Digesting the Double Helix:
Receptions and Misconceptions of DNA Evidence in the New Zealand Criminal Trial

Devon Helm

A dissertation submitted in partial fulfilment of the degree Bachelor of Laws (Honours) at the University of Otago – Te Whare Wananga o Otago.

9th October 2015

Acknowledgements

To my supervisor, Kevin Dawkins, for his wisdom, patience and guidance throughout the year, and to Richard Mahoney for his useful comments. Your help was greatly appreciated.

To Dr Anna Sandiford, for her scientific expertise and so kindly answering my questions – it was invaluable to gain the perspective of someone with such experience and esteem in the courtroom. Also to Tina Pope from the Judicial Studies Board, for her assistance in relation to the New Zealand Bench Book.

To Edana, for being my "partner in crime" and sharing a passion for law and forensic science. These university years would not have been the same without you. Thanks also to my other friends for the regular lunch dates, where discussions and laughs helped to keep me sane.

And finally, to my family – thank you so much for the unconditional love, support and homemade meals. I am truly grateful.

Table of Contents

Abbreviations

CPA	Criminal Procedure Act 2011
DNA	Deoxyribonucleic Acid
EA	Evidence Act 2006
ESR	Institute of Environmental Science and Research New Zealand
LCN DNA	Low Copy Number DNA
LR	Likelihood Ratio
MAP	Multidisciplinary Advisory Panel
mRNA	Messenger Ribonucleic Acid
NFI	Netherlands Forensic Institute
OCME	Office of the Chief Medical Examiner (New York)
STR	Short Tandem Repeat

Introduction

As the "customers" for forensic evidence,[1] criminal justice systems have benefitted immeasurably from the development of DNA[2] profiling technologies. Further refinements to the specificity and sensitivity of analytical techniques have widened the circumstances in which DNA can be of forensic use, increasing its evidentiary application in the courtroom. Over the years, the criminal trial has thus experienced a "creeping scientisation."[3] Yet the portrayal of forensic science in the media has resulted in a public expectation and acceptance that DNA will always be available in criminal investigations.[4] Failing appropriate direction from judges and lawyers, the presence (or absence) of DNA evidence may affect jurors' tendencies to convict in a case.[5]

This dissertation will trace the use of DNA evidence in the courtroom, concentrating on the way in which it is received by lawyers, judges and juries. After an initial embarkation into the relationship between law and science, Chapter I will outline principles of DNA evidence in the forensic context and highlight some of the reliability concerns which challenge its perceived status of infallibility. Identification of these issues is important given that reliability is encapsulated in the admissibility criteria for expert evidence under the Evidence Act 2006 (EA). Chapter II will discuss how the formal admissibility requirements under this legislation operate to control the entry of DNA expert opinion evidence into the criminal trial process. Close attention will be given to the requirement that the test imposes on the judge – to act as a gatekeeper and filter out only the evidence which is likely to be substantially helpful to the fact-finder. The *Lundy* case will be used to demonstrate that this can be a highly burdensome task. Additionally, Chapter II will consider recent developments in the English admissibility test for expert evidence, and evaluate whether the difference in approach is likely to be more or less effective in regulating the admissibility of DNA.

DNA is unique in that its evidential strength is quantified in the form of a numerical statement about profile origin. Chapter III will examine how these likelihood ratios are presented by the expert in court, and why the attached verbal equivalent scale may operate too strongly in favour of the prosecution case. Because juries are not naturally equipped to

[1] Lord Thomas of Cwmgiedd (Lord Chief Justice of England and Wales) "Expert Evidence: The Future of Forensic Science in Criminal Trials" (The 2014 Kalisher Criminal Bar Association Lecture, 14 October 2014) at 2.
[2] Deoxyribonucleic acid.
[3] Mirjan Damaška *Evidence Law Adrift* (Yale University Press, New Haven, 1997) at 150.
[4] Rhonda Wheate "The importance of DNA evidence to juries in criminal trials" (2010) 14 International Journal of Evidence and Proof 129 at 129.
[5] This phenomenon has been labelled the "CSI Effect": Tom R Tyler "Viewing CSI and the threshold of guilt: Managing truth and justice in reality and fiction" [2006] The Yale Law Journal 1050 at 1072.

handle probabilistic evidence, a number of methods to improve jury understanding of DNA evidence will also be suggested.

Finally, Chapter IV will observe how trial safeguards within the adversarial process function to reduce the misuse of DNA evidence in criminal cases. From an analysis of these safeguards, it will be shown that thorough cross-examination and judicial directions are particularly important in ensuring the fact-finder does not place undue weight on expert opinion. Moreover, claims will be advanced that adjustments to the order of giving evidence within the trial process may further improve the way in which DNA evidence is received in the courtroom. Enhanced communication and education will emerge as the most appropriate means of resolving the tensions between legal, scientific and common-sense reasoning.

Chapter I
Principles of DNA Evidence in the Criminal Justice System

A Introduction: Exploring the Law-Science Relationship in the Criminal Trial Context

> In this age of science, science should expect to find a warm welcome, perhaps a permanent home, in our courtrooms. The legal disputes before us increasingly involve the principles and tools of science. Proper resolution of those disputes matters not just to the litigants, but also to the general public – those who live in our technologically complex society and whom the law must serve. *Our decisions should reflect a proper scientific and technical understanding so that the law can respond to the needs of the public* (emphasis added).[6]

As modern technologies continue to develop, there is an increasing reliance on scientific evidence in criminal proceedings to assist fact-finding. In the eyes of the law, science is perceived as impartial and objective. Precise methodologies are followed to produce empirical conclusions specific to the case at hand, the core principles of which can be applied to future investigations.[7] Both disciplines essentially use evidence and structured debate "to arrive at rational conclusions that transcend the prejudices and self-interest of individuals."[8] The law cannot deny the role of scientific evidence in criminal investigations - "forensic science" *means* the field of science applied to the administration of justice.[9]

However, the objectives of law and science are fundamentally different. While the law is concerned with promptness and finality in its search for justice, the investigative nature of science strives for objective truth and is thus open to continuing revision.[10] Scientific values therefore do not fit naturally with the adversarial character of criminal trial, in which the court must make clear decisions within the constraints of time and resources using the current

[6] Stephen Breyer "Science in the Courtroom" (2000) 16(4) Issues in Science and Technology 52.
[7] Oriola Sallavaci *The Impact of Scientific Evidence on the Criminal Trial: The case of DNA evidence* (Routledge, Oxon, 2014) at 32.
[8] Federal Judicial Center *Reference Manual on Scientific Evidence* (3rd ed, National Academy Press, Washington, DC, 2011) at 52.
[9] Paul Roberts "Renegotiating forensic cultures: Between law, science and criminal justice" (2013) 44 Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences 47 at 48; also described by the online Oxford Dictionary as "the application of scientific methods and techniques to matters under investigation by a court of law" (11 August 2015, <www.oxforddictionaries.com>).
[10] Susan Haack "A Match Made on Earth: Getting Real about Science and the Law, A" (2013) 36 Dalhousie LJ 39 at 52; and more recently Susan Haack *Evidence matters: Science, proof and truth in law* (Cambridge University Press, New York, 2014) at 79.

available evidence before it.[11] Suggestions have been made that adjustments to the traditional adversarial process could overcome such difficulties – by changing the admissibility rules governing expert evidence, making trial judges more active, having court-appointed experts or by implementing specialist juries.[12] Many of these initiatives will be contemplated throughout this dissertation, although not all will be advocated for. With the tensions between law and science laid out, the remainder of the dissertation will focus specifically on DNA evidence, which has been used in the New Zealand courtroom for the past 25 years.

