree, and burglary in the second degree. The County Court, Albany County, 140 Misc.2d 306, 533 N.Y.S.2d 643, granted motion. Defendant was later convicted in the County Court, Albany County, Harris, J., on all counts, and his motion to vacate judgment of conviction was denied. Defendant appealed. The Supreme Court, Appellate Division, Mahoney, J., affirmed, 183 A.D.2d 75, 589 N.Y.S.2d 197, and appeal was permitted. The Court of Appeals, Smith, J., held that: (1) deoxyribonucleic acid (DNA) profiling evidence is admissible, and (2) DNA evidence was properly admitted in this case.

Affirmed.

Kaye, C.J., concurred in result and filed opinion in which Ciparick, J., joined.

West Headnotes

[1] Criminal Law 110 388.2

110 Criminal Law
110XVII Evidence
110XVII(1) Competency in General
110k388 Experiments and Tests; Scientific and Survey Evidence
110k388.2 k. Particular Tests or Experiments. Most Cited Cases

"Frye test" was standard for determining admissibility of deoxyribonucleic acid (DNA) profiling evidence, which was novel scientific evidence at time of prosecution; thus, question was whether accepted techniques, when properly performed, generated re-

sults which were accepted as reliable within the relevant scientific community.

[2] Criminal Law 110 388.2

110 Criminal Law
110XVII Evidence
110XVII(1) Competency in General
110k388 Experiments and Tests; Scientific and Survey Evidence
110k388.2 k. Particular Tests or Experiments. Most Cited Cases

Deoxyribonucleic acid (DNA) profiling evidence is generally accepted as reliable by relevant scientific community; accordingly, it is no longer necessary to conduct *Frye* inquiry to determine whether such evidence is admissible.

[3] Criminal Law 110 388.2

110 Criminal Law
110XVII Evidence
110XVII(1) Competency in General
110k388 Experiments and Tests; Scientific and Survey Evidence
110k388.2 k. Particular Tests or Experiments. Most Cited Cases

Evidence supported hearing court's determination that deoxyribonucleic acid (DNA) profiling evidence was generally accepted as reliable by relevant scientific community, for purposes of admitting DNA evidence in prosecution for murder, rape, burglary, and attempted sodomy, and, therefore, DNA evidence was admissible subject to compliance with other foundation requirements; several experts testified to acceptance of DNA evidence by relevant scientific community, to reliability of DNA evidence, and to reliability of procedures used in defendant's case.


[4] Criminal Law 110 388.2

110 Criminal Law
110XVII Evidence
110XVII(1) Competency in General
110k388 Experiments and Tests; Scientific

and Survey Evidence

110k388.2 k. Particular Tests or Experiments. Most Cited Cases

State presented adequate foundation for admission of deoxyribonucleic acid (DNA) profiling evidence, which had earlier been found to be generally accepted as reliable by relevant scientific community, by putting forth testimony that appropriate steps were taken in analyzing the DNA evidence at issue and providing explanation of assumptions underlying probability calculations, even though defendant presented conflicting evidence as to reliability of particular procedures used.

[5] Criminal Law 110  736(1)

110 Criminal Law

110XX Trial


110XX(F) Province of Court and Jury in General

110k733 Questions of Law or of Fact

110k736 Preliminary or Introductory Questions of Fact

110k736(1) k. In General. Most Cited Cases

In determining whether adequate foundation for evidence has been presented, court should not decide whether such evidence is true, but rather, should leave that function to the jury.

[6] Criminal Law 110  695.5

110 Criminal Law


110XX Trial

110XX(D) Procedures for Excluding Evidence

110k695.5 k. Hearing, Ruling, and Objections. Most Cited Cases

(Formerly 110k6951/2)

Trial court need not hold hearing before admitting novel scientific evidence.

[7] Criminal Law 110  695.5

110 Criminal Law


110XX Trial

110XX(D) Procedures for Excluding Evi-

dence

110k695.5 k. Hearing, Ruling, and Objections. Most Cited Cases
(Formerly 110k6951/2)

Pretrial *Frye* hearing, to determine whether novel scientific evidence is generally accepted as reliable by relevant scientific community, does not encompass matters going to trial foundation or to weight of evidence.

[8] Criminal Law 110  741(2)

110 Criminal Law

110XX Trial

110XX(F) Province of Court and Jury in General

110k733 Questions of Law or of Fact

110k741 Weight and Sufficiency of Evidence in General

110k741(2) k. Identity and Presence of Accused. Most Cited Cases

Evidence presented jury question, in prosecution for rape, murder, burglary, and attempted sodomy, as to whether deoxyribonucleic acid (DNA) profiling evidence showed that defendant was perpetrator, despite defendant's challenges to population studies on which DNA testing facility relied to estimate probability of coincidental match.

[9] Criminal Law 110  388.2

110 Criminal Law


110XVII Evidence

110XVII(I) Competency in General

110k388 Experiments and Tests; Scientific and Survey Evidence

110k388.2 k. Particular Tests or Experiments. Most Cited Cases

Defendant's challenges to population studies on which deoxyribonucleic acid (DNA) testing facility relied to estimate probability of coincidental match went to weight, rather than admissibility, of DNA profiling evidence.

[10] Criminal Law 110  1186.1

110 Criminal Law

110XXIV Review

110XXIV(U) Determination and Disposition of Cause

110k1185 Reversal

110k1186.1 k. Grounds in General. Most Cited Cases

Defendant was not entitled to have conviction vacated based on fact that procedures used by deoxyribonucleic acid (DNA) testing facility which prepared profiling evidence in defendant's case were held to be unreliable in unrelated case; evidence at *Frye* hearing and at trial established that procedures used in defendant's case met standards of scientific acceptance and reliability. McKinney's CPL § 440.10, subd. 1(g).

***98 *418 **452 Roger M. Fritts, Public Defender of Albany County, Albany (Douglas P. Rutnik and Jeanne M. Heran, of counsel), for appellant.

Sol Greenberg, Dist. Atty. of Albany County, Albany (George H. Barber, of counsel), for respondent.

*419 Robert T. Johnson, Dist. Atty. of Bronx County, Bronx (Peter D. Coddington and Nikki Kowalski, of counsel), for The Dist. Attys. Ass'n of the State of N.Y., amicus curiae.

G. Oliver Koppell, Atty. Gen., Albany (Richard H. Girgenti, Jerry Boone, Peter H. Schiff and M. Dawn Herkenham, of counsel), for the Div. of Crim. Justice Services, amicus curiae.

Barry C. Scheck, New York City, Lawrence Vogelmann, Ellen Yaroshefsky and Peter Neufeld, for Car-dozo Crim. Law Clinic, amicus curiae.

***420 OPINION OF THE COURT**

SMITH, Judge.

The primary issues on this appeal are whether DNA profiling evidence is admissible in this State and, if so, whether it should have been admitted against defendant in this case. Because such evidence has been accepted and found reliable by the relevant ***99 **453 scientific community and because no error was committed in the circumstances of this case, we affirm.

Facts

Defendant appeals, by permission of a Judge of this Court, from an order affirming his conviction for murder in the second degree, rape in the first degree, attempted sodomy in the first degree and burglary in the second degree. On September 15, 1987, 79-year-old Helen Kendrick was found dead in her apartment in the City of Albany. The investigation of her death focused on defendant when caseworkers from the Albany City Hostel, an organization which served developmentally disabled persons, during a routine check of defendant's apartment, found a bloodstained T-shirt with gray and white hairs on it, bloodstained underwear and bloodstained sweatpants. Both defendant and the deceased were clients of the organization.

Even without the DNA profiling evidence, proof of defendant's*421 guilt is compelling. The day after the victim's body was found, defendant told a social worker that he did not know the decedent, even though he had visited her in her apartment only three days before. During questioning by one of the detectives, defendant gave at least three conflicting accounts of how his shirt became bloodied. Defendant also gave an implausible account of how the decedent sustained her injuries. According to a detective, defendant stated that he "tripped" the decedent and she fell to the floor. Defendant noticed blood on the floor so he attempted to check her pulse by feeling in her vaginal area. Because he could not detect a pulse in the victim, he moved toward her chest area and attempted CPR. Unsuccessful in that attempt, he picked her up, thereby staining his clothes with her blood, dropped her to the floor, placed her face down and left the apartment. Defendant volunteered that he "didn't choke her" although the detective never mentioned that she was choked. Defendant also offered that he did not have sexual intercourse with the victim although the detective made no mention of a sexual crime. Defendant told the detective, "I didn't do it. I turned my head when somebody else did it."

