NOTE

BY A SCINTILLA OF EVIDENCE: THE ISSUES INVOLVED IN THE ADMISSIBILITY OF LOW COPY

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I. INTRODUCTION

Suppose there was a murder. The police find a fingerprint at the scene of the crime. This would be critical evidence to the investigation and, without a doubt, something the jury should know about. If the fingerprint identified the defendant, the evidence tends to suggest guilt strongly. If the fingerprint identified anyone other than the defendant, the evidence tends to suggest innocence strongly. Now, if we had the same situation, but investigators find a partial print at the scene, this is still evidence the jury needs to know about in order to make their decision. However, it would be improper to simply admit the fingerprint into evidence with the same amount of total probative value as a complete fingerprint.[1] In order to admit it appropriately, we must first acknowledge that the fingerprint is not whole. We would also have to ensure that the jury assessed the evidence with an understanding of this shortcoming. Perhaps we would say that if the partial fingerprint identified the defendant, the evidence tends to suggest guilt weakly. Likewise, perhaps we would say that if the fingerprint identified anyone other than the defendant, the evidence tends to prove innocence weakly. As we know, not every piece of evidence has to be a home run; a case is built brick by brick, and we would not want to lose bricks like partial fingerprints in our wall of evidence.[2]

[1] *See* United States v. Mitchell, 365 F.3d 215, 225-26 (3d Cir. 2004) (stating experiments conducted by government experts in fingerprinting found the error rate for complete fingerprints to be approximately one in ten to the eighty-sixth power, as compared to the error rate of partial fingerprinting, which was one in ten to the sixteenth power); *see also* NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES, ET AL., STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD 139 (2009) (stating that an inherent subjectivity in fingerprint comparison and the possibility of stretched or contorted fingerprints means that the outcome of fingerprint analysis is not always repeatable, even when performed later by the same examiner).

[2] FED. R. EVID. 401 advisory committee's notes ("[a]s McCormick says, 'A brick is not a

Fingerprints and DNA evidence are similar in multiple ways. Both types of evidence prove the identity of a person by comparison of impressions an individual gives either voluntarily or after an arrest with impressions left at the scene of a crime. Both rely on the same principle: that the human body leaves impressions that are unique to the individual and therefore are useful as clear markers of identity. Coincidentally, DNA samples can even be extracted from a fingerprint; this DNA is known as Touch DNA.[3] Touch DNA is recovered from biological cells left when a person contacts an object, such as the collar of a shirt after it has been worn or the steering wheel of a vehicle used in a bank robbery.[4] It can establish identity from evidence samples that are imperceptible to the human eye.[5]

Using a process called Polymerase Chain Reaction ("PCR"), a DNA testing laboratory will take samples of skin, blood, hair, and other DNA found at the scene of the crime and copy or "amplify" the sample's nucleic acid sequence.[6] This process is usually repeated twenty-eight times to create millions of copies of the sample sufficient to allow a lab analyst to determine whether the sample matches other DNA given by a particular individual. The scientific community has overwhelmingly accepted PCR, hailed as "one of the most substantial technical advances in molecular genetics in the past decade."[7] The development of PCR earned Kary Mullins, the discoverer of PCR, the 1993 Noble Prize for Chemistry.[8] Meanwhile courts in two federal districts, and ten states, including

wall,' or, as Falknor quotes Professor McBaine, ' * * * [I]t is not to be supposed that every witness can make a home run.'") (citations omitted).

[3] JUSTICE MING CHIN, ET AL., FORENSIC DNA EVIDENCE: SCIENCE AND THE LAW § 7.4, Westlaw (database updated April 2016). The Touch DNA process is distinct from the traditional, and more widely accepted, restriction fragment length polymorphism (RFLP) analysis which analyzes the lengths of sequences of base pairs in DNA without amplification. George Smith, *The Admission of DNA Evidence in State and Federal Courts*, 65 FORDHAM L. REV., 2465, 2468-69 (1997) [hereinafter G. Smith, *The Admission of DNA Evidence*].

[4] *See* CHIN, ET AL., *supra* note 3, § 7.4.

[5] *See id.*

[6] *Id.* at § 2.2. The nucleic acid sequence is the twisted ladder of alternating sugar and phosphate molecules as the sides of the ladder with pairs of molecules called bases forming the rungs. The combination of a sugar, phosphate, and base forms a nucleotide. *Id.*

[7] Barry I. Eisenstein, *Polymerase Chain Reaction: A New Method of Using Molecular Genetics for Medical Diagnosis*, 322 NEW ENG. J. OF MED. 178, 178-183 (1990).

[8] HARLAN LEVY, AND THE BLOOD CRIED OUT: A PROSECUTOR'S SPELLBINDING ACCOUNT OF THE POWER OF DNA 137-38 (1996). *Cf.* Kary B. Mullis & Fred A. Faloona, *Specific Synthesis of DNA in Vitro Via a Polymerase-Catalyzed Chain Reaction*, 155 METHODS ENZYMOLOGY 335, 335-50 (1987); Kary Mullis, et al., *Specific Enzymatic Amplification of DNA in Vitro: The Polymerase Chain Reaction*, 51 COLD SPRING HARBOR SYMP. ON QUANTITATIVE BIOLOGY 263, 263-273 (1986).

New York, have sustained admissibility of PCR evidence.[9] Additionally the Federal Bureau of Investigation ("FBI") accepts results from PCR testing for their National DNA Index System.[10]

When a DNA sample is found that is below 100 picograms, the amplification of the sample will be repeated for additional cycles to create a final sample large enough for analysis.[11] The use of PCR on samples less than 100 picograms has been termed Low Copy Number ("LCN") DNA testing.[12] The risk of stochastic[13] effects increases with the addition of extra amplification cycles.[14] But, through the use of a computer algorithm that accounts for those effects, known as the Forensic Statistical Tool ("FST"), laboratories are able to accurately calculate the margin of error and factor it into the final likelihood that the DNA samples match.[15] So, much like its predecessor the partial fingerprint, this DNA "fingerprint" simultaneously carries both probative value and known drawbacks.

This note argues that while there are legitimate legal criticisms against evidence derived from LCN DNA testing, the value of the information far outweighs the drawbacks, and therefore the evidence should be admissible along with the factual criticisms about LCN to allow the jury to decide its ultimate value in New York and other jurisdictions. Part II will detail how DNA testing works. Part III will outline the competing points of view of the admissibility of LCN DNA testing. Part IV will look to analogous case law to show that it is appropriate to include LCN DNA evidence at trial. Part IV will also advocate for admission of LCN evidence in New York and other jurisdictions.

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[9] People v. Lopez, 23 N.Y.S.3d 824 (Sup. Ct. 2015) (stating approvingly that a New Jersey court admitted low copy DNA analysis evidence without *Frye* hearing); CHIN, ET AL., *supra* note 3, § 11.7 (stating that the 8th Circuit, the 3rd Circuit, California, Minnesota, Missouri, and New Hampshire have accepted PCR testing technology); G. Smith, *The Admission of DNA Evidence, supra* note 3 at 2482-83 (stating that Kansas, New York, South Dakota, Oregon, and Virginia have admitted the PCR technique).

[10] *Frequently Asked Questions (FAQs) on the CODIS Program and the National DNA Index System*, FEDERAL BUREAU OF INVESTIGATION https://www.fbi.gov/about-us/lab/biometric-analysis/codis/codis-and-ndis-fact-sheet. (last visited Dec. 30, 2015)[https://perma.cc/SBR3-XTAP].

[11] 100 picograms is approximately thirty-three human cells' worth of DNA. CHIN, ET AL., *supra* note 3, § 7.4; One picogram is the size of ten to the negative twelfth, or one-trillionth, of a gram. PROGRESS IN BIOTECHNOLOGY, BIOSEPARATION ENGINEERING 17 (I. Endo & T. Nagamune et al., eds., 2000).

[12] CHIN, ET AL., *supra* note 3, § 7.4.

[13] Stochastic, or random, effects are variations in the DNA samples, such as allelic drop-in or drop-out, stutter, and peak height imbalance. JOHN BUTLER, ADVANCED TOPICS IN FORENSIC DNA TYPING: METHODOLOGY 324-25 (2011).

[14] BUTLER *supra* note 13, at 324; CHIN, ET AL., *supra* note 3, § 7.4.

[15] People v. Collins, 15 N.Y.S.3d 564, 577 (N.Y. Sup. Ct. 2015).

II. HOW DNA TESTING WORKS

A. Introduction

Beginning with Watson and Crick's discovery of the DNA molecular structure in 1953, and continuing on through Holley, Khorana, and Nirenberg's understanding of how the genetic code actually works,[16] science has made great strides in the past sixty-five years to reach the possibility human identification by DNA for forensic use.[17] While humans share about 99.9% of their DNA, the remaining .1% consists of about 300 bases, molecules that form the ladder of the DNA double helix.[18]

B. Short Tandem Repeat Analysis

Within that .1% of unshared human DNA, lab technicians look at thirteen different loci,[19] or specific locations on a chromosome, to compile a genetic profile.[20] These locations contain large numbers of repetitive base sequences.[21] The number of times the base sequence repeats varies from person to person and is useful for genetic identification.[22] This type of analysis for DNA identification is called Short Tandem Repeat ("STR") analysis, and is one of the most widely used types of forensic DNA testing.[23] The predecessor to STR analysis, restriction fragment length polymorphism ("RFLP") testing, has been abandoned

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[16] The trio won the Nobel Prize in Physiology or Medicine in1968. FRANK N. MAGILL, THE NOBEL PRIZE WINNERS: PHYSICS 1968-1988 935 (1989).

[17] CHIN, ET AL., *supra* note 3, § 1.1 (stating that the twenty-first century is the biology century and cataloging the milestone discovery regarding DNA).

[18] *Id.* at §§ 1.1, 2.2.

[19] *Id.* at § 2.4 (stating that the thirteen specific loci used in DNA testing are: "D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S539, D18S51, D21S11, CSF1O, FGA, TH01, TPOX, and VWA").

[20] *Id.* at §§ 1.1, 2.3.

[21] *Id.* at § 2.3 ("Analysis of short tandem repeats (STRs), VNTRs [variable number tandem repeats] of two to six bases, is currently the most widely used form of forensic DNA testing.").