B Early Developments and Concepts of DNA Profiling

Intrinsic to forensic science is the notion that "every contact leaves a trace."[13] Therefore, during the commission of a crime, a transference of physical evidence is expected to occur between individuals, surfaces and objects.[14] In the criminal context, the aim of forensic DNA analysis is to identify the source of biological evidence recovered at the crime scene, and to establish whether any links exist between that and the sample collected from the suspect under investigation.[15]

In 1985, English geneticist Alec Jeffreys became the first to describe DNA profiling when he discovered that certain parts of the DNA sequence varied from individual to individual. By formulating a technique which examined these differences, he found that DNA could be used as a "fingerprint" for the purposes of human identification.[16] It was not long before these techniques were applied in a forensic setting; in 1986 Colin Pitchfork became the first person to be convicted on the basis of DNA evidence after his profile was matched to semen stains found at the murder scenes of two young women.[17]

New Zealand became the second country in the world to launch DNA profiling, largely because of our associations with the United Kingdom. In *R v Pengelly*,[18] the first New

[11] Haack, above n 10, at 50; see also *Wallace v R* [2010] NZCA 46 at [51], where the Court discusses the challenge of expressing scientific results within the "complex adjectival rules and evidential protocols" of the legal domain.
[12] Sallavaci, above n 7, at 33; see generally Roberts, above n 9.
[13] Postulated by Sir Edmund Locard in 1930 and now considered fundamental to forensic science, this principle states that "the dust and debris that cover our clothing are the mute witnesses, sure and faithful, of all our movements and all our encounters" – ie in any exchange a person is bound to leave physical traces of their presence:
[14] Andrew Jackson and Julie Jackson *Forensic Science* (3rd ed, Prentice Hall, Harlow, 2011) at 3.
[15] Andrei Semikhodskii *Dealing with DNA evidence: a legal guide* (Routledge, Oxon, 2007) at 1.
[16] John Butler *Forensic DNA Typing: Biology, Technology and Genetics of STR Markers* (2nd ed, Elsevier, London, 2005) at 3.
[17] Ibid. It should be noted that DNA was first used for exonerative purposes in this case, as the profile obtained from the crime scene samples (later matched to Pitchfork) did not match that of the individual who had in fact confessed to the second murder. Innocent individuals continue to be exonerated through post-conviction DNA testing today, with 330 post-conviction DNA exonerations having taken place in the United States alone (<www.innocenceproject.org>). However, the focus of this dissertation will not be on post-conviction DNA analysis, but how it is used prior to conviction in the criminal trial.
[18] *R v Pengelly* [1992] 1 NZLR 545; (1991) 7 CRNZ 333.

Zealand case concerning DNA evidence, analysis of bloodstains left at a murder scene produced a profile that "were at least 12,450 times more likely to have occurred if the blood had originated from Pengelly than if it had originated from someone else."[19] Although the use of DNA for forensic purposes was considered novel at the time, the evidence was (with sufficient warning) put before the jury and contributed towards securing Pengelly's conviction.

More recent developments in DNA technology have increased the precision and sensitivity of the technique, allowing it to be used in a wider range of casework. It is these qualities of DNA, combined with its biological robustness and widespread sample availability (similar profiles can be obtained from blood, saliva, semen, and hair follicles),[20] which have led to it being described as the "gold standard" of forensic science,[21] the "single greatest advance in the search for truth,"[22] and the "most important forensic investigative tool to be developed in the 20th century."[23]

DNA profiling has been a revolutionary contribution to forensic science and criminal justice systems worldwide.[24] However, despite the fact that DNA generally stands on stronger foundations than other types of evidence,[25] no science can be infallible. Even with its technical refinements, issues in the reliability and interpretation of DNA profiling remain of prominent concern today, leaving it far from a "scientific litmus test of culpability."[26] These issues, in addition to a number of others, will be elaborated upon in turn.

C The Modern Basis of DNA Profiling

1 DNA in the forensic context: utilising the "junk"

Often described as the "building block of life", DNA is a complex biological molecule that encodes the complete genetic information of an individual.[27] Half of this code is maternally inherited and half is paternally inherited. DNA can be found in many cell types, packaged tightly into chromosomes in a "double helix" structure. Most humans have 23 pairs of chromosomes, 22 pairs of non-sex chromosomes and a pair of XX or XY chromosomes

[19] *R v Pengelly* , above n 18, at 550.
[20] Jackson and Jackson, above n 14, at 159.
[21] Michael Lynch "God's signature: DNA profiling, the new gold standard in forensic science" (2003) 27 Endeavour 93 at 93–96.
[22] *New York v Wesley*, 140 Misc 2d 306, 533 NYS 2d 643, 644 (1988).
[23] John Buckleton and Craig Ruane *Forensic Evidence* (New Zealand Law Society, 2008).
[24] Paul Roberts and Adrian Zuckerman *Criminal Evidence* (2nd ed, Oxford University Press, Oxford, 2010) at 470.
[25] National Research Council of the National Academies *Strengthening Forensic Science in the United States: A Path Forward* (National Academies Press, August 2009).
[26] Deborah L Kellie "Justice in the Age of Technology: DNA and the Criminal Trial" (2001) 26 Alternative LJ 173 at 175.
[27] Semikhodskii, above n 15, at 3.

(determining female and male sex respectively). In the forensic context, an individual's pattern of genetic information is referred to as their DNA profile.

Modern DNA profiling is based largely on Short Tandem Repeat (STR) analysis. STRs are small sections of DNA repeated consecutively a number of times in the sequence, and are "junk" in the sense that they do not encode for protein.[28] At given positions on the chromosome ("loci") the number of repeats will differ markedly between individuals, even those within the same family.[29] The number of repeats at a locus is called an allele, and each individual can have two alleles, one inherited from each parent.[30]

After amplification,[31] the quantity of DNA in a sample is measured using a process called electrophoresis, which separates the STR fragments according to size. It is then run through complex computer software that separates out the relevant information for the analyst to interpret.[32] From the alleles at each locus assigned by the graph, the analyst can determine whether there is a match between the crime and reference/suspect samples. In New Zealand, standard autosomal DNA profiling detects 15 loci plus a gender test to generate a full profile.[33] Because of the high variability of STRs, standard DNA profiling produces greatly discriminating results. The probative value of the evidence increases with every locus that matches between a known suspect sample and an unknown crime sample, and thus reduces the likelihood that a match has occurred due to chance.