In addition, a microscopist testified that nylon from the carpet in the decedent's apartment was on the decedent's dress and on defendant's T-shirt, underpants and sweatpants. She testified that fibers from a blanket in defendant's bedroom were located on the decedent's dress and underpants and on defendant's T-shirt and underpants as well.

The DNA Issue

As stated, the primary issue on this appeal is the introduction of DNA profiling evidence. Such evidence, consisting of unique genetic characteristics belonging to an individual, can provide strong evidence of a person's presence at and participation in a criminal act. In this case, DNA comparison was made of a bloodstain taken from defendant's T-shirt, hair follicles taken from the deceased and blood drawn from the defendant. The conclusion was that the DNA print pattern on the defendant's T-shirt matched the DNA print pattern from the deceased and that the DNA print pattern from the blood of the defendant was different from that of the decedent.

Prior to the trial, a hearing was held to determine whether or not the DNA evidence proffered should be admissible. Following that hearing the trial court ruled the evidence admissible and the defendant was convicted at a subsequent *422 trial (140 Misc.2d 306, 533 N.Y.S.2d 643). The Appellate Division affirmed (183 A.D.2d 75, 589 N.Y.S.2d 197).

Because the issue here is novel, we will discuss (1) the standard to be used in determining admissibility, (2) the use of DNA evidence in this case and (3) whether the standard was met here.^{FN1}

FN1. The nature of the DNA evidence sought to be admitted is contained in an Appendix.

The Standard of Admissibility

[1] It should be emphasized that the inquiry here is into the reliability of the DNA evidence at the time of the proceedings in this case in 1988 and 1989. The DNA evidence was presented as novel scientific evidence requiring a determination as to its ***100 **454 reliability (see, *People v. Magri*, 3 N.Y.2d 562, 565-566, 170 N.Y.S.2d 335, 147 N.E.2d 728 [approving the use of radar in speed detection]; *People v. Middleton*, 54 N.Y.2d 42, 49-50, 444 N.Y.S.2d 581, 429 N.E.2d 100 [holding that identification through bite marks is accepted by the scientific community]). While foundation concerns itself with the adequacy of the specific procedures used to generate the particular evidence to be admitted, the test pursuant to *Frye v. United States*, 293 F. 1013 poses the more elemental question of whether the accepted techniques, when properly performed, generate results accepted as reliable within the scientific community generally. Only that *Frye* question is before

us. The issues of a proper foundation and of the adequacy of laboratory procedures here are not before us, though some of the arguments made by the parties appear not to make this distinction.

In determining whether the DNA profiling evidence was properly admissible, attention must focus on the acceptance of such evidence as reliable by the relevant scientific community. The long-recognized rule of *Frye v. United States* (*supra*) is that expert testimony based on scientific principles or procedures is admissible but only after a principle or procedure has "gained general acceptance" in its specified field. In *Frye* (*supra*, at 1014) the court stated:

"Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle *423 or discovery, the thing from which the deduction is made must be *sufficiently established to have gained general acceptance in the particular field in which it belongs*" (emphasis supplied).

The *Frye* court rejected evidence that a person's truthfulness could be determined by a study of systolic blood pressure.

This Court has noted that the particular procedure need not be "unanimously indorsed" by the scientific community but must be "generally acceptable as reliable" (see *People v. Middleton*, 54 N.Y.2d 42, 49, 444 N.Y.S.2d 581, 429 N.E.2d 100, *supra*).^{FN2} Thus, the issue here concerns the acceptance by the relevant scientific community of the reliability of DNA evidence.

FN2. *Daubert v. Merrell Dow Pharms.*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 is not applicable here. In that case the United States Supreme Court held that, at least in Federal courts, the rule of *Frye v. United States*, 293 F. 1013, *supra*, was superseded by the Federal Rules of Evidence, particularly rule 702 which allows the court to permit testimony concerning scientific or technical evidence if such evidence will aid the fact finder in understanding the evidence

or determining a fact in issue (Fed. Rules Evid., rule 702). The Court noted the rigidity of the "general acceptance" rule in contrast to the "liberal thrust" of the Federal Rules and their "general approach of relaxing the traditional barriers to "opinion" testimony" (*see, Daubert v. Merrell Dow Pharms.*, 509 U.S. 579, ----, 113 S.Ct. 2786, 2794, *supra*, quoting *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169, 109 S.Ct. 439, 450, 102 L.Ed.2d 445).

The Use of DNA Evidence in this Case

Prior to the trial in this case, a *Frye* hearing was held to determine whether the relevant scientific community had accepted DNA evidence as reliable. The trial court found that DNA evidence was accepted as reliable. Lifecodes Corporation (Lifecodes) was then asked to perform DNA fingerprint identification on items of biological evidence in this case. Specifically, Lifecodes was asked to analyze a bloodstain on a T-shirt belonging to defendant, hair follicles which were taken from the victim, and whole blood that was drawn from the defendant. At trial, after the *Frye* hearing had been held and the trial court had found DNA evidence to be reliable and in order to lay a foundation for its admission at trial, Dr. Michael Baird, Director of Forensic and Paternity Testing at Lifecodes, explained how each piece of evidence was analyzed. He stated that, in each instance, DNA was extracted from the nucleus of a cell and purified to get a fairly pure DNA sample, free of contaminants. Using a restrictive enzyme that recognizes a particular sequence of DNA, the DNA was then cut into shorter pieces. Agarose gel was then used to separate the *424 DNA pieces by length. The DNA pieces were then stained with ethidium bromide to permit increased***101 **455 visibility using ultraviolet light and to determine whether the separation by size was correctly done. Thereafter, the DNA was split into single strands and transferred from the gel to a nylon membrane. Next, a DNA probe,^{FN3} which had been labelled with radioactive phosphate, was applied to the nylon membrane, causing the probe to bind with the complementary, single-stranded pieces of DNA. Any DNA probe that did not bind, as well as any excess DNA, were washed away. The nylon membrane was then placed on a piece of X-ray film and the pieces of the DNA probe that had been bonded to the membrane were revealed. The X-ray film, now referred to as an autorad, was then analyzed and compared with a known sample.

This process is referred to as autoradiography. Dr. Baird concluded that the DNA print pattern that was generated from the bloodstain on the T-shirt matched the DNA print pattern from the victim's hair follicles, and that pattern was different from the DNA pattern from defendant's blood.

^{FN3}. In analyzing the evidence, Lifecodes used three different DNA probes, one for each evidentiary sample.

Application of the Standard to the Facts Here

[2][3] Contrary to the contentions of the defendant, DNA profiling evidence is generally accepted as reliable by the relevant scientific community and was so accepted at the time of the *Frye* hearing in 1988. There was sufficient evidence in the record to support the hearing court's determination on general reliability as a matter of law and, second, the determination comported with generally accepted scientific authority (*see, People v. Hughes*, 59 N.Y.2d 523, 543, 466 N.Y.S.2d 255, 453 N.E.2d 484; *see also, People v. Taylor*, 75 N.Y.2d 277, 286, 552 N.Y.S.2d 883, 552 N.E.2d 131).

The testimony in this case met the applicable standard of reliability. Several experts, including Dr. Sandra Nierzwicki-Bauer, Dr. Richard John Roberts, Dr. Michael Baird, and Dr. Kenneth Kidd, testified to the acceptance of DNA profiling evidence by the relevant scientific community and to its reliability, as well as to the reliability of the procedures used by Lifecodes.^{FN4}

^{FN4}. Dr. Sandra Nierzwicki-Bauer received a Ph.D. in Microbiology from the University of New Hampshire and was an Assistant Professor of Biology at Rensselaer Polytechnic Institute. Her expertise was in molecular biology and molecular genetic techniques.