[22] *See id.* ("For example, the sequence G-A-T-A is the repeat sequence for the locus D7S820. This base sequence at this location is most commonly repeated between six and fifteen times. The number of times the sequence repeats is a person's "type" for that locus. For example, an individual with the sequence G-A-T-A-**G-A-T-A**-G-A-T-A-**G-A-T-A**-G-A-T-A-**G-A-T-A** would have a D7S820 type of 6.").

[23] *Id.* at §11.7 ("The fundamental validity of polymerase chain reaction (PCR), as well as its Short Tandem Repeat (STR) analysis applications, is well-established as reflected by appellate decisions in California, as well as state and federal courts nationwide."). *See also* R.S. Diaz & E.C. Sabino, *Accuracy of Replication in the Polymerase Chain Reaction*, 31 Braz. J. Med. Biol. Res. 1239, 1239-40 (1998) (concluding that "0.2% and 0.13% are the error rates for ULTMA [a method that uses the thermotoga maritama ezyme to denature, or break up DNA, for replication] and Taq [a method that uses the therus aquaticus (Taq) enzyme to denature], respectively, after reading about 3,000 bases each.").

for STR in some jurisdictions.[24]

Since every human receives a set of chromosomes from each parent, there are actually two versions, or alleles, at each locus.[25] Importantly, the number of repeats at each allele may differ, resulting in two numbers (of repeated bases) per locus.[26] Additionally, it is common for a sequence to contain a partial repeat which will be noted by a decimal followed by the number of extra partial bases (e.g., 8.1 for eight complete repeats and one partial repeat unit with one base pair).[27]

Once the genetic profile is complete, a lab technician will make a determination of the evidentiary significance to express the rarity of the shared profile.[28] This determination, known as the Random Match Probability ("RMP") statistic, which is the answer to the question: "What is the rarity of a specific DNA profile given the alleles observed?"[29] This probability will depend on the loci available for comparison and the rarity of the alleles in the profile.[30] RMP is calculated by multiplying the genotype (the frequency of the allele(s))[31] of each loci with the genotype frequency at each of the other available loci.[32]

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[24] CHIN ET AL., *supra* note 3, § 2.3 ("RFLP testing is now obsolete. . . . PCR-STR testing has many advantages over RFLP testing. It can test a far smaller sample than RFLP testing requires. It is less susceptible to sample degradation. It is simpler and less time consuming.") (quoting People v. Nelson, 185 P.3d 49 (2008)).

[25] *Id.*

[26] *Id.* ("These alleles, which together are a person's genotype, may be the same or different. Individuals with two of the same alleles are considered homozygous at a particular locus. For example, a 10 allele from both one's mother and father would result in a genotype of 10,10. Individuals with two different alleles at a locus (e.g. 10,12) are considered heterozygous.").

[27] *Id.*

[28] *Id.*

[29] BUTLER, *supra* note 13, at 252.

[30] *See* MOLLY FITZGERALD-HAYES & FRIEDA REICHSMAN, DNA AND BIOTECHNOLOGY 180 (3rd ed. 2010).

[31] Frequency meaning the number of copies of an allele in a group divided by the number of that same allele in the relevant population. CHIN ET AL., *supra* note 3, § 5.1.

[32] *Id.* This calculation is a valid use of the "product rule." *See id.* ("The product rule states that the probability of two separate events occurring simultaneously is the product of their probabilities. For example, the probability of rolling a five on a six-sided die is one in six. The probability of rolling a five again on the same die is also one in six. The first roll happens independently of the second roll, and has no effect on the second roll's outcome. Each subsequent roll of the die will carry the same probability of rolling a five. Because of the independence of these events, the product rule can be used to calculate the combined probability (P) that a five will be rolled on each of three consecutive rollsFalse There is a one in 216 chance that three separate rolls of the die would produce a five each time. This same principle applies to the markers used for STR testingFalse For the product rule to apply to allele frequencies, then, a necessary premise is that the alleles at any one locus are inherited independently of

Finally, a Likelihood Ratio ("LR") is created by taking the probability that the suspect is the source of the evidence (P1) and dividing it by the RMP (P2); the equation is LR = P1 / P2.[33] The likelihood ratio compares two different hypotheses: first, the numerator, that the suspect's DNA matches the sample DNA; second, the denominator, that a match would occur with the population at random.[34] For this calculation, it is assumed that the suspect matches the evidence profile, so P1 = 1, and the equation is LR = 1 / RMP.[35] The lab technician will testify in plain language: "This profile match is 10,000 [if the RMP = 10,000] times more likely if the DNA is from the suspect than if the DNA is from a random individual."[36]

For single-source profiles, where the sample contains the DNA of only one individual, the likelihood ratio is simply one over the RMP, so experts generally use the RMP instead of a LR.[37] When the DNA sample contains a mixture of DNA profiles, the LR equation is used for multiple hypotheses.[38] For example, if a DNA sample contains DNA from two individuals, a likelihood ratio will be calculated to determine the probability that the mixture contains DNA from the victim and the suspect as opposed to the probability that the DNA came from two random individuals, or from the victim and a random individual.[39] Both the RMP and LR techniques have been widely accepted and admitted in courts across the country.[40]

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the alleles at any other given locus—like separate rolls of the die. Each of the STR loci commonly used for forensic science testing in the United States was selected in part because the inheritance of alleles at any one locus occurs independently of alleles at any other loci.").

[33] *Id.* at § 5.5.

[34] *See* BUTLER, *supra* note 13, at 605.

[35] CHIN ET AL., *supra* note 3, § 5.5.

[36] *Id.*

[37] *Id.*

[38] *Id*

[39] *Id.*

[40] *Id.* at § 11.7 ("The "product rule," underlying calculation of random match probability statistics, is now universally accepted in the forensic DNA scientific community for use in evaluating the rarity of a given forensic DNA profile developed using PCR-based technology."); MICHAEL SAKS ET AL., ANN. REFERENCE MANUAL ON SCI. EVID., 543 (2d ed.) ("Although LRs [likelihood ratios] are rarely introduced in criminal cases, we believe that they are appropriate for explaining the significance of data and that existing statistical knowledge is sufficient to permit their computation. . . . Therefore, legal doctrine suggests that LRs should be admissible unless they are so unintelligible that they provide no assistance to a jury or so misleading that they are unduly prejudicial. As with frequencies and match probabilities, prejudice might exist because the proposed LRs do not account for laboratory error, and a jury might misconstrue even a modified version that did account for it as a statement of the odds in favor of S [the claim that the defendant is the source of the forensic DNA sample]. [But] the possible misinterpretation of LRs as the odds in favor of identity. . . is a question of jury ability and performance to which existing research supplies no clear answer."). Since that time, many Federal and state courts have admitted likelihood ratios in criminal cases. *See* Coy

C. The Process

The first step in DNA testing is collection of a sample from a crime scene and collection of a separate reference sample for comparison.[41] The second step is DNA extraction from the sample.[42] A sample obtained from a crime scene or a known individual will contain other substances besides DNA.[43] Through a number of different extraction methods,[44] a lab technician will add chemical solutions to the samples; these solutions will separate DNA molecules from proteins and other non-DNA materials contained in the cell.[45] Using PCR, the technician will amplify, or copy, the DNA at the specific loci used for comparison and separate the alleles by size using capillary electrophoresis and data analysis software.[46] Finally, the technician will conduct the STR analysis and assess the rarity of the alleles with the statistical interpretation described above.[47]

D. Low Copy Number Testing

If a DNA sample contains a small amount of DNA,[48] a technician will conduct PCR, but may find that the STR data results exhibit characteristics not present in amplifications of higher amounts of that same sample.[49] While a technician will usually perform twenty-eight amplification cycles on DNA samples over 100 picograms, DNA samples under 100 picograms require additional cycles of

v. Renico, 414 F. Supp. 2d 744, 762 (E.D. Mich. 2006); State v. Belton, 846 A.2d 526, 530 (N.H. 2004); State v. Ayers, 68 P.3d 768, 778 (Mont. 2003); Commonwealth v. McNickles, 753 N.E.2d 131, 138-39 (Mass. 2001); People v. Garcia, 963 N.Y.S.2d 517, 523 (N.Y. Sup. Ct. 2013); State v. Bander, 208 P.3d 1242, 1251-54 (Wash. Ct. App. 2009).

[41] BUTLER, *supra* note 13, at 1, 7.

[42] *Id.* at 1.

[43] *Id.* at 29.

[44] The three most common methods of DNA extraction are the organic method, Chelex extraction, and FTAPaper. *Id.* at 30-33.

[45] *Id.* at 29.

[46] BUTLER, *supra* note 13, at 1. Capillary electrophoresis separates DNA fragments by size by applying electric current and gel to the fragments. *See* CHIN, ET AL., *supra* note 3, § 3.4 ("Electrophoresis is an analysis technique that separates STR fragments based on size. To do this, DNA is applied to a gel or polymer matrix. Then an electric current is applied which causes the DNA in the sample to migrate through the matrix. Over a period of time, different sizes of DNA in a sample will become separated according to their ease of movement through the gel or polymer. The smaller a DNA fragment is, the faster it will migrate through the matrix; larger fragments will migrate at a slower rate. Once the fragments in a DNA sample are separated, they can be individually identified, sized, and characterized.").

[47] BUTLER, *supra* note 13, at 1; CHIN ET AL., *supra* note 3, § 7.4.

[48] Typically, the amount of DNA used for LCN is less than 100 picograms of DNA. United States v. Davis, 602 F. Supp. 2d 658, 669 (D. Md. 2009) ("LCN testing involves testing minuscule amounts of DNA that fall below the (somewhat amorphous) stochastic threshold—around 100 picograms or less.").