2 Current DNA techniques available for use in forensic casework in New Zealand

A DNA sample may not always yield a full profile, thereby limiting the applicability of the standard profiling technique. Various other approaches based on STR analysis are conducted by ESR[34] for use in forensic casework. The analytical procedure for building a DNA profile essentially remains the same – extraction, quantification, amplification, electrophoresis and interpretation[35] – but the techniques are specifically tailored to samples that may be degraded

[28] Jackson and Jackson, above n 14, at 169. Therefore, when a person's STR profile is stored on a DNA database, no information is revealed about their physical characteristics.
[29] Butler, above n 16, at 85.
[30] Jackson and Jackson, above n 14, at 162. As an example, at the commonly used TH01 locus a person's STR profile might be "12, 14" - meaning that they have one allele with 12 repeats and one with 14 repeats.
[31] The Polymerase Chain Reaction (PCR) is a technique used to amplify DNA of minute quantity, acting as a "molecular photocopier" so that samples can be detected and analysed: Jane Taupin *Introduction to Forensic DNA Evidence for Criminal Justice Professionals* (CRC Press, Boca Raton, Florida, 2013) at 18.
[32] Erin Murphy "The Art in the Science of Dna: A Layperson's Guide to the Subjectivity Inherent in Forensic Dna Typing" (2008) 58 Emory Law Journal 489 at 498.
[33] The Institute of Environmental Science and Research "DNA Techniques Available for Use in Forensic Casework" (3 October 2014) <www.esr.cri.nz>.
[34] The Institute of Environmental Science and Research New Zealand.
[35] Michael Dean and Marci Wease "Understanding DNA Analysis and Interpretation" (2015) 30 Crim Just 11 at 14.

or of low quantity. What technique is employed will depend on the type and quality of sample available for analysis. In some cases a combination of techniques may be used.[36]

(a) Minifiler DNA analysis

This technique analyses eight of the fifteen STR loci used in the standard DNA profiling test, and is used on samples containing DNA which have been degraded due to either age or environmental conditions.[37] On its own, Minifiler analysis does not have the same discriminating power as standard profiling since less sites are examined, but can supplement the results of other techniques by providing additional information in relation to partial profiles and profiles of low DNA quantity.[38]

(b) Y-chromosome DNA analysis

The Y-STR profiling test detects the presence of male DNA in a sample by analysing 12 loci on the Y chromosome. Though it selectively targets male DNA, it is unable to distinguish between father and sons or other paternally related males.[39] Hence Y-STR profiling is usually used in conjunction with a technique of higher individual discriminating power.

(c) mRNA analysis

Messenger RNA (mRNA) is an intermediary compound between DNA in the cell nucleus and the cell proteins.[40] As the mRNA profile of a cell is unique for each cell type, analysis of this molecule can identify the body fluid from which the DNA profile originated (for example, vaginal fluid, semen or saliva).[41] This can be used to corroborate versions of events, such as in cases of alleged sexual assault. However, because mRNA is more fragile than DNA, it is more vulnerable to environmental influences. Other techniques will be used in addition to mRNA analysis wherever possible in casework.

[36] Techniques which are not carried out by ESR but by international laboratories can also be introduced in the courtroom, provided they meet the evidential admissibility requirements. Funding issues mean that it will usually be the Crown who introduces this type of evidence – for example, the organ typing analysis in *Lundy* (discussed further in Chapter II).
[37] The Institute of Environmental Science and Research, above n 33.
[38] Ibid.
[39] Ibid.
[40] Ibid.
[41] Ibid.

(d) Low Copy Number (LCN) DNA analysis

Arguably the most controversial profiling technique, LCN or "low template"[42] analysis is available for use on samples containing only trace amounts of DNA as little as 1ng (roughly the size of a pinprick of blood). LCN profiling uses 34 PCR amplification cycles rather than the standard 28, thereby increasing the amount of product about 100 fold.[43] In detecting 10 variable STR loci plus a gender test, it is extremely unlikely that two unrelated individuals will have matching profiles. However, because of the extreme sensitivity of the technique, the reliability of LCN testing has been questioned within both forensic and legal communities worldwide. The results of LCN analysis can currently be used as admissible evidence in New Zealand, the UK and Netherlands; elsewhere, such as in the United States, its use is limited to investigative purposes only.

(i) England and Wales

Following concerns expressed by Weir J in *R v Sean Hoey* about its reliability as an evidential tool,[44] the use of LCN evidence became temporarily suspended in the UK and an independent review into the validity of the technique was commissioned by the Forensic Science Regulator in 2007. Findings from the Caddy Report established that LCN DNA was scientifically robust and hence appropriate for use in police investigations.[45] Nevertheless, the report recommended that improvements to existing guidelines and standards were necessary to guide the courts in the interpretation of low template DNA evidence.[46] It also indicated that the appropriate caveats should always accompany LCN evidence when reported to the jury:[47]

- That the nature of the original starting material is unknown;
- That the time at which the DNA was transferred cannot be inferred;
- That the opportunity for secondary transfer is increased in comparison to standard DNA profiling;
- When DNA profiles match as a result of LCN DNA profiling, the significance of the match should be reported on the probability that the two DNA profiles match only; and
- As the results were obtained from LCN it is inappropriate to comment upon the cellular material from which the DNA arose or the activity by which the DNA was transferred.

[42] The term "low template" is commonly used in the UK, whereas New Zealand tends to make reference to "low copy number" analysis. However, the terms can be used interchangeably.
[43] Jackson and Jackson, above n 14, at 202.
[44] *R v Sean Hoey* [2007] NICC 49 at [64].
[45] Brian Caddy and others *A Review of the Science of Low Template DNA Analysis* (Home Office, 11 April 2008) at 22.
[46] At 30.
[47] At 23-24.

The Court of Appeal of England and Wales articulated its position on LCN evidence in *R v Reed and Garmson,* accepting that at least when above a certain threshold, low template DNA can form an admissible profile capable of reliable interpretation.[48] Later comments from the same court suggested that it would be "wrong wholly to deprive the justice system of the benefits to be gained from the new techniques and advances which it embodies, in cases where…the profiles are sufficiently reliable."[49]

Yet there has been an absence of further litigation around LCN evidence in the English courts. Continued concerns around its reliability have led the UK to move away from LCN DNA profiling in favour of a more sensitive form of SGM+ (a modification of the standard test using 28 PCR amplification cycles).[50] Irrespective of the methodology used, DNA cannot be used as "sole-plank" evidence against a defendant in the UK – it is corroborative only.[51]

(ii) New Zealand

LCN DNA has been of evidential use in New Zealand criminal proceedings since 2005.[52] Following an examination of the English case law around the LCN technique, the Court of Appeal in *R v Lepper* could not find any basis for a challenge to the reliability of the evidence, especially where the trial judge had given cautioned directions to the jury.[53] In what is now the leading case on LCN evidence in New Zealand, the same court in *Wallace v R* confirmed LCN DNA as a sufficiently reliable means of evidence, essentially settling any doubts around its admissibility in court.[54]

LCN evidence is now routinely admissible in New Zealand provided it is explained fairly to the jury. Courts have swiftly dismissed appeals in which attempts have been made to re-litigate the threshold reliability issue,[55] and where cross-examination at trial has already canvassed the areas of concern around LCN analysis.[56] Any limitations of the evidence (as those stated above, for example) will be incorporated by the ESR expert into a formal witness statement, and good reasons must be given if it is not present.[57] However, it should be noted that LCN DNA has never of itself been sufficient to secure a conviction; it is always supported by other circumstantial and identification evidence where available.