Dr. Richard John Roberts received a Ph.D. in Organic Chemistry from the University of Sheffield, in England, and was an Assistant Director for Research at the Cold Spring Harbor Laboratory in Suffolk County. He was a molecular biologist and had done research on restriction enzymes.

Dr. Michael Baird was the Director of Pa-

ternity and Forensic Evaluation at Lifecodes Corporation. He has a Ph.D. in Genetics from the University of Chicago. His specialty was genetic testing.

Dr. Kenneth Kidd was a Professor of Human Genetics, Psychiatry and Biology at the Yale University School of Medicine. He was trained as a geneticist, had experience in population genetics and had done research in RFLP studies (The "[u]se of DNA restriction fragment length polymorphisms for gene mapping and for population studies").

Dr. Neville Colman holds a medical degree and a Ph.D. and is certified by the American Board of Pathology as a clinical pathologist. He is an Associate Professor of Pathology at the Mount Sinai School of Medicine in New York City and Director of the Blood Bank and Hematology Laboratory at the Veterans Administration Medical Center in Bronx County.

[4][5] *425 We hold that since DNA evidence was found to be generally accepted as reliable by the relevant scientific community and since a proper foundation was made at trial, DNA profiling evidence was properly admitted at trial. It was admitted under customary foundation principles. The foundation included testimony that the appropriate steps were taken in analyzing the DNA evidence and an analysis and explanation of the assumptions underlying the probability calculations (see, United States v. Jakobetz, 955 F.2d 786, 799-800). The foundation did not and should not include a determination of the court that such evidence is true. That function should be left to the jury (see, United States v. Jakobetz, 955 F.2d at 796-797).

With respect to the assertion in the concurring opinion that the prosecution did not show that the relevant scientific community had accepted Lifecodes' protocols for determining a match, it is clear that the testimony ***102 **456 supported the conclusion that the procedures used by Lifecodes were generally accepted by the scientific community. The defendant did not raise the specific problem of matching at the Frye hearing, through its expert testimony or examination of the prosecution's experts.

Moreover, the record supports the view that visual matching was accepted by the scientific community in 1988. "The use of simple visual comparisons to determine whether two prints match is widespread in biology and appears to be well-accepted, even though it relies, to some extent, on the analyst's subjective judgment" (Thompson and Ford, *426 DNA Typing: Acceptance and Weight of the New Genetic Identification Tests, 75 Va.L.Rev. 45, 75 [1989]). According to the Thompson and Ford article, which was written around the same time the trial court decided this case, the Lifecodes test had been admitted in 22 criminal trials by October of 1988. The same article made the observation that matching could be done either visually or by machine:

"The final step in RFLP analysis is to compare two DNA prints to see if they match, and therefore could have originated in the same individual. In most cases, DNA prints are simply eyeballed to see whether they match. The comparison can also be done by machines, which read DNA prints and convert each print into a numerical code. Numerical codes can be compared with one another by computer to determine the degree to which two prints match. Moreover, the use of numerical codes makes possible the creation of large computerized data bases of DNA prints which can be searched to find a match for a given specimen" (*id.*, at 74-75).

[6] It should be noted that novel scientific evidence may be admitted without any hearing at all by the trial court (see, e.g., Matter of Lahey v. Kelly, 71 N.Y.2d 135, 524 N.Y.S.2d 30, 518 N.E.2d 924; People v. Middleton, 54 N.Y.2d 42, 444 N.Y.S.2d 581, 429 N.E.2d 100, *supra*). Moreover, the modern trend in the law of evidence has been away from imposing a special test on scientific evidence and toward using the "traditional standards of relevancy and the need for expertise" (1 McCormick, Evidence § 203, at 873-874 [4th ed. 1992]).

[7] Thus, the general reliability of DNA matching was established at the hearing. The Frye test—the sole issue before us—requires no more, despite the new and more stringent requirements that would be added under the test proposed by the concurring opinion. It is important to note that some of defendant's other objections, which were made at the Frye hearing but not at trial, are actually matters going to

trial foundation or the weight of the evidence, both matters not properly addressed in the pretrial *Frye* proceeding.

As to the procedures used by Lifecodes, the only expert witness for the defense on this issue, Dr. Neville Colman, opined that the procedures, methodology, and quality control used by Lifecodes were inadequate to assure the accuracy and reliability of its testing results. However, three of the prosecution's*427 expert witnesses, Dr. Richard J. Roberts, Dr. Kenneth K. Kidd, and Dr. Sandra Nierzwicki-Bauer, reviewed Lifecodes' written laboratory protocols and concluded that the practices and procedures used by Lifecodes in its DNA fingerprinting were generally accepted by the scientific community as accurate, reliable and appropriate.^{FN5}

^{FN5}. In reaching his conclusion that Lifecodes' DNA fingerprinting process was accepted by the scientific community, Dr. Kidd not only reviewed Lifecodes' written laboratory protocols, but also visited Lifecodes' laboratory and observed a portion of each step in the process.

Dr. Michael Baird, who is responsible for Lifecodes' standards of quality control, testified that Lifecodes' quality control program (1) analyzes the quality of the DNA that has been isolated from a piece of evidence to make sure that DNA is of appropriate quality for fingerprinting tests, (2) examines the enzyme digestion to make sure that the correct digestion and fragmentation has taken place, (3) evaluates the DNA fragment separation, the DNA probe and data analysis, and (4) monitors the maintenance of equipment being used throughout the test, as well as the preparation of any reagents.

***103 **457 As for peer review of Lifecodes' procedures in performing DNA fingerprint testing, even the defense expert agreed that no peer review articles have discredited the RFLP procedures used by Lifecodes.

[8][9] Defendant's challenges to the population studies relied on by Lifecodes to estimate the probability of a coincidental match^{FN6} go not to admissibility, but to the weight of the evidence, which should be left to the trier of fact (see, *United States v. Jakobetz*, 955 F.2d 786, 796-797, *supra*). These chal-

lenges were never made by the defendant at trial. Such challenges were, however, made at the *Frye* hearing and were answered by the prosecution. To the extent the defendant at the *Frye* hearing focused on the inadequacy of the DNA population studies done by Lifecodes as indicative of the unreliability of DNA evidence in general, defendant did not prevail. Once there was testimony as to the reliability of the *428 statistical population studies, the trial court was justified in admitting that testimony. Assuming that the defendant had presented evidence of the inadequacy of those studies, defendant would have been entitled to have the jury consider them, not exclude their admissibility entirely. In any event, the record before us indicates that defendant's challenge to Lifecodes' population studies lacks merit.

^{FN6}. Generally, statistical probability studies are admitted as part of the DNA proof in a case. At least one court has, however, precluded such evidence even though DNA evidence of a match was allowed. In *Rivera v. State*, 840 P.2d 933 [Wyo.], the Supreme Court of Wyoming upheld a conviction for first degree sexual assault and the introduction of DNA profiling evidence. In referring to statistical probability population studies, the court found that the better practice was that they not be admitted. Their admission in the case was held not to be reversible error.

Dr. Richard Borowsky, who was called as a witness for the defense, testified that the population genetics studies performed by Lifecodes were inadequate, and in many ways incorrect. Specifically, Dr. Borowsky stated that the data base used was too small to obtain a Hardy-Weinberg equilibrium^{FN7} or linkage disequilibrium.^{FN8} On the other hand, Dr. Kidd stated that in his opinion, and in the opinion of the scientific community in general, the data base used by Lifecodes was sufficiently large for such experiments, and a review of the data submitted by Lifecodes regarding its population genetics study revealed no linkage disequilibrium. Furthermore, Dr. Kidd testified that since there are individual genotypes that have been observed to occur more frequently than expected and others that have been observed to occur less frequently than expected, an adjustment in the claimed mean power of certainty of identification should be made. He opined that the adjustment warranted was much less than a factor of

10, but gave that amount as “the largest estimate” of a possible deviation. A factor of 10 reduced the mean power of certainty of identification for American Blacks from 1 in 1.4 billion to 1 in 140 million and for Caucasoids from 1 in 840 million to 1 in 84 million. Here, statistical evidence was admitted based upon expert testimony as to its reliability.