[49] *See* CHIN, ET AL., *supra* note 3, § 7.4.

amplification.[50] Increasing the amplification cycles increases the amount of DNA available to test, but may result in so-called stochastic effects.[51] These effects include severe peak imbalances, allelic drop out, allelic drop in, and increased stutter peaks.[52]

A severe peak imbalance occurs when two alleles that should be matching, or homozygous, appear to have different values.[53] Allelic drop out means that one-half of a pair of alleles was over-amplified, creating a false impression that a heterozygous allele is actually homozygous, i.e. a loci without a matching allele.[54] When allelic drop in occurs, spurious, or false alleles appear.[55] Allelic drop in usually occurs because of contamination, either at the laboratory, or from environmental contamination at the crime scene.[56] Finally, stutter peaks are non-allelic peaks in a DNA profile that occur due to over- or under-replication during PCR.[57] Stutter peaks occur in standard DNA profiles, but are sometimes exaggerated in LCN.[58] In DNA samples with a major contributor, a stutter peak of a major contributor may be confused for an allelic peak of a minor contributor.[59]

As alarming as these stochastic effects may sound, these problems begin to occur only under a certain size sample, and the source of the problem is usually either external contamination of the sample, or residual chemicals from the amplification mixture.[60] Purifying the DNA extract greatly increases the quality of the STR DNA.[61] Furthermore, some of these problems occur both above the

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[50] *Id.*

[51] *Id.*

[52] *Id.*

[53] DAVID J. BALDING & CHRISTOPHER D. STEELE, WEIGHT-OF-EVIDENCE FOR FORENSIC DNA PROFILES 133 (2d ed. 2015).

[54] WILLIAM GOODWIN ET AL., AN INTRODUCTION TO FORENSIC GENETICS 85 (2d ed. 2011).

[55] *Id.*

[56] BALDING & STEELE, *supra* note 53, at 133.

[57] *Id.* at 134.

[58] *Id.*

[59] *Id.*

[60] *See* CHIN ET AL., *supra* note 3, § 7.4 ("At the end of a PCR, a reaction tube contains not only amplified DNA but also residual chemicals from the amplification mixture. These residual chemicals are co-injected into the capillary of the genetic analyzer for electrophoresis. The presence of these components can interfere with the injection (uptake) of amplified DNA into the capillary, and the quality of the data generated by the genetic analyzer."); BALDING & STEELE, *supra* note 53, at 133 ("The appearance of sporadic alleles in DNA-negative controls confirms the existence of drop-in within LTDNA [Low Template DNA] work, possibly arising from airborne DNA fragments generated by previous analyses in the same laboratory. . . . [D]rop-in alleles could arise from environmental exposure to degraded DNA at the crime scene.").

[61] CHIN ET AL., *supra* note 3, § 7.4 ("Purification of amplified PCR product has been shown to improve overall STR resultsFalse Similar to purifying a DNA extract after organic extraction, the removal of these residual chemicals by filtration can greatly increase the quality of the STR data generated by the genetic analyzer.").

somewhat arbitrary 100 picogram demarcation[62] and in other types of DNA testing.[63] While these types of errors are checked for in validation studies[64] and accounted for when calculating likelihood probabilities,[65] studies have shown the accuracy of amplifying to be as high as ninety-two percent with samples as low as twenty-five picograms.[66] Finally, the "stochastic threshold," the mark at which inaccuracies begin to occur (usually determined somewhere between 100

[62] BALDING & STEELE, *supra* note 53, at 134 ("Stutter occurs in standard DNA profiles . . . but can be exaggerated in some LTDNA protocols.").

[63] *See* CHIN ET AL., *supra* note 3, § 2.3 ("RFLP fragments are much larger than STR fragments, which make them much more susceptible to degradation. Smaller fragment size means that STRs have a better chance of escaping endonuclease activity. Because homologous STR alleles are within a very narrow size range, there is less chance of losing one allele in a heterozygous pair. Heterozygous RFLP allele pairs may be on two fragments that very greatly in size. One may be degraded and drop out entirely.").

[64] BUTLER, *supra* note 13, at 334 ("Observing PCR performance in a range of samples, which may have slightly different true amounts of DNA, is valuable in setting interpretation guidelines based on the validation data obtained.").

[65] Peter Gill et al., *An Investigation of the Rigor of Interpretation Rules for STRs Derived From Less Than 100 pg of DNA*, 112(1) FORENSIC SCI. INT. 17, 17 (2000) ("We demonstrate that the duplication guideline is robust by applying a statistical theory that models three key parameters - namely the incidence of allele drop-out, laboratory contamination and stutter. The advantage of the model is that the critical levels for each parameter can be calculated. This information may be used (for example) to determine levels of contamination that can be tolerated within the strategy employed."). *See also* Theresa Caragine et al., *Validation of Testing and Interpretation Protocols for Low Template DNA Samples Using AmpFlSTR Identifiler*, 50 CROAT. MED. J. 250, 250 (2009) ("To account for allelic dropout, interpretation guidelines were made especially stringent for determining homozygous alleles. Due to increased heterozygote imbalance, stutter filters were set conservatively and minor components of mixtures could not be resolved. Applying the resultant interpretation protocols, 100% accurate allelic assignments for over 107 non-probative casework samples, and subsequently 319 forensic casework samples, were generated."); BALDING & STEELE, *supra* note 53, at 134 ("A threshold is often used, so that a peak is treated as stutter if it is below the threshold fraction (often 15%) of the 'parent' allele peak height. A single 'hard' threshold is clearly unsatisfactory . . . and . . . we discuss an improvement in which peaks in stutter positions lying between two thresholds are designated as 'uncertain' and peak height models can explicitly model stutter and allelic peak heights").

[66] Caragine et al., *supra* note 65, at 250 ("Amplification of 100 [picograms] or less of DNA generated reproducible results with anticipated stochastic effects. Down to 25 [picograms] of DNA, 92% or more of the expected alleles were consistently detected while lower amounts yielded concordant partial profiles. Although spurious alleles were sometimes observed within sample replicates, they did not repeat.").

to twenty-five picograms), is used in conjunction with the FST computer program, based on Bayesian mathematics,[67] to take into account the chance of inaccuracies and determine the likelihood of a DNA match.[68]

II. CONFLICT

A. ALCN Admissibility in New York State Courts

i. People v. Megnath

In 2010, the State of New York sought to admit evidence of DNA tested with the LCN method for the first time.[69] In *People v. Megnath*, the state charged the defendant with first-degree murder.[70] The police investigation found several small DNA samples in the defendant's automobile that linked the defendant to the murder.[71] The DNA samples were too small for twenty-eight cycles of amplification, or High Copy Number ("HCN") testing, so they were tested at the Office of the Chief Medical Examiner ("OCME") using LCN analysis.[72] The defendant moved for a *Frye*[73] hearing[74] before trial to determine the reliability and acceptance of LCN in the relevant scientific community.[75] Justice Hanophy of the Supreme Court of Queens County, New York granted the motion.[76]

In the pre-trial hearing, the court found that the evidence presented showed that LCN uses the same scientific process as HCN, used for samples larger than

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[67] For how Bayesian mathematics is used in the FST *see* FORENSIC DNA EVIDENCE INTERPRETATION, 284-96 (John Buckleton et al. eds., 2005).

[68] People v. Collins, 15 N.Y.S.3d 564, 568 (Sup. Ct. 2015) ("The validity of the math in the probability analysis underlying the FST software is not at issue. That mathematical analysis is "Bayesian" analysis. Bayes was a mathematician who worked in the 18th century. His methods for calculating probabilities are employed throughout all fields in which probabilities are calculated, including medicine and molecular genetics.").

[69] People v. Megnath, 898 N.Y.S.2d 408, 412 (Sup. Ct. 2010) (finding that admissibility of LCN data was an issue of first impression).

[70] *Id.* at 410.

[71] *Id.*

[72] *Id.* at 410-11.

[73] United States v. Frye, 293 F. 1013, 1013-14 (D.C. Cir. 1923) (finding that novel methods of scientific analysis can produce admissible evidence only if the relevant scientific community generally, though not necessarily unanimously, considers those methods to be reliable) *superseded by rule*, Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 587 (1993).

[74] In 1923, the *Frye* case set out the general acceptance standard for the reliability of scientific evidence. The *Frye* test dominated this issue in federal and state courts until *Daubert*, in 1993, held that FRE 702 superseded the *Frye* test in federal courts. Alice B. Lustre, Annotation, *Post-Daubert Standards for Admissibility of Scientific and Other Expert Evidence in State Courts*, 90 A.L.R.5th 453, 453 (2001). After *Daubert*, many states moved to a *Daubert* test, but many, like New York, remained *Frye* states. *Id.* at 481.

[75] People v. Megnath, 898 N.Y.S.2d 408, 410 (N.Y. Sup. Ct. 2010).

[76] *Id.*

200 picograms, and "is simply a more sensitive form of HCN DNA testing."[77] The court noted that LCN had been used worldwide for ten years and in a number of other capacities.[78] The court relied on the fact that the principal differences between HCN and LCN testing are the number of amplification cycles and additional precautionary measures are taken when the data is interpreted to account for the small sample size.[79] When the OCME began LCN testing, they conducted extensive studies that showed consistent and accurate results, which the New York State Commission on Forensic Science approved.[80]

Considering all of this information, the court then applied the *Frye* test to the findings.[81] The court concluded that since the "LCN DNA method of testing . . . [was] basically the same as the HCN DNA testing[,]" it was not a novel technique and therefore not subject to preclusion by the *Frye* test.[82] The court further held that based on the OCME's extensive studies and the testimony of five reputable forensic scientists at the *Frye* hearing, the relevant scientific community had generally accepted as reliable the LCN testing as conducted by the OCME.[83] The court found that the LCN DNA evidence was admissible at trial.[84] The consensus thereafter was a general acceptance of LCN, which New York courts refused to challenge and repeatedly reaffirmed for five years. People v. Collins likely should have followed that precedent.[85]

ii. People v. Collins

In 2015, Justice Dwyer of the Supreme Court of Kings County, New York,

[77] *Id.* at 411.

[78] *Id.* (finding that LCN had been used to identify bodies, bones, and artifacts and to determine birth defects pre-birth).

[79] *Id.*; *see also* Caragine et al., *supra* note 65, at 250 (finding that, "[a]mplification of 100 pg or less of DNA generated reproducible results with anticipated stochastic effects. Down to 25 pg of DNA, 92% or more of the expected alleles were consistently detected while lower amounts yielded concordant partial profiles.").

[80] *Megnath*, 898 N.Y.S.2d at 411–12 ("The validation studies that were conducted were reviewed by the DNA subcommittee for the New York State Commission on Forensic Science and were implicitly found to . . . be scientifically reliable and reproducible. The Commission therefore granted the OCME permission to use LCN DNA testing in forensic casework.").