---

[48] *R v Reed, Reed and Garmson* [2009] EWCA Crim 2698, [2010] 1 Cr App R 23 at [48]–[49].
[49] *R v Broughton* [2010] EWCA (Crim) 549 at [36].
[50] A new 16-loci system (compared to the 15-loci test currently used in New Zealand) for profiling DNA called "DNA-17": "Expert Evidence: The Future of Forensic Science in Criminal Trials", above n 1, at 10.
[51] *Wallace v R*, above n 11, at [88]; see also Jackson and Jackson, above n 9, at 159.
[52] However, at this time samples had to be sent to the UK for analysis using the technique. LCN testing was only introduced at ESR in New Zealand in November 2006.
[53] *R v Lepper* CA334/04, 1 November 2005.
[54] *Wallace v R*, above n 11, at [112].
[55] *Manoharan v R* [2015] NZCA 237 at [43].
[56] *R v Reid* [2009] NZCA 281 at [43].
[57] Anna Sandiford *Forensic Science and the Law: A Guide for Police, Lawyers and Expert Witnesses* (Brookers Ltd., Wellington, 2013) at 317.

(iii) The United States: A continuing debate?

With the exception of the OCME[58] in New York, no forensic laboratories in the United States (including the FBI) pursue LCN DNA testing as part of criminal casework.[59] Consequently, the use of LCN evidence has only been debated at State level in the USA. In *United States v Grinnage*, the United States Court of Appeals permitted LCN DNA evidence to be used for exonerative purposes without any great discussion as to the reliability of the science, as it went uncontested by either expert.[60] But in the recent case of *People v Collins*, the Supreme Court for the State of New York was given an opportunity to rule on the admissibility of LCN evidence in light of its reliability. After much deliberation, Dwyer J ruled that high sensitivity DNA did not meet the Frye standard of general acceptance and was thus inadmissible.[61] He later added:[62]

> To have a technique that is so controversial that the community of scientists who are experts in the field can't agree on it and then throw it in front of a lay jury and expect them to be able to make sense of it, is just the opposite of what the Frye standard is about.

The debate around the admissibility of LCN DNA appears to be ongoing in the USA, with a panel discussion expected to be presented at the International Symposium on Human Identification in October 2015. Further developments in this jurisdiction can be expected, but are likely to be of little relevance to New Zealand given our tendency to follow the UK's approach to DNA evidence.

D Reliability Concerns around DNA Profiling

One of the most fundamental principles surrounding the use of all scientific evidence in court is that it must be reliable, so as not to "subvert attempts to do justice 'in the pursuit of truth.'"[63] While sensitivity and specificity are perceived as two of the greatest benefits of DNA evidence, they also provide the greatest threats to its reliability.[64] Such concerns are magnified when it comes to LCN evidence, although as previously mentioned some

---

[58] Office of the Chief Medical Examiner.
[59] Erin Murphy *Inside the Cell: The Dark Side of Forensic DNA* (Nation Books, in press, 2015) at 77.
[60] 486 Fed. Appx. 325; 2012 U.S. App. (11th Cir).

[61] 2015 NY Slip Op 25227 at 13, reversing the decision upholding the use of high sensitivity DNA analysis in *People v. Megnath* 27 Misc 3d 405, 898 N.Y.S.2d 408 (Sup. Ct. Queens Co. 2010). The "Frye Standard" will be discussed further in Chapter II.
[62] Terri Sundquist "DNA Evidence: Measuring up to the Frye Standard of Acceptance" (8 April 2015) Promega Connections <www.promegaconnections.com>.
[63] Gary Edmond and Andrew Roberts "Procedural fairness, the criminal trial and forensic science and medicine" (2011) 33 Sydney L Rev 359 at 392.
[64] Allan Jamieson "LCN DNA – Devil in the Detail" (2007) J Law Soc Sc at 22-23.

jurisdictions (including New Zealand) have opted to proceed with caution rather than abandon the technique altogether.[65]

1 Sensitivity issues: contamination and transference

Contamination can occur at any stage of the collection and analytical process if DNA samples are not properly handled, thereby affecting the legitimacy of any profile match obtained.[66] If a court considers that the presence of a profile can be attributed to contamination, then the issue becomes one of relevance rather than match probability itself.[67]

To reduce the possibilities of contamination, it is imperative that all individuals who come into contact with a DNA sample can be accounted for. Documented chain of custody records are kept from the time the sample is collected from the crime scene until the time it is presented in court. In the laboratory, quality assurance and control procedures operate to uphold the integrity of the evidence;[68] these protocols include the use of clean equipment, controlled environmental conditions, negative control blanks (ie samples with no DNA), and positive controls using the analyst's DNA.[69] Replicate and duplicate analyses will also be conducted where possible.

A further challenge to the reliability of DNA evidence can be run on the basis of "secondary transfer." Individuals can inadvertently carry another source of DNA as the result of either direct person-to-person contact or by indirect transference after contacting an object previously touched by another person.[70] This can be useful in linking different individuals to the same crime scene; for example, where suspect DNA is found under the victim's fingernails[71] or a mixed DNA sample containing both the suspect and victim's DNA in cases of alleged sexual violation.[72] Where there is insufficient expert opinion on the manner of transference, it will ultimately be for the jury to determine the issue when drawing a conclusion about guilt in light of all the evidence.[73]

---

[65] Murphy, above n 59, at 77.
[66] Angela van Daal, Andrew Haesler and others "DNA evidence: current issues and challenges" (2011) 23 Judicial Officers Bulletin 55 at 56.
[67] *Wallace v R,* above n 11, at [84]. The possibility of accidental contamination was also pursued by the defence in *R v Lundy* (2002) 19 CRNZ 574, where counsel argued that argued that brain tissue found on Mr Lundy's shirt "could have been transferred accidentally to the shirt by someone who had attended the post mortem and had later come into contact with the shirt" (at [15]).
[68] "Quality assurance" refers to proactive preventive operations to prevent errors, whereas "quality control" measures are those carried out during the actual analysis to reduce errors.
[69] Dean and Wease, above n 35, at 16.
[70] Sallavaci, above n 7, at 58.
[71] *McLaughlin v R* [2015] NZCA 339 at [13].
[72] *Donnelly v R* [2011] NZCA 660 at [11].
[73] *McLaughlin v R,* above n 71, at [32]; see also *Donnelly v R,* above n 72, at [48].