FN7. A Hardy-Weinberg equilibrium is a test performed on a sample of a large, random, interbreeding population, whereby one compares the frequencies of alleles or genes in a population with the frequencies with which one would expect to find in the individuals.

FN8. Linkage disequilibrium is a phenomenon whereby a specific allele of one locus becomes associated with another locus on the same chromosome with a frequency greater than expected by chance.

Finally, no support exists in the record for defendant's claim that Lifecodes may have tried to correct “bandshifting” in this case.

After the Frye inquiry, the issue then shifts to a second phase, admissibility of the specific evidence—i.e., the trial foundation—and elements such as how the sample was acquired, whether the chain of custody was preserved and how *429 the tests were made. This distinct voir dire foundation is presented at the trial and is the same as that applied to all evidence, not just to scientific evidence. This was not part of the Frye hearing or ruling and was not addressed by the trial court here. Indeed, Lifecodes had not completed all the testing here at the time of the Frye hearing. Once Frye has been satisfied, the question is “whether the accepted techniques were employed by the experts in this ***104 **458 case” (People v. Middleton, 54 N.Y.2d, at 50, 444 N.Y.S.2d 581, 429 N.E.2d 100). The focus moves from the general reliability concerns of Frye to the specific reliability of the procedures followed to generate the evidence proffered and whether they establish a foundation for the reception of the evidence at trial. The trial court determines, as a preliminary matter of law, whether an adequate foundation for the admissibility of this particular evidence has been established.

At trial, the prosecution laid a foundation for the

introduction of DNA evidence, but the defendant made no objection at trial that a proper foundation was lacking. Once the Frye reliability and the trial foundation have been established, the evidence is admissible. At this third stage, the jury is left to hear the testimony and consider the weight of the evidence—i.e., “possible infirmities in the collection and analysis of data” (1 McCormick, Evidence § 203, at 877 [4th ed. 1992]; People v. Middleton, *supra*. at 51, 444 N.Y.S.2d 581, 429 N.E.2d 100).

CPL Article 440 Motion

[10] Defendant contends that the trial court erred in denying his CPL 440.10(1)(g) motion to vacate the judgment of conviction based on newly discovered evidence that would have dictated a more favorable result for him at trial. According to defendant, Lifecodes' practice of visually matching bands on autorads, rather than using a computer digitized apparatus to declare matches that fell within three-standard deviations of error, rendered the results of DNA forensic testing performed by that company unreliable under New York State law. Defendant asserted further that he would have received a more favorable verdict if the autorads used by Lifecodes had been produced, and if defense experts, who were unavailable at the time of the trial, had been permitted to properly examine the actual sizing reports. Defendant's assertions were based on another case, People v. Castro, 144 Misc.2d 956, 545 N.Y.S.2d 985, which was decided after County Court decided this case.

Defendant's reliance on Castro is misplaced. In that case, the court concluded that there is general scientific acceptance *430 of the theory underlying DNA identification, and that DNA forensic identification techniques and experiments are generally accepted in the scientific community and can produce reliable results. As for the techniques utilized in that case, however, the court concluded that Lifecodes failed in several major respects to use the generally accepted scientific techniques and experiments for obtaining reliable results, within a reasonable degree of scientific certainty. In this case, the evidence at both the Frye hearing and at trial was that the procedures used by Lifecodes met standards of scientific acceptance and reliability.

We have examined defendant's remaining arguments and conclude that they are without merit.

Accordingly, the order of the Appellate Division should be affirmed.

APPENDIX

The Nature of DNA Profiling Evidence ^{FN9}

^{FN9}. Sources: US Congress, Office of Technology Assessment, Genetic Witness: Forensic Uses of DNA Tests, at 3-6, 41-50; Prescott, Harley, Klein, Microbiology, at 236-307 (2d ed.).

Deoxyribonucleic acid (DNA) is a molecule that is present in every cell of the body that contains a nucleus. DNA is identical in every cell of the human body. It is the chemical dispatcher of genetic information and is composed of a double helix, which resembles a spiral staircase or a twisted ladder. The DNA molecule consists of repeated sequences of phosphate and deoxyribose sugar along each strand of the helix. Four types of organic bases, adenine (A), thymine (T), cytosine (C), and guanine (G), are attached to the deoxyribose sugar-phosphate groups on each strand, ^{FN10} and the bases on each strand bond in pairs (base pairs) to form the rungs of the double-stranded helix. Due to the chemical composition of these bases, only A from one strand and T from the other strand can bond together (i.e., A-T, T-A), and only G from one strand and C from the other strand can *****105 **459** bond together (i.e., G-C, C-G). The unique order, or sequence, of the base pairs along the double helix determines the structure of proteins and the regulation of cell activities.

^{FN10}. The unit of DNA consisting of one of the four bases attached to the deoxyribose sugar-phosphate group is called a nucleotide.

In human beings, DNA is found in all body cells except red ***431** blood cells, ^{FN11} and each body cell contains the same DNA. An individual's entire complement of DNA, the genome, exists in that individual's chromosomes, which are threadlike microscopic bundles consisting of a complex of nucleic acids and proteins found in each body cell. ^{FN12} Generally, humans have 46 chromosomes, including a pair of chromosomes that determine the sex of the individual and 22 pairs of autosomes (a total of 44), which are chromosomes that are not involved in sex determina-

tion. Individuals receive 22 autosomes plus one X sex chromosome from their mothers, and 22 autosomes plus either an X or a Y sex chromosome from their fathers.

^{FN11}. In addition to red blood cells, human blood contains other cells, such as white blood cells, which contain DNA.

^{FN12}. A person's DNA is the same regardless of the biological sample-blood, hair, flesh-from which it is taken. The genome of an individual does not vary from cell to cell, except in sperm and egg cells, which have half the complement of DNA present in other body cells.

As stated, an individual's chromosomes contain his or her genome. Genes, which are DNA segments or sequences that are responsible for producing a particular product or function, and of which an individual's genome is comprised, reside in the chromosomes. For example, individuals have genes that are responsible for producing eyes, ears, and hands. The physical site of a gene on a chromosome is the locus. Each gene is situated at a specific locus on a specific chromosome, and each chromosome contains many loci occupied by different genes. Human beings inherit half of their genes from their mother and the other half from their father.

Alternative genes, such as genes for brown hair or genes for red hair, at a particular locus, are called alleles. ^{FN13} At each locus, an individual may have two identical alleles (e.g., two alleles for brown hair) or two different alleles (e.g., one allele for brown hair and one allele for red hair). An individual who has two identical alleles at a particular locus is said to be homozygous for that particular locus, and an individual who has two different alleles at a particular locus is said to be heterozygous for that locus. Each individual has, at most, two alleles at a given locus—one from the mother and one from the father.

^{FN13}. The differences in alleles is explained by the difference in the ways the base pairs (A-T, T-A, C-G, G-C) arrange themselves along the DNA molecule.

Although an individual has, at most, two alleles at a given locus, many different alleles can exist for

the same locus *432 within a given population. When multiple alleles exist at a particular locus, the genetic variant is referred to as a polymorphism. Polymorphisms are simply the genetic differences among members of a population, and are caused by the variations in base sequences in the DNA in the population.

The genome of an individual consists of approximately 3.3 billion base pairs, of which only 3 million base pairs differ from one individual to another. ^{FN14} It is these areas where the base pairs differ among individuals that provide the basis for DNA identification and have great significance for DNA forensic analysis.

FN14. Identical twins have the same DNA composition.

DNA fingerprint identification tests allow scientists to look at the DNA from an individual, or a piece of evidence, and compare it with other DNA. Recently, DNA profiling identification tests have been conducted in laboratories in the United States. Commercial laboratories, such as Lifecodes, Cellmark Diagnostics Corporation and Cetus Corporation, offer DNA testing. In addition, government laboratories, such as laboratories within the Federal Bureau of Investigation and the Federal Drug Enforcement Administration, also perform DNA testing.

The primary technique for DNA testing is Restriction Fragment Length Polymorphism (RFLP) and analysis, which is referred to in ***106 **460 the scientific community as Southern Blotting. The Southern Blotting technique detects specific DNA fragments so that a particular gene may be isolated from a sample of DNA and compared with a known sample of DNA. A brief summary of this procedure follows.