[81] *Id.* at 410. *See also* United States v. Frye, 293 F. 1013, 1014 (D.C. Cir. 1923) (finding that novel methods of scientific analysis can produce admissible evidence only if the relevant scientific community generally (though not necessarily unanimously) considers those methods to be reliable.) *superseded by rule*, Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 597 (1993).

[82] *Megnath*, 898 N.Y.S.2d at 413.

[83] *Id.* at 410–14.

[84] *Id.* at 413–14.

[85] People v. Belle, No. 3955/13, 2015 WL 2131497 at *1, *3 (N.Y. Sup. Ct. Apr. 29, 2015); People v. Garcia, 963 N.Y.S.2d 517, 523 (N.Y. Sup. Ct 2013); Megnath, 898 N.Y.S.2d at 414.

heard a LCN DNA case.[86] In *Collins*, DNA was offered to show that the defendant rode a bicycle used in a shooting.[87] The DNA samples were small and from a mixture of three individuals' DNA.[88] The OCME used LCN testing to determine that one sample was 972,000 times more likely to have originated from the defendant and two unknown individuals than three unknown individuals.[89] The defendant moved to preclude high sensitivity and FST DNA evidence, the court ordered a *Frye* hearing.[90]

During the hearing, Dwyer recognized that the DNA testing process is not controverted when DNA is amplified twenty-eight times for HCN testing, but it might be with the three additional amplifications that occur during LCN testing.[91] No one disputed that LCN testing increases stochastic effects at certain sample sizes. The dispute was whether OCME's protocols were generally accepted by the relevant scientific community so as to ensure sound scientific conclusions or not.[92] Justice Dwyer gave a thorough explanation of the LCN testing process, discussed the credentials of all expert witnesses, and outlined the potential issues that arise with LCN testing.[93]

After hearing diametrically opposed testimony from experts on both sides, the court found that aside from OCME, no other laboratory in America produced high sensitivity testing as evidence in criminal cases, but acknowledged that labs do use LCN for other purposes, such as investigative leads.[94] This finding was incorrect; the Prince George County DNA laboratory in Maryland also conducts LCN DNA testing, and the Court of Special Appeals of Maryland accepted LCN evidence as generally accepted as reliable by the relevant scientific community in October 2015.[95] The court further noted that the FBI database refuses to accept

[86] People v. Collins, 15 N.Y.S.3d 564, 565 (N.Y. Sup. Ct. 2015).

[87] *Id.*

[88] *Id.*

[89] *Id.* at 568. A second sample was found to be nineteen times more likely to belong to the defendant than an unknown individual. *Id.*

[90] *Id.* at 566.

[91] *Id.* at 567.

[92] *Id.* at 568.

[93] *Id.* at 570-75.

[94] *Id.* at 575 (stating that witnesses from OCME claimed LCN was robust and not "novel", while witnesses for the defense cited multiple problems with LCN testing).

[95] Phillips v. State, 126 A.3d 739, 750-751 (Md. Ct. Spec. App. 2015). ("[a]lthough, perhaps, not the best, most accurate, or most 'cutting-edge' technique, the Prince George's County DNA laboratory used a generally accepted methodology to analyze the steering wheel DNA sample . . . Additionally, Charak and Dr. Word both testified that forensic labs commonly use the methods employed by the Prince George's County DNA laboratory when analyzing complex, low copy number DNA. For these reasons, we find that the lack of a validated stochastic threshold does not mean that the analysis performed was 'junk science.' Any challenges to the Prince George's County DNA laboratory's lack of a set stochastic threshold properly goes, and did go, to weight rather than admissibility.").

profiles created from LCN testing, will not use HCN test results to search for missing persons, and is currently conducting research in LCN.[96] However, the FBI study that concludes LCN should not be accepted in the national database clearly states that LCN is suitable for single source DNA samples.[97]

One of the defense experts in *Collins*, Dr. Shapiro, was later discredited in a separate trial.[98] *People v. Lopez* discusses the testimony of Dr. Shapiro, and the court ruled that evidence of low copy DNA testing as well as the FST likelihood ratio calculated by the OCME was admissible without a *Frye* hearing.[99] Dr. Shapiro gave opinion testimony for the defense at the trial advocating against the FST tool. On cross-examination, Shapiro divulged that he had no training in statistical analysis and, although he had worked at the OCME, had never used the FST.[100]

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[96] People v. Collins, 15 N.Y.S.3d 564, 575 (N.Y. Sup. Ct. 2015); FEDERAL BUREAU OF INVESTIGATION, FREQUENTLY ASKED QUESTIONS ON CODIS AND NDIS, https://www.fbi.gov/about-us/lab/biometric-analysis/codis/codis-and-ndis-fact-sheet [https://perma.cc/TRY3-WCUD] ("Y STR and mtDNA data is only searched with the missing person-related indexes. The National DNA Index no longer searches DNA data developed using restriction fragment length polymorphism (RFLP) technology."); FEDERAL BUREAU OF INVESTIGATION LABORATORY DNA CASEWORK UNIT CASE ACCEPTANCE https://www.fbi.gov/file-repository/dcu-case-acceptance-guidance-final.pdf/view [https://perma.cc/34S5-7563]("The usage of test strategies to enhance the detection of DNA (sometimes referred to as Low-Copy Number, or LCN, testing) is currently being researched by the FBI Laboratory, however, none have yet demonstrated the necessary reliability for use in forensic casework by the DCU nor are any approved for uploading into the Combined DNA Index System (CODIS).").

[97] BRUCE BUDOWLE, ET AL., LOW COPY NUMBER - CONSIDERATION AND CAUTION, 2 https://www.promega.com/~/media/files/resources/conference%20proceedings/ishi%2012/oral%20presentations/budowle.pdf [https://perma.cc/9XXP-LA7V] ("In contrast, samples that can be cleansed of exogenous DNA may be more suitable for LCN typing. These include: bones, teeth, and hair shafts (10,11). LCN typing of these single source samples then can be used for exculpatory, as well as inculpatory, purposes. One may consider the typing of human remains that contain little intact DNA appropriate for LCN typing (usually the typing is not used for identification of perpetrator(s) of a crime(s)). These samples are still subject to allele drop-out and sporadic low level background contamination from laboratory chemical reagents, but exogenous DNA from casual contact or secondary transfer can be minimized or eliminated.").

[98] People v. Lopez, 23 N.Y.S.3d 820, 827 (N.Y. Sup. Ct. 2015) ("This Court agrees with the decision in *Rodriguez* that Dr. Shapiro's vote on the acceptance of FST statistical analysis lacked sufficient credibility to be weighed in making a finding precluding the admission of such testimony."); *Id.* at 827 n.3. The court further ruled that evidence of low copy DNA testing as well as the FST likelihood ration calculated by the OCME was admissible without a *Frye* hearing. *Id.* at 822.

[99] *Id.* at 822.

[100] *Id.* at 827 n.3 (citing People v. Garcia, 963 N.Y.S.2d 517 (N.Y. Sup. Ct. 2013) (holding defendant charged with second degree murder and related crimes was not entitled to a *Frye* hearing)).

Equating LCN to a polygraph machine or facial recognition software,[101] the *Collins* court found that LCN is not generally accepted as reliable by the "relevant scientific community."[102] The court relied on their finding to hold that the *Frye* test precluded both single-contributor samples and mixtures from admission as evidence.[103] In doing so, the court disagreed with Justice Hanophy in *Megnath*, specifically with the fact that *Megnath* refused to acknowledge that LCN "involves 'novel' scientific procedures" that require *Frye* review.[104] The court in *Collins* did note that even opponents of LCN testing consider LCN viable for investigative leads.[105] In light of the technique's value, the court addressed (and dismissed) the possibility of allowing the evidence by simply requiring the criticisms of LCN to go to the weight of the evidence.[106] The court found that the *Frye* test, which determined LCN as novel and not generally accepted by the relevant scientific community, precluded LCN evidence and its criticisms from ever reaching the jury.[107] This decision strayed from precedent and set the stage for the New York appellate court to inevitably conclude either that the *Collins* court is correct in their suspicions about LCN, or, more likely, that the preclusion of the evidence was unjust.

B. LCN Denied in New Mexico

i. People v. McCluskey

In 2013, the Federal District Court of New Mexico excluded the results of LCN DNA testing for its insufficient reliability.[108] In *McCluskey*, police took swabs of DNA from handguns and a steering wheel in a murder investigation.[109] Police took one of the samples from the magazine of the gun used as the murder weapon and measured 215 picograms.[110] The New Mexico Department of Public Safety ("NMDPS") used PCR to amplify STR to create a DNA profile.[111] By the NMDPS' own protocol to red flag samples under 250 picograms for possible stochastic effects, the NMDPS presented the sample to the court and acknowledged that the profile exhibited allele drop-out.[112] In deciding on admissibility, the New Mexico court dismissed *Megnath*, reasoning that LCN was not a novel

[101] People v. Collins, 15 N.Y.S.3d 564, 576 (N.Y. Sup. Ct. 2015).
[102] *Id.* at 585.
[103] *Id.* at 576.
[104] *Id.* at 585-86.
[105] *Id.* at 575.
[106] *Id.* at 576.
[107] *Id.*
[108] United States v. McCluskey, 954 F. Supp. 2d 1224, 1288 (D.N.M. 2013).
[109] *Id.* at 1229–1230.
[110] *Id.* at 1276.
[111] *Id.*
[112] *Id.* at 1278.

science and that it allegedly ignored stochastic effects.[113] Even the *McCluskey* court, however, stated that the OCME in New York used different procedures than NMPDS, such as using less amplification cycles and having better validation of protocols.[114] Ultimately, it was the conflicting scientific research on LCN that led the court to deny admissibility.[115] Later, *Collins* would cite this reasoning in *McCluskey* to support the contention that LCN was a new science.[116]