2 *Specificity issues: resolving complex profiles*

> Physical evidence cannot be wrong; it cannot perjure itself; it cannot be wholly absent. Only in its interpretation can there be error. Only human failure to find, study and understand it can diminish its value.[74]

As long as there continues to be human input in the analysis of DNA evidence, it will not be a wholly objective science. Deducing a profile match from the data relies largely on the reasoning abilities, judgement calls and inferences of the analyst, although they do not have an "unbounded discretion" in the inferences they make.[75] The reliance on subjective interpretation can be particularly problematic when the data indicates the presence of mixed or partial DNA profiles – where there are multiple contributors to the sample or where its quality is compromised due to the effects of degradation.[76] The analyst must try and resolve these profiles in accordance with accredited laboratory standards, ensuring that any determined matches are valid and not the result of stochastic effects.[77]

ESR experts in New Zealand now benefit from the use of STRmix™, a highly developed piece of forensic software which can resolve mixed DNA profiles and interpret results at a faster rate.[78] Stringent training regimes ensure analysts are competent in the use of the software, as they must still draw the final conclusion about what the evidence does or does not say. Validation and continual refinements to the STRmix™ software by ESR are further improving the reliability of DNA evidence, and thereby "enhanc[ing] the provision of valuable information to the New Zealand Police and wider criminal justice system."[79]

Issues of specificity and sensitivity around DNA evidence must be given due consideration in that the reliability standard is encapsulated in the admissibility criteria under the EA. The next chapter will examine how these admissibility rules around expert evidence function to

---

[74] Paul Kirk *Crime Investigation: Physical Evidence and the Police Laboratory* (2nd ed, John Wiley & Sons, New York, 1974) at 2.
[75] Murphy, above n 32, at 501.
[76] For example, in *R v Dougherty* [1996] 3 NZLR 257, the ESR scientist for the prosecution interpreted the DNA profile as containing an allele belonging to the defendant; therefore he was unable to be excluded as the offender. However, the three other scientists brought in on appeal concluded that no such allele was present. The first scientist's interpretation lacked any scientific objectivity, and had the new scientific evidence been available at trial, its cogency was such that it might have reasonably led the jury to return a different verdict (at 258).
[77] Below the "stochastic threshold," accepted to be between 100-200 picograms of DNA (roughly equivalent to a ten millionth of a grain of salt), the electropherogram may not be capable of producing a reliable DNA profile. An increase in random "stutter products" can be observed, and alleles can either (i) "drop out", where an allele is not detected where it should be, essentially giving a false negative for that allele; or (ii) "drop in", where an apparently spurious allele seen in electrophoresis gives a false positive for that allele: *R v Reed, Reed and Garmson*, above n 48, at [48].
[78] The Institute of Environmental Science and Research, above n 33. STRmix™ has been in routine use at ESR since August 2012.
[79] The Institute of Environmental Science and Research "Annual Report 2014" (2014) at 6.

"adjudicate the boundaries of science"[80] in the courtroom, so that DNA evidence (and forensic science generally) can be utilised within the confines of the law to support certainty and finality in criminal verdicts.

[80] Sallavaci, above n 7, at 32.

Chapter II
Getting Through the Gates: The Admissibility of DNA Evidence in the Courtroom

A Introduction

For a number of centuries courts have acknowledged the value of expert testimony in the fact-finding process. As stated by the King's Bench in *Buckley v Rice Thomas:*[81]

> If matters arise in our law which concern other sciences or faculties, we commonly apply for the aid of that science or faculty which it concerns. Which is an honourable and commendable thing in our law. For thereby it appears that we do not despise all other sciences but our own, but we approve of them and encourage them as things worthy of commendation.

The rationale behind the admission of expert opinion evidence is that those who possess special knowledge are often able to draw inferences and make conclusions which are not apparent to the fact-finder.[82] However, some oversight is necessary to reduce the risk of the jury unduly deferring to the expert's opinion. This chapter will examine how the relevant provisions in the EA operate to control the admissibility of DNA evidence in the New Zealand courtroom, drawing on aspects of the *Lundy* decision as an example. The New Zealand position will then be compared to the English admissibility test of expert evidence, which has recently undergone development.

B The Current Regime under the Evidence Act 2006

1 DNA as "expert opinion evidence"

DNA evidence will often be a mixture of fact and inference. Physical profiling results are subject only to the general exclusionary provisions in the EA in that as long as they are relevant and have more probative value than unfair prejudicial effect, they will be admissible in court.[83] However, it is the analyst's *interpretation* of the results which is more commonly sought to be introduced in evidence. Pre-trial admissibility hearings will often take place for novel or complex DNA evidence to reduce the length of the trial process.[84]

---

[81] *Buckley v Rice Thomas* (1554) 1 Plowden 118, 75 ER 182 (KB) at 124, 192.
[82] Elisabeth McDonald *Principles of Evidence in Criminal Cases* (Brookers Ltd, Wellington, 2012) at 275.
[83] Evidence Act 2006, ss 7 and 8(1)(a).
[84] An application for a pre-trial order relating to admissibility of the evidence must be made under s 101 of the Criminal Procedure Act 2011 (for jury trials).

When drafting the new Evidence Act, the Law Commission favoured the retention of the common law rule of exclusion around unreliable and superfluous evidence.[85] In addition, the Law Commission considered that more specific provisions were necessary in order to facilitate the admissibility of helpful and reliable expert opinion evidence.[86] An exception to the general exclusionary rule that a "statement of an opinion is not admissible in a proceeding"[87] was enacted for expert opinion evidence, which is now found in s 25 of the EA:

> **25 Admissibility of expert opinion evidence**
> (1) An opinion by an expert that is part of expert evidence offered in a proceeding is admissible if the fact-finder is likely to obtain substantial help from the opinion in understanding other evidence in the proceeding or in ascertaining any fact that is of consequence to the determination of the proceeding.
> (2) An opinion by an expert is not inadmissible simply because it is about –
> (a) an ultimate issue to be determined in a proceeding; or
> (b) a matter of common knowledge.
>
> (emphasis added).

Section 4(1) of the EA defines an "expert" as a "person who has specialised knowledge or skill based on training, study or experience," and "expert evidence" as including evidence given by the expert in the form of an opinion. This is a codification of the wide and flexible common law approach to the issue of expertise.[88] There is no explicit requirement for the expert to have "impressive scientific qualifications,"[89] but they must demonstrate to the court at the outset of their evidence that they possess the requisite expertise in the field in question (in the present context, DNA analysis).[90] It is then for the judge to determine whether the expert is properly qualified to testify.

2 The "substantial helpfulness" test and its application in Lundy

(a) Satisfying the substantial helpfulness requirement

After the expertise requirement has been satisfied, s 25(1) of the EA provides that expert opinion evidence will only be admissible "if the fact-finder is likely to obtain *substantial help* from the opinion." Section 25(2) abolishes former common law rules to the effect that DNA

[85] Law Commission *Evidence Law: Expert Evidence and Opinion Evidence* (NZLC, PP18, 1991) at [23]–[25].
[86] Ibid.
[87] Evidence Act 2006, s 23.
[88] McDonald, above n 82, at 284, referring to Law Commission *Evidence: Evidence Code and Commentary* (NZLC R55, Volume 2, 1999) at [C15].
[89] *R v Turner* [1975] QB 834 (CA) at 841.
[90] Richard Mahoney and others *The Evidence Act 2006: Act and Analysis* (3rd ed, Brookers Ltd, Wellington, 2014) at 106.

expert opinion evidence will not be inadmissible simply because it is about the ultimate issue to be determined in the proceeding, or is a matter of common knowledge. Section 25(2) of the EA will usually be of limited applicability to DNA evidence; the analyst's interpretation of the results will rarely be a matter of common knowledge, and the imposition of a standard presentation format by ESR serves to limit what the expert is permitted to comment on. If the expert's opinion does touch on the ultimate issue in a case, then any risks of the jury attaching inappropriate weight to the statement can (and should) be addressed by judicial directions.