(1) Using chemical enzymes, the DNA to be examined is extracted from the evidentiary sample and then purified.

(2) The extracted DNA is then cut into fragments at specific sites by the use of restrictive enzymes known as restriction endonucleases. The restriction endonucleases recognize certain sequences of base pairs along the DNA, and cut the DNA every time it finds the appropriate sequence to produce discrete

fragments known as RFLPs. Using different enzymes leads to different DNA patterns for the same individual.

(3) The RFLPs are placed into a semisolid matrix, called an agarose gel, which is then electrically polarized to sort the RFLPs by length so that they can be measured. To accomplish this step, known as "gel electrophoresis," the agarose gel is *433 placed into a weak electric field, positive at one end and negative at the other. The RFLPs are placed at the negative end of the electric field and, because of their net negative charge, the RFLPs migrate toward the positive end of the field. The distance travelled will depend on the length of the RFLPs. The longer ones migrate more slowly than, and do not travel as far as, the shorter ones. The RFLPs are then separated and sorted according to length.

(4) The sorted RFLPs are chemically split, or denatured, into two separate strands. The single strands are then transferred from the agarose gel onto a nylon membrane, known as a nitrocellulose sheet, where they become permanently fixed in their respective positions according to length on the membrane. The membrane is now known as a "Southern Blot."

(5) The Southern Blot is then placed in a solution containing short single strands of known sequences of base pairs in DNA fragments, called genetic probes. The genetic probes are tagged with a radioactive marker and are used to bond or hybridize with RFLPs on the Southern Blot that contain the complement of that particular core sequence, or variable number tandem repeats to form hybridized polymorphic segments. The radioactive marker determines the position of the genetic probes after they bond with their complementary, single-stranded RFLPs, and facilitates the visualization of the particular RFLP to which the genetic probe is bonded. Any excess DNA is washed away.

It is at this point that any match is made. In his testimony Dr. Michael Baird explained this process and compared it to putting a key into a lock.

"THE WITNESS: * * * [T]he DNA probe identifies a particular fragment, which is done in a fashion where there is a matching of sequence or pairing, almost like a lock and key type idea, in that the only right size lock will accept the right size key. If

the key, which you can think of as the probe, is a different size, it will not be accommodated by that particular lock. I mean, it's a very simplistic way to look at it. But it's a very precise fit, in terms of the probe and DNA that is being analyzed."

(6) The radioactively marked nylon membrane, with the hybridized polymorphic segment, is then placed on a piece of X-ray film, where the radioactive probes expose the film at *434 their respective locations. Dark bands, which resemble bar codes on grocery items, appear on the X-ray film where the radioactive probes have bonded to the RFLPs, producing the DNA print. The position of each dark band indicates the location of a polymorphic segment on the blot. The location of the polymorphic segment indicates the length of the DNA fragment that contains the segment.

Among humans, there are some sections in DNA in which the precise sequence of base pairs appears in the same order from one person to the next. These are segments in DNA that have the information for proteins that are absolutely essential for bodily functions. However, there are other segments in DNA, polymorphic regions, e.g., genes for eye color, that vary from one person to another.***107 **461 It is these DNA segments that are important for testing. Because these DNA segments may differ a great deal among the population, one can look at individuals in the population and determine whether they have the same DNA segments or whether they have different, polymorphic DNA segments. Usually, individuals have polymorphic segments. In individuals, the length of the DNA fragments that contain the polymorphic DNA segments varies. Thus, the bands on the DNA prints of individuals tend to differ. The choice of restrictive enzymes and genetic probes will also affect the DNA banding pattern of each individual's DNA sample. Thus, the above process may be repeated using different probes and different enzymes.

(7) The dark bands on the DNA prints are then studied to determine if a match exists between a known sample (e.g., from a crime suspect) and an unknown sample (e.g., from a crime scene or victim). Both visual studies and computer imaging analysis are done to determine whether a match exists. A match exists when the sizes and number of the detected RFLPs in the known and unknown samples are

indistinguishable within a permissible degree of error.

(8) Once a match is declared, the DNA prints are again studied to determine the frequency with which a specific allele occurs within a specific population. Population genetics is concerned with allele frequency in a particular population.

Over a two-year period, Lifecodes performed population genetic studies using DNA probes that recognize five hypervariable loci in the human genome (D2S44, D14S1, D14S13, D17S79, and DXYS14). DNA from approximately 900 unrelated individuals, subdivided into three ethnic groups (African *435 Americans, Caucasoids, and Hispanics) were isolated and successfully hybridized to each DNA probe. The number of distinct DNA fragments identified for each of these regions varied from 30 to more than 80. The allele frequency distribution was determined for each locus. The results showed statistically significant differences, between ethnic groups, in some loci (D2S44, D14S1 and D14S13) but not in others (D17S79 and DXYS14). Overall, the studies concluded that there is a mean power of certainty of identification of 1 in 840 million for Caucasoids and 1 in 1.4 billion for American blacks. Before the population genetics studies were admitted into evidence in this trial, the over-all claimed mean power of identification was reduced by a factor of 10 in order to eliminate any possible Hardy-Weinberg equilibrium or linkage disequilibrium.

KAYE, Chief Judge (concurring).

We conclude that it was error to admit the DNA bloodstain analysis evidence in this case. We nevertheless agree that defendant's conviction should be affirmed, because that evidence comprised only a minor part of the People's case. Although the result is unaffected, we write separately out of concern, for future cases, that the principles governing admission of novel scientific evidence be correctly articulated and applied.

Lest we add to rather than ameliorate confusion, we begin by stating points on which the Court is unanimous.

The Court agrees unanimously that where the scientific evidence sought to be presented is novel, the test is that articulated in Frye v. United States,

293 F. 1013, 1014, in essence whether there is general acceptance in the relevant scientific community that a technique or procedure is capable of being performed reliably (*People v. Middleton*, 54 N.Y.2d 42, 49, 444 N.Y.S.2d 581, 429 N.E.2d 100).^{FN1} In the present case, such an inquiry required assessment of whether the technique employed in forensic DNA analysis had gained scientific acceptance—that is, whether the six steps of the Restriction Fragment Length Polymorphic (RFLP) procedure, the procedure for declaring that two samples of DNA were identical (step seven), and assessment of the significance of a “match” (step eight) were generally accepted as reliable by experts in the field.

^{FN1}. Even the new Federal test articulated in *Daubert v. Merrell Dow Pharms.*, 509 U.S. 579, 113 S.Ct. 2786 would require proof of reliability of novel scientific evidence.

The Court is unanimous, moreover, in concluding that three *436 inquiries are involved in the consideration of novel scientific evidence. ***108 **462 The first—the *Frye* hearing—asks whether, theoretically, the accepted techniques, when performed as they should be, generate results generally accepted as reliable within the scientific community. Once a scientific procedure has been proved reliable, a *Frye* inquiry need not be conducted each time such evidence is offered. Courts thereafter may take judicial notice of reliability of the general procedure.

Next, a foundational inquiry must be satisfied before such evidence is placed before the jury: in each case the court must determine that the laboratory actually employed the accepted techniques. This foundational inquiry also goes to admissibility of the evidence, not simply its weight (*People v. Middleton*, 54 N.Y.2d, at 45, 50, 444 N.Y.S.2d 581, 429 N.E.2d 100, *supra*).^{FN2} Finally, infirmities in collection and analysis of the evidence not affecting its trustworthiness go to weight, to be assessed by the jury.^{FN3}

^{FN2}. We disagree with the conclusion of the court in *People v. Castro*, 144 Misc.2d 956, 959, 545 N.Y.S.2d 985, that the foundational inquiry is part of a special “DNA *Frye* test.” Our cases have always required a foundational inquiry before scientific evidence can be admitted (*see, e.g., People v.*

Middleton, 54 N.Y.2d, at 45, 444 N.Y.S.2d 581, 429 N.E.2d 100, *supra*), even after a particular technique has passed out of the “twilight zone” of “novel” evidence that is the subject of *Frye* and is judicially noticed as reliable (*see, People v. Knight*, 72 N.Y.2d 481, 487, 534 N.Y.S.2d 353, 530 N.E.2d 1273 [radar speed detection]; *People v. Campbell*, 73 N.Y.2d 481, 485, 541 N.Y.S.2d 756, 539 N.E.2d 584 [blood alcohol content test]; *People v. Mertz*, 68 N.Y.2d 136, 148, 506 N.Y.S.2d 290, 497 N.E.2d 657 [same]; *People v. Freeland*, 68 N.Y.2d 699, 701, 506 N.Y.S.2d 306, 497 N.E.2d 673 [same]; *Pereira v. Pereira*, 35 N.Y.2d 301, 307, 361 N.Y.S.2d 148, 319 N.E.2d 413 [polygraph test used for investigative purposes]). While the *Frye* hearing and foundational inquiry may proceed simultaneously, in the present case the *Frye* inquiry was conducted before any samples were taken, so that a foundational inquiry was not possible at that time.