C. LCN in Other Jurisdictions

Three separate jurisdictions have allowed LCN.[117] A separate jurisdiction stated LCN might be less reliable than PCR testing of a small, but not LCN small, sample.[118]

i. Phillips v. State

In 2015, the Court of Special Appeals of Maryland found that the competing research on the reliability of LCN should go against the weight of the evidence, not the admissibility of the evidence.[119] The court conducted a *Frye* hearing, which involved an evaluation of the Prince George's County DNA laboratory's methodologies with LCN.[120] The court noted that the Prince George's County lab followed FBI quality assurance standards for forensic laboratories, and that two persuasive experts testified that the Prince George's County lab used methods commonly used by other forensic labs testing LCN.[121] Relying on these facts, the court found that the techniques used by Prince George's County lab were generally accepted and passed the *Frye* test.[122]

ii. United States v. Morgan

In *United States v. Morgan*, the District Court for the Southern District of New York had the opportunity to weigh in on LCN.[123] The defendant was

[113] *Id.* at 1279–80.
[114] *See id.*
[115] *See id.* at 1280–81, 1288.
[116] People v. Collins, 15 N.Y.S.3d 564, 586 (N.Y. Sup. Ct. 2015).
[117] United States v. Sleugh, No. 14-cr-00168-YGR-2, 2015 WL 3866270, at *2 –*3 (N.D. Cal. June 22, 2015); United States v. Morgan, 53 F.Supp.3d 732, 734 (S.D.N.Y. 2014); Phillips v. State, 126 A.3d 739, 748 (Md. Ct. Spec. App. 2015).
[118] United States v. Grinnage, 486 F. App'x 325, 330 (3d Cir. 2012).
[119] *Phillips*, 126 A.3d at 748.
[120] *Id.* at 748–49.
[121] *Id.* at 750–51.
[122] *Id.* at 751.
[123] United States v. Morgan, 53 F.Supp.3d 732, 734 (S.D.N.Y. 2014).

charged with being a felon in possession of a firearm.[124] The defendant challenged the admission of inculpatory LCN DNA testing evidence.[125] The district court held a *Daubert*[126] hearing and denied the defendant's motion to exclude the LCN evidence.[127] The district court specifically stated "that the methods of LCN DNA testing that the New York City Office of the Chief Medical Examiner . . . employed are sufficiently reliable to satisfy the *Daubert* standard."[128] The court reasoned that OCME's LCN testing uses the same basic steps as other PCR, or HCN, testing.[129] The court found that the amplification and analysis are the main differences between LCN and HCN, and that the difference in amplification can cause stochastic effects.[130] However, the court further found that OCME had developed a system of interpretation guidelines that accounted for the stochastic effects.[131] The court stated that:

> OCME performed its validation studies based on the guidelines created by the Scientific Working Group of DNA Analysis Methods ("SWGDAM"). As SWGDAM recommends, OCME used known samples in performing validation, so that it could verify its results. OCME ran various tests as part of its validation. In connection with that process, to determine the sensitivity of its LCN procedures, OCME tested single-source DNA samples of 150 pg, 100 pg, 50 pg, 25 pg, 12.5 pg, and 6.25 pg. For the samples containing between 150 and 25 pg, OCME successfully determined 92 percent of all alleles, while in the 12.5 and 6.25 pg samples, OCME determined 77 percent and 51 percent respectively of all expected alleles.[132]

The court also cited the OCME's testing of mixture samples:

> OCME further performed LCN testing on mixture samples containing two DNA contributors. The goal of these tests was to determine whether OCME's testing could accurately ascertain the DNA profile of the "major contributor"—the contributor with the larger percentage of DNA in the sampleFalse In total, OCME examined over eight hundred DNA samples as part of its validation studies. Based on the results of these validation studies, OCME created its interpretation guidelines, intended to allow for

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[124] *Id.*

[125] *Id.*

[126] Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 592-594 (1993) (holding that Federal Rule of Evidence 702 will supersede the *Frye* standard in federal courts, using *inter alia* five factors to determine whether expert testimony is admissible: (1) whether the scientific knowledge can, or has been tested; (2) has the knowledge been subjected to peer review; (3) what is the known or potential rate of error; (4) do standards exist and are they maintained; and (5) is the scientific knowledge generally accepted).

[127] *Morgan*, 53 F.Supp.3d at 734.

[128] *Id.*

[129] *Id.* at 736.

[130] *Id.*

[131] *Id.* at 738.

[132] *Id*. at 737-38 (citations omitted).

consistent interpretation of LCN testing results by accounting for the presence of increased stochastic effects as the quantity of DNA decreases.[133]

Next, the court cited the OCME's recent and consistent accreditations and approval by relevant forensic boards.[134] The court was persuaded by OCME's validation studies[135] and OCME's recent approval by the New York DNA Subcommittee for LCN testing in reaffirming the admissibility of LCN.[136]

iii. United States v. Sleugh

In 2012, the United States District Court of Northern California denied a motion for a *Daubert* hearing to determine the reliability of a forty picogram (0.04 nanogram) DNA sample.[137] The court allowed the sample despite simultaneously acknowledging that the critical question to ask is whether there are any stochastic effects that cause unreliability.[138] In part, the court relied on the fact that the DNA tester in this case observed no evidence of stochastic effects.[139]

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[133] *Id*. at 738. (citations omitted).

[134] *Id.* at 738-39 ("As discussed above, OCME is currently accredited by ASCLD [The American Society of Crime Laboratory Directors], a process that entails scrutiny of OCME's technical operations. The accreditation process begins with the lab's submission of an application to ASCLD, which contains documentation of the lab's conformity with ASCLD's requirements. ASCLD then performs an on-site assessment of the lab. The ASCLD assessment team interviews all relevant employees and observes the employees performing their job functions. Further, the assessment team reviews records to ensure that the documents provided in the initial application by the lab were accurate. Also analyzed are case records, to determine whether conclusions reached by the lab are accurate and appropriate. Following the on-site assessment, ASCLD issues a report detailing whether the lab has met the accreditation requirements.") (citations omitted); *Id.* at 747 ("[M]embers of the DNA Subcommittee during the summer of 2014 visited OCME and analyzed its standard operating procedures, protocols, and validations to determine whether any changes had occurred that would require further validation. Despite its members' awareness that OCME was performing LCN testing on samples smaller than 20 pg, the DNA Subcommittee found that no substantive changes had occurred to OCME's standard operating procedures for LCN testing since the Subcommittee's approval in 2005.") (citation omitted).

[135] *Id.* at 744-45 ("OCME's use of peak heights in its interpretation guidelines is not only consistent with the scientific mainstream, but also with officially-recognized best practices False OCME's peak-height related LCN protocols are also validated by sufficient data to establish their reliability under Daubert and Rule 702.").

[136] *Id.* at 747 ("[T]he [c]ourt is persuaded that OCME's representations in 2005 and 2006 regarding a 20 pg threshold do not signal that any testing OCME performed below 20 pg is unreliable. . . Given the DNA Subcommittee's ratification of OCME's ability to perform LCN testing below 20 pg, the Court agrees that OCME's representations in 2005 and 2006 do not, in and of themselves, indicate that OCME's testing of samples smaller than 20 pg are unreliable.").

[137] United States v. Sleugh, No. 14-CR-00168-YGR-2, 2015 WL 3866270, at *2-3 (N.D. Cal. June 22, 2015).

[138] *Id.*

[139] *Id.* at *3.

The court did order that the government DNA tester submit a declaration that there were no stochastic effects.[140] Inferentially, the court would apply higher scrutiny or even preclude samples with stochastic effects, common in many LCN samples.

iv. United States v. Grinnage

No federal court of appeals has taken the occasion to decide the admissibility of LCN. However, in 2012, the United States Court of Appeals, Third Circuit, found that a *Daubert* hearing was not required for a sample measured at 0.65 nanograms.[141] The court stated that while LCN might be less reliable than typical PCR testing, the 0.65 nanogram sample was above the 0.1 nanogram threshold for stochastic effects established by expert testimony.[142] It follows from the opinion that the Third Circuit would at least scrutinize a sample below 0.1 nanograms more strictly and at most preclude the sample.

IV. THE PROPER STANDARD

A. Is LCN "Novel"?

i. Defining "Novel"

Now the stage is set for the New York Court of Appeals to reconcile *Collins* and *Megnath* and determine the fate of LCN. In Justice Dwyer's opinion in *Collins*, the first issue in contention is whether the three additional amplifications is a novel scientific procedure as defined by the *Frye* test.[143] To answer this, the court should start with the plain meaning definition of novel.

The Supreme Court of the United States has referred to dictionaries to define nearly 300 words in the span of 10 years (2000-2010); the most frequently cited general use dictionary was Webster's Third New International Dictionary and the most frequently cited law dictionary was Black's Law Dictionary, but there is no definition for "novel" in Black's.[144] Webster's Third New International Dictionary tells us that novel means "something new and not resembling something formerly known or used."[145]

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[140] *Id.*

[141] United States v. Grinnage, 486 F. App'x 325, 330 (3d Cir. 2012).

[142] *Id.*

[143] *See* People v. Collins, 15 N.Y.S.3d 564, 577-578, 586 (N.Y. Sup. Ct. 2015).

[144] Jeffrey L. Kirchmeier, Samuel A. Thumma, *Scaling the Lexicon Fortress: The United States Supreme Court's Use of Dictionaries in the Twenty-First Century*, 94 Marq. L. Rev. 77, 82 (2010).

[145] WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 1546 (1986).

Few would agree that something in existence for almost thirty years is somehow new, especially in the fields of science and technology.[146] Similarly, few would agree that taking a repetitive process, the replication of DNA, and increasing the process by ten percent by adding three duplication cycles, would result in a new process or one that does not resemble a previously known process. *Collins* said that it was not for the court to decide whether LCN was "novel" because judges should simply be "'counting scientists' votes,' and not 'verifying the soundness of a scientific conclusion.'"[147] Justice Dwyer misapplied the rule, as the case he was quoting, *Wesley*, conducted a *Frye* hearing with both sides conceding that the procedure under evaluation was novel. At the time DNA testing as a whole was "novel."[148] In fact, no expert testimony was even available to because of the newness of DNA evidence in *Wesley*.[149] In addition to skipping the "novel" analysis, Justice Dwyer rejected the fact offered by the People that in 2005 the DNA Subcommittee of the New York State Forensic Science Commission approved LCN testing and advised in 2014 there had been no material changes.[150]

ii. Defining "Novel" Through Case Law

Looking to case law for the proper procedure to determine whether a method or procedure is "novel" helps mark the dividing line. The New York Court of Appeals found that where there is no novel method at issue, the inquiry is not admissibility under *Frye*; the proper inquiry is the foundation of the expert's opinions.[151] Additionally, a *Frye* hearing is unnecessary if a court can rely on previous rulings in other court proceedings.[152] Previous judicial opinions may have decided that a scientific test is reliable, rather than novel.[153] In *Collins*, Justice Dwyer had multiple previous opinions available that would have precluded the *Frye* hearing.[154]

[146] PCR developed in 1986. Mullis & Faloona, *supra* note 8, at 335-50; Mullis, et al., *supra* note 8, at 263-273.