The requirement of substantial helpfulness in s 25(1) of the EA is essentially a heightened relevance test, amalgamating the common law concepts of reliability and probative value into one comprehensive assessment of helpfulness.[91] It places the judge in a gatekeeper role, bestowing upon them the task of "determining whether the reasoning and methodology underlying the expert testimony is scientifically valid."[92] The non-exhaustive guidelines set out in the United States case of *Daubert v Merrell Dow Pharmaceuticals Inc* have been adopted in New Zealand as a useful template for judges in the examination of whether novel techniques are reliable and thus meet the substantial helpfulness test for admissibility.[93] These factors can be summarised as follows:[94]

- Whether the scientific theory or technique can be (and has been) subjected to empirical testing to see if it can be falsified;
- Whether the scientific theory or technique has been subjected to peer review and publication, increasing the likelihood that substantive flaws in methodology will be detected;
- The known or potential error rate of the technique; and
- Whether the scientific theory or technique has attracted widespread acceptance within a relevant scientific community (the *Frye* test).

Non-compliance with one factor alone will not shut the gates to admissibility, but failure to meet all four may provide a conclusive suggestion of inadmissibility.[95] Ultimately, the assessment of substantial helpfulness can go beyond *Daubert* and involve a more contextual approach to the evidence, including the basis of the particular evidence and the use to which it might be put in the case.[96]

---

[91] Mahoney and others, above n 90, at 107; see also McDonald, above n 82, at 288.
[92] Mahoney and others, above n 90, at 109.
[93] *Lundy v R* [2013] UKPC 28, [2014] 2 NZLR 273 at [139]; see also *R v Calder* HC Christchurch T154/94, 12 April 1995; and *Mahomed v R* [2010] NZCA 419 at [35].
[94] *Daubert v Merrell Dow Pharmaceuticals Inc.* 509 US 579 (1993). This approach is based on Rule 702 of the Federal Rules of Evidence (US).
[95] *R v Lundy* [2014] NZHC 2527 at [28]. The absence of publication and peer review in particular may "justify a closer and more sceptical examination of the methodology advanced to ensure it meets the s 25 threshold": at [118].
[96] Mahoney and others, above n 90, at 109.

Once the judge determines that the evidence surpasses the substantial helpfulness threshold and is therefore worthy of consideration by the fact-finder,[97] the ultimate decision as to the reliability of the expert opinion is left to the jury. The jury is then free to accept or reject the evidence as they see fit, subject to any directions given by the trial judge.[98] Though the inquiry into substantial helpfulness allows competing theories to be put to the jury, it carries the risk of the judge having to distinguish between respectable and "junk" science.[99] This was essentially the task of Kós J in the voir dire preceding the *Lundy* retrial, and the case itself has attracted great controversy for how the dispute about novel science played out in court instead of in the literature and at conferences prior to being used in casework.[100]

(b) The treatment of novel forensic science in *Lundy*

The Crown sought to introduce evidence establishing that the two stains on Mr Lundy's shirt contained human central nervous system (CNS) tissue, from which the jury could then infer to have originated from Mrs Lundy. Tissue samples were subjected to mRNA organ typing analysis[101] by two experts from the Netherlands Forensic Institute (NFI) (henceforth referred to as the "NFI brainplex"). The specimen extracted from the shirt sleeve subsequently tested positive for human CNS tissue. The NFI expert who conducted the analysis concluded that:[102]

> In my opinion, the RNA typing results are more probable if the slides from [specimen 3003/3] contained human brain tissue than if they contain brain tissue of the animal species examined. It is not possible to determine how much more probable these results are (ie to assign the exact weight of the evidence to the results).

In the High Court, Kós J found that, "albeit by a relatively narrow margin", the NFI brainplex evidence was sufficiently reliable to go to the jury.[103] Though *Lundy* was the first forensic application of the technique, His Honour correctly recognised that its novelty was a per se ground for caution rather than for refusing admission.[104] In terms of the *Daubert* factors, the brainplex had not been generally accepted by the scientific community, its error rate could not be stated with assurance, nor had it been the subject of peer review or publication. Had the brainplex methodology been tested and reviewed by another laboratory, it would have made Kós J's admissibility determination much more straightforward. Unfortunately, it had

[97] *R v Calder*, above n 93, at 6.
[98] Mahoney and others, above n 90, at 109.
[99] Ibid.
[100] Email correspondence with Dr Anna Sandiford, regarding expert opinion, DNA evidence and the CSI Effect (21 July 2015).
[101] To recall, RNA is a molecular material found in human and animal tissue cells which has a fundamental role in the creation of protein molecules, in effect directed by the DNA. Each cell type has a specific set of RNA molecules, and so the RNA analysis is able to detect the presence of brain tissue (amongst other cell types) in a trace: *R v Lundy*, above 95, at [99]-[100].
[102] At [105].
[103] *R v Lundy*, above n 95, at [117].
[104] At [118].

only been self-validated by the NFI. Only one of the two experts who analysed the *Lundy* specimens' testified at the hearing. In light of the controversy surrounding the evidence and the attack put forward by the defence, it would have been desirable for the Crown to call peer review evidence from an independent expert of high standing, even if it were just at a conceptual level.[105]

Nonetheless, Kós J placed great weight on the fact that the NFI brainplex was a "hard science" in the sense that it dealt with "theories capable of objective proof or disproof by experimentation" (satisfying the empirical testing *Daubert* requirement).[106] He accepted the Crown's argument that the technique was a logical and credible extension of existing methodology, which in itself had been subjected to peer review and publication. Refinements to genetic marker selection and temperature had been made to allow for specific detection of human CNS tissue. The fact of species specificity did not have to be proved beyond reasonable doubt given the other strands of circumstantial evidence against the defendant in the case.[107] Moreover, the Crown expert did not claim that her evidence satisfied that standard of proof; her conclusion was simply that human CNS was "more probable" than certain other animal species examined.[108] Kós J was convinced that the cautiousness of these conclusions could sensibly be put to the jury for consideration without any risk of unfair prejudice (although he did not explicitly mention the probative value/prejudicial effect assessment in his analysis). As such, the NFI brainplex evidence was ruled admissible.

On appeal, Harrison and French JJ concluded that the NFI brainplex evidence was highly relevant and substantially helpful, and that its probative value was not outweighed by a risk of unfair prejudice to the appellant.[109] The majority in the Court of Appeal agreed with Kós J's analysis and in fact found the arguments in favour of admission to be much more compelling. The methodology underlying the technique and selection of genetic markers rested on the "perfectly intelligible scientific reasoning"[110] of the NFI, a reputable organisation. Furthermore, the analysis was carried out in the presence of the defence expert and the results were expressed conservatively.[111] Allowing the evidence to go to the jury would leave them not to decide on the legitimacy of the science as such, but whether aspects

[105] *R v Lundy*, above n 95, at [98].
[106] At [119].
[107] Exceptional cases where a particular fact needs to be proved beyond reasonable doubt, identified by Turner J in *Thomas v R* [1972] NZLR 34 (CA) at 41, are where the fact or "collateral circumstance" is so essential to the Crown case that although it is not itself an essential element of the crime charged, without the Crown case must fail "for reasons special to the particular case." The other strands of circumstantial evidence, taken in combination but without that element, cannot stand the strain of meeting the Crown's burden of proof. The Court of Appeal in *Milner v R* [2014] NZCA 366 recently confirmed the continued existence of this exception (at [15]-[16]).
[108] *R v Lundy*, above n 95, at [123].
[109] *Lundy v R* [2014] NZCA 576 at [74].
[110] At [85], quoting the words of Tipping J in *R v Calder*, above n 93, at 9.
[111] At [80].