^{FN3}. Brief gaps in the chain of custody, for example, may not affect trustworthiness of the test results, while challenges to the forensic laboratory analysis may go to the heart of reliability of results and require preclusion (Imwinkelreid, *The Debate in the DNA Cases Over the Foundation for the Admission of Scientific Evidence: The Importance of Human Error as a Cause of Forensic Misanalysis*, 69 Wash.U.L.Q. 19, 27).

Where we part company with our colleagues is in the application of these principles. We do not agree that the eight steps of forensic analysis, then in its infancy, were shown to have been accepted as reliable within the scientific community. Rather, the standard for general acceptance of the new techniques was seen as commensurate with the standards adopted by Lifecodes, the commercial laboratory hired to conduct the actual tests and which virtually occupied the field of forensic DNA analysis. Additionally, the hearing court made very clear to the parties in its *Frye* decision that it *437 considered only the theory of forensic DNA analysis as going to admissibility, and relegated the remaining questions for weighing by the jury, including such foundational inquiries as whether Lifecodes' methodology and

procedures were adequate to assure the reliability and accuracy of the results (140 Misc.2d 306, 317, 533 N.Y.S.2d 643; see also, 183 A.D.2d 75, 78, 589 N.Y.S.2d 197). In our view admission of this evidence was error.

The Frye Hearing in this Case

The *Frye* hearing in this case was virtually the first in the Nation to consider whether forensic application of DNA analysis had been generally accepted as reliable. While the mere fact that a court is the first to evaluate novel scientific evidence does not mean the evidence is unreliable, it increases the task of the hearing court. If no court opinions, texts, laboratory standards or scholarly articles have been issued on the technique-the types of materials relevant to a determination of general acceptability (*Matter of Lahey v. Kelly*, 71 N.Y.2d 135, 144, 524 N.Y.S.2d 30, 518 N.E.2d 924; *People v. Middleton*, 54 N.Y.2d 42, 50, 444 N.Y.S.2d 581, 429 N.E.2d 100, *supra*; *People v. Leone*, 25 N.Y.2d 511, 516-517, 307 N.Y.S.2d 430, 255 N.E.2d 696; *People v. Magri*, 3 N.Y.2d 562, 170 N.Y.S.2d 335)-the court may, as it did here, take the testimony of expert witnesses.^{FN4}

^{FN4}. It is not for a court to take pioneering risks on promising new scientific techniques, because premature admission both prejudices litigants and short-circuits debate necessary to determination of the accuracy of a technique. Premature acceptance of "revolutionary" forensic techniques has led to wrongful conviction (see, Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 Colum.L.Rev. 1197, 1224-1225 [discussing belated discovery of inaccuracy of paraffin test]; Neufeld and Colman, *When Science Takes the Witness Stand*, 262 [No. 5] Scientific Am. 46 [discussing belated discovery of inaccuracy of gunpowder detection test]). In *People v. Leone*, 25 N.Y.2d 511, 517-518, 307 N.Y.S.2d 430, 255 N.E.2d 696, *supra* we also warned against introduction of scientific evidence before its general reliability have been resolved in the scientific community, because "the value of the test * * * could easily become the question in the trial rather than that person's guilt or credibility" (quoting *People v. Davis*, 343 Mich. 348, 372, 72 N.W.2d 269,

282). Surely this case is an example of such diversion of focus.

***109 **463 The People offered detailed testimony concerning the RFLP procedure-an accepted procedure for separating strands of DNA and locating their unique fragments-which had been in use for research and diagnostic purposes long before its forensic application was proposed. Dr. Kenneth Kidd and Dr. Richard Roberts, experts in molecular biology and population genetics, and Dr. Sandra Nierzwicki-Bauer, a molecular biologist specializing in the study of blue-green algae, vouched on *438 behalf of the People for the reliability of RFLP procedure. None of these witnesses, however, was expert in forensic DNA analysis.

In defining the relevant scientific field, the court must seek to comply with the *Frye* objective of containing a consensus of the scientific community. If the field is too narrowly defined, the judgment of the scientific community will devolve into the opinion of a few experts. The field must still include scientists who would be expected to be familiar with the particular use of the evidence at issue, however, whether through actual or theoretical research (Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 Colum.L.Rev. 1197, 1209-1210).

Focusing on DNA profiling in the forensic setting is crucial because "DNA fingerprinting is far more technically demanding than DNA diagnostics," particularly in the art of declaring a "match" between samples (Lander, *DNA Fingerprinting on Trial*, 339 Nature 501). Traditional RFLP procedure was developed to enable scientists to identify the DNA structure contained within a particular sample, and had been in use for more than a decade at the time of this hearing. Its forensic application-comparison of DNA between two or more samples, one from an unknown source-is far more susceptible to error (*id.*). Techniques must be adapted to the special requirements of crime scene samples, which are subject to contamination that can confuse results. Moreover, steps seven and eight-the steps unique to forensic analysis of DNA-were truly novel.

The theoretical use of DNA profiling as a method for identifying perpetrators of crimes was first posited in 1985 in a series of articles by British

researchers (Jeffreys, Wilson and Thein, *Hypervariable Minisatellite Regions in Human DNA*, 314 Nature 67-69; Jeffreys, Wilson and Thein, *Individual-Specific "Fingerprints" of Human DNA*, 316 Nature 76; Gill, Jeffreys and Werrett, *Forensic Application of DNA 'Fingerprints'*, 318 Nature 577). By 1988, the only practitioners of the technique in this country were the commercial laboratories Cellmark (founded by Dr. Jeffreys), Cetus and Lifecodes, which began forensic analysis just one year before the hearing in this case. Little peer review of their techniques had taken place by 1988 because these enterprises endeavored to keep their methods secret to protect their proprietary interests. According to the defense witness Dr. Neville Colman, the *439 procedures were still so new that there had not yet been efforts in the field to "validate by replication" the methods employed at Lifecodes; there had been neither refutation nor support of the technique in the professional literature. ^{FN5}

^{FN5}. The earliest law review study of forensic DNA profiling, however, completed about the same time as the decision on the suppression motion in this case, warned that "[u]nforeseen exceptions to the test's reliability are already beginning to surface" and that it was not yet ready for *Frye* scrutiny, citing concerns raised by Dr. Alec Jeffreys himself (Burk, *DNA Fingerprinting: Possibilities and Pitfalls of a New Technique*, 28 *Jurimetrics* 455, 468, 470, n. 68 [summer 1988]).

The point of noting controversy about the reliability of the forensic technique is not for our Court to determine whether the method ***110 **464 was or was not reliable in 1988, but whether there was consensus in the scientific community as to its reliability. The *Frye* test emphasizes "counting scientists' votes, rather than on verifying the soundness of a scientific conclusion." (*Jones v. United States*, 548 A.2d 35, 42 [D.C.Ct.App.]; accord, *State v. Montalbo*, 73 Haw. 130, 828 P.2d 1274, 1279.) Where controversy rages, a court may conclude that no consensus has been reached. Here, however, the problem was more subtle: absence of controversy reflected not the endorsement perceived by our colleagues, but the prematurity of admitting this evidence. Insufficient time had passed for competing points of view to emerge. ^{FN6}

^{FN6}. In the six years between the *Frye* hearing in this case and our review of it, debate within the scientific community has exploded about forensic application of DNA analysis. In New York, the Governor's Panel on Forensic DNA Analysis issued an interim report in September 1989 (Poklemba Report) with recommendations for a model program. No final recommendations have yet been issued. In April 1992, the National Research Council (NRC) issued its report, *DNA Technology in Forensic Science*, initiated in January 1990. In Fall 1993, the NRC announced its intention to issue an amended report with modified recommendations.