[147] *Collins*, 15 N.Y.S.3d at 570 (N.Y. Sup. Ct. 2015) (quoting People v. Wesley (*Wesley II*), 633 N.E.2d 451, 464 (N.Y. App. Ct. 1994)).

[148] *Wesley II* at 453-54 (finding that DNA evidence was presented as novel in 1988).

[149] *Id.* at 464 ("insufficient time had passed for competing points of view to emerge.").

[150] *Collins*, 15 N.Y.S.3d at 583.

[151] Parker v. Mobil Oil Corp., 857 N.E.2d 1114, 1120 (N.Y. 2006) (finding that expert testimony claiming that any exposure to gasoline can cause acute myelogenous leukemia was not novel and that the question at issue was whether the results were reliable).

[152] People v. LeGrande, 8 N.Y.3d 449, 458 (2007).

[153] Lahey v. Kelly, 71 N.Y.2d 135, 141 (1987).

[154] People v. Belle, No. 3955/13, 2015 WL 2131497 at *3 (N.Y. Sup. Ct. Apr. 29, 2015) ("Here, the Court is able to determine that the FST satisfies the *Frye* standard without conducting a hearing, based on the documentation provided by both parties in their weighty written submissions in this case and numerous prior rulings by other judges faced with the same request. It is, of course, a bit curious that defendant would seek such a hearing after notifying

1. Cases Where the Process Was Not "Novel"

In *People v. Borden*, the New York appellate court evaluated the defendant's contention that the trial court erred by denying a *Frye* hearing on admissibility of evidence derived from an updated form of DNA testing, the MiniFlier test.[155] The court did hear some testimony about the process pre-trial, where the expert for the State testified that the MiniFlier test is just a more advanced form of PCR and STR DNA testing.[156] The court denied the motion for a *Frye* hearing, citing the court's prior recognition of PCR and STR's general acceptance as the paramount reason.[157] Finally, the court determined that the challenges to the advanced PCR and STR DNA testing would go to the weight of the evidence.[158] The court agreed with each piece of the trial court's holding.[159] Similarly, LCN is not an advanced PCR test. Rather, it *is* the PCR test. As in *Borden*, where a motion for a *Frye* hearing was denied and the criticisms of the test went to the weight of the evidence, the *Frye* hearing should have been denied, and the criticisms of the test should have gone to the weight of the evidence in *Collins*.

In *People v. Burnell*, the same court held that the trial court was justified in denying a *Frye* hearing for a fingerprinting technique that involved a fingerprint examiner digitally scanning a fingerprint, enlarging it, adjusting the contrast, and isolating particular portions of the print.[160] In reaching its conclusion, the court relied on the fact that the examiner still made the conclusion on whether the defendant's fingerprints matched the fingerprints found at the scene of the crime despite the new technology involved.[161] Similarly, in *Collins*, the PCR process is still the same despite the additional amplification cycles, and the lab technician will still verify the LR and testify to the likelihood of a match. Therefore, like in *Burnell*, where a motion for a *Frye* hearing was denied, the judge in *Collins* should have denied the *Frye* hearing.

2. Cases Where the Process Was "Novel"

In *People v. Bohrer*, the court looked at ignition interlock devices for the first

the Court that his own expert has performed a mathematical analysis and determined a significant "likelihood ratio" on one DNA sample in this case using the FST algorithm."); People v. Garcia, 963 N.Y.S.2d 517, 523 (N.Y. Sup. Ct. 2013) ("It is abundantly clear from the foregoing that neither LCN DNA testing nor the FST is a new or novel science that requires a *Frye* hearing before it is admitted in evidence."); *see also* People v. Megnath, 898 N.Y.S.2d 408, 414-415 (N.Y. Sup Ct. 2010).

155 People v. Borden, 90 A.D.3d 1652, 1652 (N.Y. App. Div. 2011).

156 *Id.* at 1653.

157 *Id.*

158 *Id.*

159 *Id.*

160 People v. Burnell, 89 A.D.3d 1118, 1121-22 (N.Y. App. Div. 2011).

161 *Id.* at 1121.

time.[162] The defendant contended that the court must first establish scientific reliability before allowing evidence of the device results.[163] The court found, despite no previous judicial opinions on the matter, that a *Frye* hearing was not necessary to determine the reliability of the Smart Start ignition interlock device.[164] The court came to this conclusion primarily, but *inter alia,*[165] based on the fact that the court had established other breath alcohol detection machines as reliable.[166] Similarly, in *Collins*, while few judicial opinions had approached LCN testing, DNA testing using the PCR method - the same mechanics as LCN -[167] had been accepted in New York for nearly twenty years.[168]

The *Collins* court compared LCN to the polygraph lie detector:

> The products of polygraph technology and of facial recognition technology similarly can sometimes have value, but evidence produced by those technologies is not generally accepted as reliable by the relevant scientific communities and so cannot be admitted in trials. The same should be true, at least at this time, for high sensitivity analysis.[169]

In *People v. Leone*, the Court of Appeals of New York, the highest court in New York, held that the record did not establish the polygraph lie detector test as reliable enough to justify admitting its results as evidence.[170] First, the court relied on the fact that many precursors to the polygraph, known as deception detectors, had been in use without sufficiently established reliability.[171] Second, the court looked to the refusal of the polygraph in most jurisdictions.[172] Third, the court noted that there was disagreement on the efficacy of the polygraph and, most importantly, that research had not yet proved that the polygraph actually worked.[173] The court also relied on the polygraph hearings that Congress hosted.[174] Finally, the court found that most polygraph examiners were inadequately trained to interpret results and would usually draw conclusions that help

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[162] People v. Bohrer, 952 N.Y.S.2d 375, 376 (N.Y. Just. Ct. 2012).

[163] *Id.* at 377.

[164] *Id.*

[165] The Bohrer court also cited the facts that interlock devices were on a list of devices certified by the Department of Health, and that all ignition interlock devices are required to meet specifications prescribed by the NHTSA. *Id.* at 379.

[166] *Id.* at 377-78.

[167] CHIN, ET AL., *supra* note 3, § 7.4.

[168] *See* People v. Palumbo, 618 N.Y.S.2d 197, 201 (N.Y. Sup. Ct. 1994) ("in light of the acceptance of the test in other jurisdictions, this court finds that the PCR test has been generally accepted as reliable in the scientific community.").

[169] People v. Collins, 15 N.Y.S.3d 564, 576 (N.Y. Sup. Ct. 2015).

[170] People v. Leone, 255 N.E.2d 696, 700 (N.Y. 1969).

[171] *Id.* at 697.

[172] *Id.* at 697-98.

[173] *Id.* at 698.

[174] *Id.* at 698 ("'[r]esearch completed so far has failed to prove that polygraph interrogation actually detects lies or determines guilt or innocence.'") (quoting COMMITTEE ON

the person or agency that hired the examiner instead of admitting inability to draw accurate conclusions, stating:

> Fred E. Inbau, one of the leading proponents of the polygraph, has testified before the House Committee on Government Operations that 80% [o]f the persons calling themselves polygraph examiners are not qualified to interpret test results. . . Inbau and his associate, John Reid, admit that as a result of this lack of training, the incompetent examiner, rather than admit his inability to draw any conclusion from the test results, is likely to render a report which will meet with the favor of the person or agency which retains him.[175]

The court would reach a different conclusion for LCN at each point of the reasoning used in *Leone*. First, unlike the polygraph, LCN's precursors are accepted as reliable and even LCN's own process, STR, is accepted as reliable.[176] Second, unlike the majority of jurisdictions that refused the polygraph, only one jurisdiction out of the five that have made rulings on admissibility of LCN has refused the evidence.[177] In that case, the court's holding was narrowly tailored to the conditions and reliability of the lab that conducted the testing.[178] Third, unlike the polygraph, LCN has been proven to work and only begins to have

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GOVERNMENT OPERATIONS, USE OF POLYGRAPHS AS 'LIE DETECTORS' BY THE FEDERAL GOVERNMENT, H. REP. NO. at 1 (1965)).

[175] *Id.* at 699.

[176] *See supra* note 23 and accompanying text.

[177] In United States v. McCluskey, the court held a *Daubert* hearing on LCN and precluded the evidence mainly on the expert's inability to explain the results. United States v. McCluskey, 954 F.Supp.2d 1224, 1286 (D.N.M. 2013) ("The Court does not find credible Davis's testimony and conclusion on the reliability of the DNA profile for Item 1B23B. The Court is not persuaded by Davis's insistence that her experience—without citation to scientific studies, scientific literature, or any special training—justified her conclusion."). Three jurisdictions have specifically admitted LCN. *See* United States v. Sleugh, No. 14-CR-00168-YGR-2, 2015 WL 3866270, at *6 (N.D. Cal. June 22, 2015); United States v. Morgan, 53 F.Supp.3d 732, 747 (S.D.N.Y. 2014); Phillips v. State, 126 A.3.d 739, 751 (Md. Ct. Spec. App. 2015). One other jurisdiction that heard a case involving LCN testing did not reach the issue of its admissibility. United States v. MacDonald, 37 F.Supp.3d 782, 793 (E.D.N.C. 2014) ("MacDonald's motion is presumed to be untimely under the IPA, and he has failed to rebut the presumption of untimeliness. The motion, therefore, is DENIED."). One other jurisdiction has had a case mistakenly thought to be an LCN. United States v. Davis, 602 F.Supp.2d 658, 672 (D. Md. 2009) ("At the hearing, Dr. Krane seemed to concede that the amount of template DNA was ten times that indicated on the Quantiblot, but proceeded to argue that sufficient uncertainty remained about the precise quantity tested that this Court should find that LCN testing had been done, and conduct a *Daubert* hearing to determine the reliability of the test results. The Court declines to so find.").