of the testing were sufficiently rigorous so as to justify placing weight on the results.[112] Any risks of unfair prejudice at trial could be sufficiently mitigated by the cautiousness of the evidence, as well as the opposing defence expert evidence and directions given by the trial judge.[113]

Ellen France P came down in favour of exclusion in her dissent, ruling that the probative value of the evidence was outweighed by the risk it would have an unfairly prejudicial effect on the appellant. Her Honour chose to bypass the substantial helpfulness test and conduct an assessment of the evidence solely in relation to its probative value. In reaching her verdict, Ellen France P expressed concerns about the lack of validation and international standards regarding the NFI brainplex technique before it could be used in a forensic setting.[114]

In view of both the pre-trial and appeal judgments, a ruling in favour of admissibility cannot be viewed as highly erroneous. Justice Kós, in particular, seemed to have an extremely good understanding of the NFI brainplex evidence.[115] Threshold reliability (the substantial helpfulness test) is an entirely different issue to ultimate reliability, that is whether and how the jury will use the evidence once it is let in.[116] Nevertheless, there are still concerns that "availability and perceived necessity"[117] may have motivated the admissibility decision. The NFI brainplex was the only scientific method which could show *human* specificity of CNS tissue, positive identification of which was "the Crown's most cogent piece of evidence" against Mr Lundy.[118] Inadmissibility of the brainplex evidence would not have been fatal to the Crown case, given the large amount of other scientific evidence it had available in support of its proposition. However, it would have been significantly compromised.

Considering the uncertainties attached to the technique, particularly the absence of peer review and error rate, it is not difficult to see how Ellen France P reached her dissenting view. With respect, the case for admission does not seem to be as "compelling" as the majority in the Court of Appeal suggested. Was an undue amount of deference placed on the NFI expert's (albeit conservative) opinion when she claimed the brainplex to be a "logical extension" of existing methodology? Though strong challenges were mounted by the defence expert, was the Court's true evaluation of these coloured by the fact that she had been present during the NFI expert's analysis? Questions and controversy continue to surround the *Lundy* case. As at the 28th April 2015, Mr Lundy's defence team plans to lodge an appeal against

[112] At [93].
[113] At [97].
[114] *Lundy v R* [2014] NZCA 576 at [68]-[69].
[115] Personal opinion of Dr Anna Sandiford, email correspondence 21 July 2015.
[116] *R v Lundy*, above n 95, at [116].
[117] Edmond and Roberts, above n 63, at 372.
[118] *R v Lundy*, above n 67, at [2].

conviction and sentence with the mRNA evidence to be raised as a ground for consideration.[119]

The jury-focused substantial helpfulness test of admissibility in New Zealand is somewhat different from the new approach to expert evidence introduced in England and Wales, which is described below.

C The English Practice Direction: A New Approach to the Admissibility of Expert Evidence

1 Overview

Unlike New Zealand, England and Wales has not codified the admissibility requirements for expert opinion evidence. Following an identification of risks posed to the criminal trial by unreliable forensic science,[120] in March 2011 the English Law Commission recommended a codification of the existing common law rules, incorporating an explicit reliability standard as a threshold issue for the admissibility of expert opinion evidence.[121] The proposed reforms were an attempt to reign in what the Law Commission perceived to be an "overly inclusive approach"[122] to expert evidence by the courts:[123]

> …a number of recent criminal cases suggest that expert opinion evidence of doubtful reliability is being proffered for admission, and placed before the jury, too readily. This follows from the current *laissez-faire* approach to admissibility. It has even been suggested that there may be a "culture of acceptance" on the part of some trial judges, particularly in relation to evidence of a scientific nature.

A draft Bill was enacted which, inter alia, incorporated the *Daubert* factors as guidelines to assist judges in the determination of admissibility of expert evidence. The Bill was however rejected by the Government in November 2013.[124] Rather than passing primary legislation, the Rule Committee adopted as many of the Law Commission's recommendations as it could through the Criminal Procedure Rules – in accompaniment to a Practice Direction issued by the Lord Chief Justice of England and Wales.

---

[119] New Zealand Media and Entertainment "Mark Lundy to appeal double-murder conviction" *The New Zealand Herald* (online ed, Auckland, 28 April 2015).
[120] *Forensic Science on Trial* (2005).
[121] Gary Edmond and others "Admissibility Compared: The Reception of Incriminating Expert Evidence (ie, Forensic Science) in Four Adversarial Jurisdictions" [2013] at 61; see also Gary Edmond "Advice for the courts? Sufficiently reliable assistance with forensic science and medicine (Part 2)" (2012) 16 The International Journal of Evidence & Proof 263 at 271.
[122] Gary Edmond "Is reliability sufficient? The Law Commission and expert evidence in international and interdisciplinary perspective (Part 1)" (2012) 16 The International Journal of Evidence & Proof 30 at 32.
[123] Law Commission of England and Wales *Expert Evidence in Criminal Proceedings in England and Wales* (Law Com No 325, 21 March 2011) at 1.17.
[124] "Expert Evidence: The Future of Forensic Science in Criminal Trials", above n 1, at 5.

In England and Wales, Part 33 of the Criminal Procedure Rules lists the matters which an expert's report must cover before the court can conduct an admissibility assessment of the opinion evidence. The requirement of "expertise" described in the Criminal Procedure Rules serves as a precondition to the reliability inquiry, and in this respect is equivalent to the New Zealand position.

Effective from October 2014, the Practice Direction advises judges that, as a matter of common law, expert evidence must have a "sufficiently reliable scientific basis…to be admitted."[125] It also preserves and extends the *Daubert* approach by listing the factors the court may take into account in determining the reliability of the evidence, as well as those which may detract from reliability. These factors focus largely on the methodologies, inferences and quality of the data relied upon to reach the expert opinion (Appendix A). Overall, the aim of the Practice Direction is to introduce a "new and more rigorous approach on the part of advocates and the courts to the handling of expert evidence."[126]

2 Reducing the risks of passive deference

Recent English commentary on expert evidence has suggested that for an admissibility test to be effective in the adversarial system, it should have a twofold objective:[127]

> It should reduce the risk of passive deference to unreliable expert evidence, but it should also assist juries in arriving at an appropriate level of deference to moderately reliable evidence and a reasoned assessment of its weight.