The inquiry into forensic analysis of DNA in this case also demonstrates the "pitfalls of self-validation by a small group" (Hoeffel, *The Dark Side of DNA Profiling: Unreliable Scientific Evidence Meets the Criminal Defendant*, 42 *Stan.L.Rev.* 465, 502, citing Black, *A Unified Theory of Scientific Evidence*, 56 *Fordham L.Rev.* 595, 625). Before bringing novel evidence to court, proponents of new techniques must subject their methods to the scrutiny of fellow scientists, unimpeded by commercial concerns (Thompson, *Evaluating the Admissibility of New Genetic Identification Tests: Lessons From the "DNA War"*, 84 *Crim.L. & Criminology* 22, 95).

*440 A *Frye* court should be particularly cautious when-as here-"the supporting research is conducted by someone with a professional or commercial interest in the technique" (Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 *Colum.L.Rev.* 1197, 1213). DNA forensic analysis was developed in commercial laboratories under conditions of secrecy, preventing emergence of independent views. No independent academic or governmental laboratories were publishing studies concerning forensic use of DNA profiling. The Federal Bureau of Investigation did not consider use of the technique until 1989. Because no other facilities were apparently conducting research in the field, the commercial laboratory's unchallenged endorsement of the reliability of its own techniques was accepted by the hearing court as sufficient to represent acceptance of the technique by scientists generally. The sole forensic witness at the hearing in this case was Dr. Michael Baird, Director

of Forensics at Lifecodes laboratory, where the samples were to be analyzed. While he assured the court of the reliability of the forensic application of DNA, virtually the sole publications on forensic use of DNA were his own or those of Dr. Jeffreys, the founder of Cellmark, one of Lifecodes' competitors. Nor had the forensic procedure been subjected to thorough peer review.

The absence of agreed-upon standards and laboratory protocol for the conduct of a technique can also serve to establish that the technique has not yet gained general acceptance (*People v. Leone*, 25 N.Y.2d 511, 307 N.Y.S.2d 430, 255 N.E.2d 696, *supra*). Here, no laboratory conducting DNA analysis had been accredited for that purpose. As early as 1984, the Legislature set standards, in the Family Court Act, for admissibility of blood genetic marker tests. Analysis of DNA samples considered on the question of paternity—where laboratories must also declare that two samples “match”—must be shown to have been performed in accordance with proper procedures by a laboratory authorized by the Commissioner of Health to conduct such tests (Family Ct. Act §§ 418, 532). As of July 1992, however, no laboratory, including Lifecodes, had yet been authorized by the Commissioner of Health to conduct DNA testing (*Matter of S.L.B. v. K.A.*, 155 Misc.2d 458, 459, 588 N.Y.S.2d 710). The defense introduced testimony from Dr. Anne Willey of the Department of Health establishing that no licensing or certification standards governing DNA profiling evidence had ***111 **465 yet been developed in New York State, although discussions were ongoing. Lifecodes was licensed only *441 to conduct genetic tests of amniotic fluid. As defendant pointed out to the hearing court, the evidence proffered against him to prove murder would not have been admissible in this State on the question of paternity.

The opinions of two scientists, both with commercial interests in the work under consideration and both the primary developers and proponents of the technique, were insufficient to establish “general acceptance” in the scientific field (*People v. Leone*, 25 N.Y.2d 511, 514, 307 N.Y.S.2d 430, 255 N.E.2d 696, *supra*). The People's effort to gain a consensus by having their own witnesses “peer review” the relevant studies in time to return to court with supporting testimony was hardly an appropriate substitute for the thoughtful exchange of ideas in an unbiased scientific

community envisioned by *Frye*. Our colleagues' characterization of a dearth of publications on this novel technique as the equivalent of unanimous endorsement of its reliability ignores the plain reality that this technique was not yet being discussed and tested in the scientific community.^{FN7}

^{FN7}. While DNA evidence had been admitted in some criminal cases by mid-1988, the defense in this case was the very first to “mount * * * a serious challenge to DNA typing” (Thompson and Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Tests*, 75 Va.L.Rev. 45, 46, n. 4). Contrary to the observations of our colleagues, therefore (majority opn, at 426 at 102 of 611 N.Y.S.2d, at 456 of 633 N.E.2d), the fact that Lifecodes DNA evidence had been admitted without objection prior to the time of the hearing in this case was of little significance. This is particularly so since Dr. Michael Baird was also the witness vouching for the reliability of the unopposed Lifecodes evidence in those cases as well (Thompson and Ford, *op. cit.*, 75 Va.L.Rev. 45, 49, n. 20). The mere fact that the same assertions he made here had been repeated elsewhere—without challenge—did not render those statements more reliable.

The hearing court also erred in failing to scrutinize the seventh and eighth steps of forensic DNA analysis pursuant to *Frye* standards. Our colleagues obscure this shortcoming by focusing on the wealth of evidence establishing the reliability of the first six steps of forensic analysis (the RFLP procedure)—a question that was not even disputed at the hearing. It is the absence of evidence concerning accepted standards for steps seven and eight that compels me to conclude admission of this evidence was error.

It is the declaration of a match between two samples of DNA, depicted on two separate autorads, that distinguishes forensic use of DNA from traditional, research-based application of RFLP procedure. The only evidence offered on this point was, again, the testimony of Dr. Michael Baird, who *442 testified as to how a Lifecodes technician would visually compare the bands on two autorads to determine if they were the same. During the testimony of Dr. Borowsky, the court had the following ex-

change with the District Attorney:

"Let me ask you this. Let's just keep on this field. Is there some person who looks at the autorad, gentlemen, and says 'All right, this is included, this one is not included?' or is the autorad read by computer or some kind of machine?"

"DISTRICT ATTORNEY: It's read by a person.

"THE COURT: It's read by a person?"

"DISTRICT ATTORNEY: Yes.

"THE COURT: All right. And a person with what expertise?"

"DISTRICT ATTORNEY: Well, Dr. Balasz from Lifecodes, who's a Ph.D., he has read the auto[rads]."

The People presented no evidence as to whether this was the procedure generally accepted as reliable in determining whether two DNA samples match beyond Dr. Baird's broad assertion that it was. Given the testimony from Dr. Borowsky indicating that autorad readings could lead to highly subjective results, it cannot be said that the People met their burden of clearly establishing that there were generally accepted procedures for "reading" autorads in the scientific community.

Moreover, we can take note that the "visual" matching technique was rejected as unreliable once it came to the attention of neutral peers in the scientific community (National Research Council, DNA Technology in Forensic***112 **466 Science ["NRC Report"] § 2.3.5).^{FN8} We now know that "visual matches" *443 must be confirmed by a computerized measurement of the apparently matching bands. Only if these bands fall within certain defined parameters, called a "match window," will a match be declared (Attorney-General's *amicus* brief, at 20). Moreover, band appearance and position may be altered by testing conditions, environmental factors or sample contamination, compelling scientists to employ a wide "latitude of acceptance" to account for discrepancies between prints and to permit declaration of a match even where bands are not identical. This creates a danger that DNA prints of different individuals will

be mistakenly declared to match, and no formal standards existed for declaring a match in 1988 (Thompson and Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Techniques*, 75 Va.L.Rev. 45, 87-89 [1989]).