[178] United States v. McCluskey, 954 F. Supp. 2d 1224, 61286 (D.N.M. 2009) ("The Court concludes that the Government has not carried its burden of demonstrating, by a preponderance of the evidence, that LCN testing by the NMDPS Lab is reliable and admissible under Daubert and Rule 702.").

accuracy issues below a certain sample size.[179] Fourth, like the *Leone* court's reliance on the Congressional hearings, the DNA Subcommittee of the New York State Forensic Science Commission approved LCN testing in 2005.[180] Finally, unlike the untrained polygraph examiners, the OCME in New York employs some of the highest trained, and highest recognized, genetic experts in the world.[181] Therefore unlike *Leone*, where the court found that the polygraph test was not reliable as evidence, here, LCN should not be precluded for lack of reliability because there is an opposite result at each factor used in *Leone*.

The *Collins* court also compares LCN to facial recognition software ("FRS").[182] While it is true that FRS is not admissible as evidence in New York, the first and most evident distinction from LCN is that facial recognition software looks at faces, which are easily subject to change, whereas DNA is completely unique to the individual and cannot be changed.[183] This is the characteristic that makes DNA valuable as evidence. The *Collins* court incorrectly claims that LCN is novel because it is distinct from PCR, likening it to FRS.[184] But unlike LCN, FRS is novel because it is distinct from any other type of device or process in existence, and has not been subjected to a *Frye* hearing in New York. So unlike FRS, which should be precluded because it has not passed a *Frye* hearing nor has its precursor, here, LCN should not be precluded because LCN and its precursors have passed *Frye* hearings.

B. Is LCN Accepted as Reliable?

Hypothetically, and most likely incorrectly, if LCN is accepted as "novel," the next step of the *Frye* process is to determine if the relative scientific community accepts the evidence as reliable.[185] In order to determine this, the case

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[179] *See supra* note 66 and accompanying text.

[180] *See supra* note 150.

[181] OFFICE OF CHIEF MEDICAL EXAMINER OCME DNA LABORATORY RECEIVES PERFECT SCORE AS INTERNATIONAL ACCREDITATION RENEWED, (Dec. 30, 2015), http://www.nyc.gov/html/ocme/html/event/OCMEDNALaboratory.shtml; Chief Medical Examiner Barbara Sampson "earned her Bachelor's degree at Princeton and obtained a Ph.D. in Molecular Biology at Rockefeller University. She earned her degree in medicine at Cornell University Medical College, followed by a residency at Brigham and Women's Hospital in Boston. Chief Medical Examiner, OFFICE OF CHIEF MEDICAL EXAMINER, (Dec. 30, 2015) http://www.nyc.gov/html/ocme/html/about/ChiefMedicalExaminer.shtml.

[182] People v. Collins, 15 N.Y.S.3d 564, 575-76 (N.Y. Sup. Ct. 2015) ("In that regard, the results of some other techniques—polygraphs and facial recognition software, for example—likewise can aid an investigation, but are not considered sufficiently reliable to be admissible at a trial.").

[183] CHARLES P. KINDREGAN JR., ET AL., MASS. PRACT., FAMILY LAW AND PRACTICE § 89.28 (4th ed. 2015).

[184] People v. Collins, 15 N.Y.S.3d 564, 575-76 (N.Y. Sup. Ct. 2015) (quote *supra* note 138).

[185] Frye v. United States, 293 F. 1013, 1013 (D.C. Cir. 1923).

law for procedures similar to LCN is instructive. This will allow us to articulate a standard for reliability as prescribed by the New York courts.

i. People v. Wesley

In *Wesley*, the Court of Appeals of New York first decided on the admissibility of DNA testing.[186] In 1994, neither defense nor prosecution contested whether DNA testing was a novel scientific procedure and the court proceeded to conduct the second step of the *Frye* inquiry.[187] Experts on both sides of the issue testified as to the reliability of what is now considered standard DNA testing and the court held that the procedure was found to be reliable by the scientific community.[188] The defense accepted that the scientific principles and underlying technology of the particular fields of "molecular biology, biochemistry and human genetics" were generally accepted.[189] The attack was focused, *inter alia*,[190] on the quality control and procedures of the Lifecodes laboratory ("Lifecodes").[191] The expert witness for the defense, Dr. Neville Colman, specialized in laboratory procedure.[192] Colman raised concerns about whether the methods used by Lifecodes were adequate, but was overwhelmingly refuted by the opinions of the experts for the prosecution with "superior qualifications," including Dr. Alec Jeffreys, a British proponent of DNA fingerprinting.[193] Testimony in support of DNA fingerprinting claimed that the process entailed only scientific principles long established and accepted, stating that Dr. Roberts "testified that all of the principles and technology underlying DNA Fingerprinting and Lifecodes' Print Identification Test were valid and generally accepted by the scientific community in the fields of molecular biology and genetics."[194]

[186] People v. Wesley (*Wesley II*), 633 N.E.2d 451, 452 (N.Y. App. Ct. 1994).

[187] *Id.* at 453-54.

[188] People v. Wesley (*Wesley I*), 533 N.Y.S.2d 643, 659 (N.Y. Cty. Ct. 1988).

[189] *Id.* at 650.

[190] *Id.* (stating that the second point of contention was that the Lifecodes population studies were inadequate. A similar position taken by the defense in *Collins* but an issue not addressed in this article).

[191] *Id.*

[192] *Id.* at 651; *Wesley II,* 633 N.E.2d at 452 (stating Colman's qualifications, "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.").

[193] *Wesley I,* 533 N.Y.S.2d at 651. Dr. Jeffreys founded the Cellmark laboratory, one of the three first DNA testing laboratories, and is the author of much of the early theoretical use of DNA in the criminal field. *Wesley II*, 633 N.E.2d at 463.

[194] *Wesley I*, 533 N.E.2d at 651. Dr. Roberts is the Assistant Director at the Cold Spring Harbor Laboratory in New York. Many recombinant DNA (rDNA) techniques used in the field were developed at Cold Spring Harbor Laboratory. The Director of the laboratory is

In its conclusion, the court expressly equated the reliability and acceptance of the underlying principles of the test to the reliability and acceptance of the test itself.[195] The court further noted that the contradictory testimony should not prevent the evidence from admissibility but that it could go to the weight of the evidence.[196]

Applying the reasoning from *Wesley* to the facts of *Collins* would demand a different result. LCN DNA testing is based on the same principles as the accepted twenty-eight cycle amplification testing of DNA samples over 100 picograms.[197] LCN testing is used in Britain and other countries for evidence in criminal trials.[198] LCN is without opposition for various other uses.[199] Even the opponents of LCN testing agree that it can be used for investigative leads.[200] The *Collins* court admitted this fact.[201] So, with the same scientific principles as *Wesley*, similar endorsements in the principles from the relevant British science community as *Wesley*, and even the opponent experts agreeing that the principles are valid in other contexts, the same result as *Wesley* is appropriate.

The *Collins* court hangs its divergent conclusion on the fact that LCN testing has problematic effects.[202] But, the problematic effects that were complained of and ultimately led the court in *Collins* to prevent admissibility also occur in the accepted twenty-eight cycle amplification testing.[203] It is true that these problematic effects[204] occur more often in LCN DNA testing than the testing analyzed in *Wesley*, but the problem with LCN is not in the principles, for which

James Watson, winner of the Nobel Prize for his discovery of the double helix structure of DNA. *Id.*

[195] *Id.* at 659.

[196] *Id.* at 650.

[197] People v. Collins, 15 N.Y.S.3d 564, 570-71 (N.Y. Sup. Ct. 2015) (outlining the process of STR DNA testing).

[198] JOHN D. WRIGHT, HAIRS AND FIBERS 87 (2008); *See* Crown Prosecution Service, *International use of LCN*, LOW COPY NUMBER DNA TESTING IN THE CRIMINAL JUSTICE SYSTEM https://www.cps.gov.uk/publications/prosecution/lcn_testing.html#_06 [https://perma.cc/F69U-MUQB] (listing the eight countries in addition to Britain that use LCN methods for evidence, "United States (New York), New Zealand, Holland, Italy, Germany, Croatia, Austria and Switzerland.").

[199] People v. Megnath, 898 N.Y.S.2d 408, 411 (N.Y. Sup Ct. 2010) (finding that LCN had been used to identify bodies, bones, artifacts, and used to determine birth defects pre-birth).

[200] Collins, 15 N.Y.S.3d at 575.

[201] *Id.* at 567 ("[t]he hearing evidence focused on four stochastic effects that may complicate DNA analysis under any procedure, including standard DNA analysis.").

[202] *Id.* at 585.

[203] *Id.* at 567; ERIN E. MURPHY, INSIDE THE CELL: THE DARK SIDE OF FORENSIC DNA 4-5, 11-12 (2015).

[204] Allelic drop in, allelic drop out, peak imbalance, and stutter. BUTLER, *supra* note 13, at 324-25.

Frye tests, but the adequacy of the method used by the laboratory.[205] This is no different from the defense expert's testimony in *Wesley* that was refuted and ultimately used to go to the weight of the admitted evidence.[206] Similarly, the contrary research and expert testimony should simply go to the weight of the LCN evidence after admission.

ii. People v. Middleton

In *Middleton*, the defendant worked at Mount Sinai hospital in the maintenance-engineering department.[207] Authorities found the defendant's supervisor dead in the defendant's office with five distinct bite marks on his body.[208] The prosecution used a procedure to link the bite marks found on the victim to the defendant's teeth.[209] The defendant argued that the scientific community had not accepted the prosecution's procedure, pointing to studies attacking the reliability of the process.[210] The People cited other studies in support of the procedure.[211] The court found that the majority of experts in the field accepted the procedure's techniques—"photography, freezing of tissue specimens, the taking of dental molds, [and] visual observation."[212] The court detailed the way in which the techniques were used later in the opinion:

> But the test is not whether a particular procedure is unanimously endorsed by the scientific community, but whether it is generally acceptable as reliable. The techniques employed (photography, freezing of tissue specimens, the taking of dental molds, visual observation) are accepted and approved by the majority of the experts in the field . . . It was not error, therefore, for the Trial Judge, without a hearing concerning the scientific principles involved, to hold the evidence generally reliable . . . The only remaining question, then, is whether the accepted techniques were employed by the experts in this case in reaching the conclusion that the bite marks on the decedent's back were made by defendant's teeth.[213]

The court was persuaded by the acceptance of the techniques used, the volume

[205] United States v. Morgan, 53 F.Supp.3d 732, 744-45 (S.D.N.Y. 2014) ("OCME's use of peak heights in its interpretation guidelines is not only consistent with the scientific mainstream, but also with officially recognized best practices. . . OCME's peak-height related LCN protocols are also validated by sufficient data to establish their reliability under Daubert and Rule 702.").