FN8. Because the question of admissibility of novel evidence is one of law, our determination on appeal should acknowledge when subsequent developments have cast doubt upon the result of the *Frye* hearing (see, e.g., *People v. Hughes*, 59 N.Y.2d 523, 543, 466 N.Y.S.2d 255, 453 N.E.2d 484; *People v. Taylor*, 75 N.Y.2d 277, 552 N.Y.S.2d 883, 552 N.E.2d 131; *People v. Williams*, 6 N.Y.2d 18, 26, 187 N.Y.S.2d 750, 159 N.E.2d 549; *People v. Magri*, 3 N.Y.2d 562, 566, 170 N.Y.S.2d 335, 147 N.E.2d 728). Defendant unsuccessfully brought a motion pursuant to CPL 440.10(1)(g) to vacate the conviction on April 18, 1990, alleging that the technique for declaring a "match" employed in 1988 had been proven unreliable. Indeed, the slip opinion-relying on 1990 and 1993 texts describes step seven as including both visual studies and computer imaging analysis. No such evidence was before the hearing court when it passed on the techniques at issue; it dispensed with this crucial phase of determining that an autoradiograph is suitable for analysis, and that two samples match, in just one sentence: "When comparing two DNA fragment patterns * * * one simply looks to see where the probe 'landed' " (140 Misc.2d 306, 317, 533 N.Y.S.2d 643).

The People's failure to adduce evidence on the matching standards was pointed out by the defense at the hearing. In the course of examining Lifecodes' methods for assessing the statistical significance of a match, the defense witness Dr. Richard Borowsky, a population geneticist, repeatedly questioned the criteria employed by Lifecodes for determining that two autorads "matched." Defense counsel emphasized that "the way they read" autorads raises issues relevant to the reliability of the testing and that a negative result "may be just a matter of interpretation." Dr. Borowsky specifically cautioned that "the probability of error" in evaluating the frequency with which a particular gene will appear on an autorad

band “has not been evaluated by the scientific community,” and declared that “interpretation is as much as part of the print test as the molecular biology.”

Our colleagues' conclusion that the reliability of the procedures employed in the instant case had been satisfactorily established overlooks that the samples had not been tested at the time of the *Frye* hearing, and the autoradiographs never examined prior to their admission at trial. Establishing a proper foundation requires at a minimum a determination that the autoradiographs were of a quality susceptible to interpretation (*People v. Castro*, 144 Misc.2d 956, 967, 973-979, 545 N.Y.S.2d 985), an inquiry that was here foreclosed by the court's erroneous determination in its *Frye* decision that all questions as to how a sample was tested go to weight, not admissibility.

Defendant also challenged the reliability of step eight, application of statistical methods to determine the significance *444 of a “match.” In its written decision, the court summarized what it saw as part of “[t]he defense attack”: “that Lifecodes' population studies are inadequate to establish a claimed power of identity for its results under the laws of population genetics” (140 Misc.2d, at 317, 533 N.Y.S.2d 643). Dr. Borowsky sought to evaluate independently the autorads which comprised the population genetics database, warning that the absence of standards in the field led to subjective results.

Step eight is an integral part of DNA forensic analysis. Indeed, evidence of a “match” is virtually meaningless without resort to the statistical interpretation; population genetics is arguably the most crucial step of the analysis. It is the area of greatest***113 **467 controversy among the experts.^{FN9} Whether the statistical technique employed by the laboratory meets the standards in the field and is capable of producing reliable results goes directly to admissibility. The hearing court erroneously characterized these concerns as affecting only the weight of the population genetics evidence.

^{FN9}. Some jurisdictions have barred DNA evidence altogether because of the uncertainty of the statistical significance of a match (*Commonwealth v. Curnin*, 409 Mass. 218, 565 N.E.2d 440, 443; *Ex parte Perry*, 586 So.2d 242, 254 [Ala.]; *People v. Barney*, 8 Cal.App. 4th 798, 10 Cal.Rptr.2d

731, 742). Others have simply barred any statistical evidence of a match, while allowing testimony that the DNA test did not exclude the defendant as a suspect (*Prater v. State*, 307 Ark. 180, 820 S.W.2d 429; *State v. Bible*, 175 Ariz. 549, 858 P.2d 1152; *State v. Pennell*, 584 A.2d 513 [Del.]; *State v. Schwartz*, 447 N.W.2d 422 [Minn.]; *State v. Houser*, 241 Neb. 525, 490 N.W.2d 168; *State v. Vandebogart*, 136 N.H. 365, 616 A.2d 483; *State v. Anderson*, 115 N.M. 433, 853 P.2d 135; *Rivera v. State*, 840 P.2d 933 [Wyo.]; *United States v. Porter*, 618 A.2d 629 [D.C.Ct.App.]).

We therefore conclude that the court erred in holding that DNA forensic analysis was generally accepted as reliable in 1988.

Harmless Error

Because of the overwhelming evidence of defendant's guilt, we join in affirming defendant's conviction in this instance where it can fairly be said that use of DNA evidence was harmless beyond a reasonable doubt (*People v. Crimmins*, 36 N.Y.2d 230, 237, 367 N.Y.S.2d 213, 326 N.E.2d 787). At the time the People raised the possibility of introducing DNA evidence, they apparently hoped tests would establish that semen found on the body of the deceased originated from defendant, establishing his guilt of her sexual assault. It is unclear why the court instigated a *Frye* hearing *445 before these tests had even been conducted, for it turned out that the DNA tests on the semen sample were inconclusive. While evidence concerning the source of the semen would have been probative, it never materialized and was not introduced at trial.

Instead, the People presented evidence that DNA contained in blood found on defendant's shirt matched that of the deceased and was not defendant's. This evidence added nothing to the People's case, however, since defendant admitted that he had been at the deceased's apartment at the time of her death and touched her body, albeit in an attempt to revive her (majority opn., at 421, at 99 of 611 N.Y.S.2d, at 453 of 633 N.E.2d). Moreover, independent forensic analysis of fibers found at the crime scene also established that defendant had been present at the apartment. The DNA evidence, therefore, was simply cumulative on this point, as both parties acknowledged

on summation:

“[DEFENDANT’S LAWYER]: What does [the DNA evidence] establish? That Helen Kendrick’s blood was on George Wesley’s T-shirt. That’s all it establishes. It establishes nothing else. What it establishes is exactly what George Wesley admitted, that he was there. * * *

“[DISTRICT ATTORNEY]: In this case, as it turns out, [the DNA evidence’s] significance is perhaps less than we anticipated, because it’s unquestioned that the victim’s blood is on the defendant’s clothing.”

Future Use of Forensic DNA Analysis

We join our colleagues in concluding that RFLP-based forensic analysis is today generally accepted as reliable. We know that, in principle, DNA polymorphisms provide a reliable method of comparing samples, that other than identical twins, each person has unique DNA, and that the current laboratory procedures for detecting DNA sequence variations are fundamentally sound. While the general acceptability of these techniques is no longer an open question, and trial courts may take judicial notice of their reliability, the adequacy of the methods used to acquire and analyze samples must be resolved case by case. As new forensic procedures are developed, *Frye* hearings will have to be conducted to assess the reliability of those methods.

The NRC panel called for formal quality-control programs *446 in all laboratories, called on Congress to require external accreditation and proficiency testing of laboratories by a governmental body, and recommended the establishment of a National Committee on ***114 **468 Forensic DNA Typing to provide scientific and technical advice on new methods of DNA typing and related issues as they arise (Annas, *Setting Standards for the Use of DNA-Typing Results in the Courtroom-The State of the Art*, 326 N.Eng.J. of Med. 1641, 1642). Such a call is a useful reminder, even in 1994. As the NRC recommended:

“[f]orensic DNA analysis should be governed by the highest standards of scientific rigor in analysis and interpretation. Such high standards are appropriate for two reasons: the probative power of DNA typing can be so great that it can outweigh all other evidence in a trial; and the procedures for

DNA typing are complex, and judges and juries cannot properly weigh and evaluate conclusions based on differing standards of rigor.” (NRC § 2.1.)

Accordingly, we would affirm defendant’s conviction, but only because, in the unusual circumstances of this case, the erroneous admission of the DNA evidence was harmless beyond a reasonable doubt.

SIMONS and BELLACOSA, JJ., concur with SMITH, J.

KAYE, C.J., concurs in result in a separate opinion in which CIPARICK, J., concurs.

TITONE and LEVINE, JJ., taking no part.

Order affirmed.

N.Y., 1994.

People v. Wesley

83 N.Y.2d 417, 633 N.E.2d 451, 611 N.Y.S.2d 97, 62 USLW 2655

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