[206] People v. Wesley (*Wesley I*), 533 N.Y.S.2d 643, 651(N.Y. Cty. Ct. 1988). (stating that Dr. Colman testified to concerns about Lifecodes' laboratory methods).

[207] People v. Middleton, 429 N.E.2d 100, 101 (N.Y. 1981).

[208] *Id.* at 101.

[209] *Id.* at 104.

[210] *Id.* at 103.

[211] *Id.*

[212] *Id*.

[213] *Id.* at 103, 104.

of studies in support of the process, and the fact that every appellate court that had previously addressed the issue accepted the reliability of the bite mark analysis.[214] The court found that unanimous endorsement was not required for a process like bite mark analysis to be generally accepted under *Frye*.[215]

Applying the reasoning of *Middleton* to the LCN process demands a different result than that reached by the *Collins* court. In *Middleton*, the acceptance of the bite mark identification techniques persuaded the court.[216] The components that make up the LCN process are the same whether they are done twenty-eight or thirty-one times.[217] While there are competing studies that arrive at different conclusions about the accuracy of LCN results, there is no question about the components of the process. So, like in *Middleton*, where the court applied the criticisms of the bite mark identification to the evidence used in the case, *Collins* should have applied the criticisms of the LCN process to the techniques employed by OCME and the results OCME arrived at. In *Middleton*, the volume of studies in support of the process persuaded the court.[218] LCN has been verified in peer review journals by multiple studies from the OCME and the Forensic Science Service in Britain.[219] The court in *Middleton* was also persuaded by the fact that every appellate court that had addressed the issue accepted the reliability of the procedure.[220] It is telling that in the ten years since the DNA Subcommittee of the New York State Forensic Science Commission approved LCN, no appellate court has yet addressed the reliability of LCN. This shows that the New York court system has confidence in LCN's reliability. So like in *Middleton*, where the court found the bite mark matching process reliable because the techniques were accepted, there was research backing up the soundness of the components, and that no court had refused the technique, here, *Collins* should have found LCN to be reliable and let the criticisms go to the weight of the evidence because the techniques are the same as PCR testing, there is researching backing up the techniques, and the New York appellate courts never overturned the admissibility of LCN.

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[214] *Id.* at 103.

[215] *Id.*

[216] *See id.* at 104.

[217] *See* People v. Megnath, 898 N.Y.S.2d 408, 413 (N.Y. Sup Ct. 2010) ("In HCN and LCN DNA testing, the same four steps for analysis are used. They are extraction, quantitation, amplification, and electrophoresis.").

[218] *Middleton*, 429 N.E.2d at 103.

[219] Caragine et al., *supra* note 65, at 250 (2009); *See generally* BRIAN CADDY ET AL., A REVIEW OF THE SCIENCE OF LOW TEMPLATE DNA ANALYSIS (2008) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/117556/Review_of_Low_Template_DNA_1.pdf (endorsing LCN DNA testing and concluding that while guidelines and standards must be followed that LCN DNA testing is based on sound scientific principles).

[220] *Middleton*, 429 N.E.2d at 103.

C. Applying Daubert to LCN

In 1999, the Supreme Court declared a new standard, overruling *Frye* as the test for admissibility of expert testimony in federal courts.[221] In *Daubert*, the Court outlined five non-exclusive factors to determine whether expert testimony is scientifically valid. The five factors are whether the technique: (1) can, and has been, tested; (2) has been subjected to peer review; (3) has a known potential rate of error; (4) has maintenance standards that control the operation; and (5) whether the relevant scientific community has widely accepted the technique.[222]

LCN continues to pass as scientifically valid today just as it did when the *Morgan* court applied the test in 2014.[223] In the United States, LCN can –and has been– rigorously tested for seven years.[224] In that same time period, the scientific community, while not unanimously in favor of the process, did subject LCN to peer review.[225] Thirdly, while the potential rate of error may vary depending on the particular study, it is ever-improving and specific enough to be accounted for in the calculation of results.[226] Regarding maintenance standards, numerous regulatory boards, including SWGDAM, created guidelines for DNA testing under which LCN qualifies.[227] Finally, while acceptance of LCN is mixed, nine countries and three United States jurisdictions accept LCN as evidence.[228] Scientists in the field unanimously accept the theory and method behind LCN; some, however, doubt the quality of the implementation.[229] So, while it has some shortcomings, LCN passes the factors test overall and therefore should be admissible as evidence in courts across the United States.

[221] Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 587 (1993).

[222] *Id.* at 579-580.

[223] United States v. Morgan, 53 F.Supp.3d 732, 737-738 (S.D.N.Y. 2014); People v. Bullard-Daniel, 2016 WL 5724204, at *10-*11 (N.Y. Co. Ct. March 10, 2016).

[224] *Supra* note 175.

[225] *Supra* note 219.

[226] Morgan, 53 F.Supp.3d 732, 738 ("Based on the results of these validation studies, OCME created its interpretation guidelines, intended to allow for consistent interpretation of LCN testing results by accounting for the presence of increased stochastic effects as the quantity of DNA decreases.").

[227] United States v. Morgan, 53 F.Supp.3d 732, 737 (S.D.N.Y. 2014).

[228] WRIGHT, *supra* note 198, at 87-88. *See also* United States v. Sleugh, No. 14-CR-00168-YGR-2, 2015 WL 3866270, at *2-*3 (N.D. Cal. June 22, 2015); Morgan, 53 F.Supp.3d at 734 (S.D.N.Y. 2014); Phillips v. State, 126 A.3d 739, 748 (Md. Ct. Spec. App. 2015); *see* Crown Prosecution Service, *supra* note 196.

[229] BUDOWLE, *supra* note 97, at 1–2, 4.

IV. CONCLUSION

A. LCN Should Not Be Precluded - Jurors Will Understand the Shortcomings

The American judicial system entrusts to the jury the capacity to kill, the capacity to imprison, and the capacity to exonerate. The system allows this because there are experts to explain the process and the consequences, and judges and lawyers who instruct the jury and present options. The methods employed to help jurors understand the shortcomings of a piece of evidence are far less sophisticated. Further, the safeguards furnished by experts are still present: experts can testify, advocate for use, and introduce the shortcomings of evidence. Throughout the generational waves of new evidence – from fingerprints, to bite mark identification, to interlock ignition devices – we continue to trust juries, and the experts who prepare them, to make decisions about whether to accept evidence and how much weight to give it.[230] It is time that we continue that tradition with LCN, not only in in New York, but also in courts throughout the United States.

Cynics will say that juries are too suggestible. The CSI Effect will confuse them; as soon as they hear "DNA," they will convict. This line of thinking underestimates the solemnity of the legal system and misstates the effect that DNA evidence has on juries. Jurors take the responsibility seriously.[231] Jurors have integrity: jurors are willing to sacrifice time from work to better society, and jurors are unwilling to make up excuses during voir dire.[232] Jurors care about doing the right thing because they realize the burden of their responsibility.[233] Jurors are, in fact, the reasonable person.

The CSI Effect suggests that a criminal television drama has tainted juries to the point that jurors expect DNA evidence for every crime.[234] The supposed result of this phenomenon is that juries are far more likely to acquit in cases that fail to present DNA evidence.[235] Assuming this were the case, producing more DNA evidence, both inculpatory and exculpatory, would simply meet juror expectations. Additionally, reasonably competent people will be able to understand that, much like partial fingerprints, partial DNA profiles carry less proof than

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[230] *See* People v. Middleton, 429 N.E.2d 100, 104 (N.Y. 1981); People v. Jennings, 96 N.E. 1077, 1084 (Ill. 1911); People v. Bohrer, 952 N.Y.S.2d 375, 377 (N.Y. Just. Ct. 2012).

[231] *See* Alicia I. Dearn, *What I Learned Sitting on a Jury*, AMERICAN BAR ASSOCIATION (Feb. 6, 2016), http://www.americanbar.org/publications/gpsolo_ereport/2015/march_2015/what_i_learned_sitting_on_a_jury.html [https://perma.cc/FA3N-8L4K].

[232] *Id.*

[233] *Id.*

[234] *See generally* Tom R. Tyler, *Viewing CSI and the Threshold of Guilt: Managing Truth and Justice in Reality and Fiction*, 115 YALE L.J. 1050 (2006).

[235] *Id.*

complete profiles.[236]

Indeed, discerning jurors will want to question: how significant is the evidence that the likelihood ratio is 576,000 to 1? These seemingly unbelievable odds given in the presentation of any type of DNA evidence have a counterintuitive effect because of the outlandish proportions. So, this is a perfect opportunity for a neutral, possibly court appointed,[237] expert to take the stand and explain to the jury what all this means. Allow the expert to criticize the shortcomings of the evidence, explain what the probabilities in likelihood ratios really mean in terms of probability of guilt, and then allow the jury to decide for themselves what the evidence means, as the justice system intends.

[236] United States v. Mitchell, 365 F.3d 215, 225 (3d Cir. 2004) (finding that latent fingerprint identification may be used as evidence in a criminal case).

[237] *See* R.E. Barber, Annotation, *Trial Court's Appointment, in Civil Case, of Expert Witness*, 95 A.L.R. 2d 390, §2 (1964) (Authors were not able to discover any case in which it was held that a court does not have the power and right to select an impartial expert witness, and to appoint him, either on the court's motion or that of one of the parties; in two instances it was indicated that a trial judge may sometimes have the duty to make such an appointment.).