There will be an understandable reliance by the fact-finder on the expert's findings, given that they do not possess such specialist knowledge. The problem that both *Daubert* and the Practice Direction attempt to resolve is the risk of *undue* deference, the "danger that juries will abdicate their duty to ascertain and weigh the facts and simply accept the experts' own opinion as evidence."[128] Yet the Practice Direction may be better equipped to do so, as its focus lies more on the permissible strength of the particular inference to be drawn from the body of expertise, rather than whether the opinion qualifies as expertise at all.[129] Rather than issues about conflicting expert opinion emerging in cross-examination, the jury is exposed to the controversial evidence from the outset (provided it meets the admission criteria laid down by the Practice Direction).[130] By arming the jury with the relevant aspects of the scientific evidence before they commence their decision-making, conclusions about the strength of the

[125] Criminal Practice Directions Amendment No.2 [2014] EWCA Crim 1569 2014 (England & Wales).
[126] *R v H* [2014] EWCA Crim 2 at [44].
[127] Tony Ward "An English Daubert? Law, Forensic Science and Epistemic Deference" (2015) 15 The Journal of Philosophy, Science & Law: Daubert Special Issue 26 at 29.
[128] Law Commission, above n 97, at 1.9.
[129] Ward, above n 127, at 34.
[130] At 31-32.

evidence should be less prone to being made uncritically. The Practice Direction is thus intended to combine the admissibility criteria for expert evidence with a measure of acceptable deference and juror education.

3 Criticisms and evaluation of the English approach

Whilst envisioned as a procedurally robust method of assessing expert evidence, the Practice Direction has attracted its share of criticism. Many commentators argue that the regime places a higher demand on judges, advocates and expert witnesses alike.[131] In order to filter out "sufficiently reliable" evidence, judges are required to closely scrutinise the expert's reasoning and examine what is often extremely technical science. Lawyers must also have a heightened understanding of what is being presented by the expert. The Practice Direction places more of a burden on the trial judge in making a determination about reliability than New Zealand's jury-focused, substantial helpfulness test. Whereas the New Zealand approach is concerned with expert evidence being admitted too readily, the English approach risks judges going too far in the other direction and "deny[ing] the jury the opportunity of critically assessing the weight of expert testimony." However, the admissibility of DNA evidence under the Practice Direction has not been considered in case law to date, and thus its true effect remains to be seen.

D Conclusions

In its 2013 review of the EA, the New Zealand Law Commission considered whether the process for giving expert evidence in New Zealand should be changed following concerns about the CSI Effect and the effectiveness of presenting expert evidence in court.[132] Yet the Law Commission declined to make any recommendations. It acknowledged that interesting questions were raised, but felt they involved "substantive policy issues about the approach to presenting expert evidence in court, rather than an assessment of whether the current expert opinion provisions are working as intended."[133]

Although the New Zealand review came before the introduction of the English Practice Direction, it is unlikely to have any great effect on our expert evidence admissibility provisions. Despite differences, the English and New Zealand frameworks are largely similar – both include the *Daubert* factors as useful but non-exhaustive guidance for judges considering the admissibility of novel scientific evidence. The Practice Direction goes further in its attempts to reduce the degree of deference on the expert, but may place even more of a burden on judges making admissibility determinations.

---

[131] Ward, above n 127, at 34; see also Sallavaci, above n 7, at 96.
[132] Nikki Macdonald "How effective are expert witnesses?" *The Dominion Post* (online ed, Wellington, 18 December 2012).
[133] Law Commission *The 2013 Review of the Evidence Act 2006* (NZLC R127, 2013) at 12.

In many cases the admissibility inquiry will not be clear cut. What is clear, however, is that the courtroom is not the place to test new science,[134] and judges must place this at the forefront of their minds when performing their gatekeeping duties. The evidence in *Lundy* came dangerously close to traversing this boundary.

Attempts to reform the way in which DNA evidence is received in the courtroom cannot be achieved simply through formal admissibility standards and in fact "it is unrealistic to believe that there is a perfect legal formula that will allow only reliable expert evidence to be admitted."[135] Judicial responsibilities with DNA evidence extend beyond the admissibility stage to the rest of its duration in the courtroom. If the judge chooses to admit the evidence, close oversight at the presentation stage is essential to ensure conclusions on the DNA are not overstated to the jury.

[134] Email correspondence with Dr Anna Sandiford, above n 100. So as not to intrude on an individual's right to a fair trial and risk a miscarriage of justice, truly novel forensic science techniques can only be evaluated through empirical study separate from legal investigations: Edmond and others, above n 121, at 92.
[135] Sallavaci, above n 7, at 97.

Chapter III
Presentation, Interpretation and Evaluation of DNA Evidence at Trial

A Introduction

As a result of analysts' interpretations, many types of forensic evidence are presented in court as a series of evaluative judgements with a conclusive finding as to source attribution.[136] DNA evidence is unique in that it is expressed as a numerical statement, formulated using probabilistic reasoning based on a sound body of data contained in the national DNA database.[137] The power of DNA over other types of evidence therefore lies in the fact that the certainty of a "match" is quantified.[138] This chapter will examine in further detail how DNA evidence, once ruled admissible, is offered in the courtroom, and why the statistical basis of its expression may not fit naturally with the fact-finding process.

B Conduct of Expert Witnesses in Criminal Proceedings

Pursuant to s 26(1) of the EA, when preparing and giving expert evidence in civil proceedings experts must "conduct themselves… in accordance with the applicable rules of court relating to the conduct of experts." It is now generally recognised that similar principles also apply in criminal proceedings; counsel should refer the witness to these principles as part of trial preparation, and the witness should state at the outset of giving their evidence that they understand and accept them.[139] As such, experts presenting DNA evidence in criminal cases must comply with the applicable code of conduct or an equivalent provided by their institution.

The "Code of Conduct for expert witnesses" is contained in r 9.43 of the High Court Rules, found in Schedule 4 of the Judicature Act 1908 (Appendix B). Most importantly in proceedings, the witness has an overriding duty to assist the court impartially on relevant matters within their expertise,[140] and must not act as an advocate for the party that engages

[136] As in the case of fingerprints or ballistic evidence, where the analyst will draw a conclusion about whether the sample (e.g. print or bullet) originated from the source in question (e.g. the suspect or the firearm associated with the suspect).
[137] Ian Evett "DNA Profiling: A discussion of issues relating to the reporting of very small match probabilities" [2000] Crim LR 341 at 341. Note, however that the introduction of glass refractive index databases have also led to this type of evidence being presented in statistical form – although its use is much rarer than DNA.
[138] Sallavaci, above n 7, at 166.
[139] *Lisiate v R* [2013] NZCA 129, (2013) 26 CRNZ 292 at [53]; see also *Balfour v R* [2013] NZCA 429 at [50], where the Court emphasised the importance of compliance with the Code of Conduct in criminal cases, particularly in relation to impartiality.
[140] Expert Witness Code of Conduct, cl 1.

them.[141] Additional requirements that the expert must adhere to when giving evidence include stating their qualifications, the facts and assumptions on which their opinion is based, the reasons for their opinion, and a description of any tests or examinations conducted to reach the opinion.[142] If the expert believes that their evidence may be incomplete, inaccurate or inconclusive, this also must be qualified in their opinion so as not to overstate the strength of the evidence.[143]

C DNA Evidence in Numbers

1 Likelihood ratios and fallacious interpretations

In New Zealand, DNA evidence is presented by the expert in court in the form of a likelihood ratio (LR). The LR is a relative assessment of two hypotheses for the same assertion given different conditions – that the defendant is the source of the DNA, depending on whether they are guilty or innocent. It is generated using data from the New Zealand DNA Profile Databank, which contains DNA profiles previously obtained from individuals representative of the population. In calculating the LR, the analyst assesses the likelihood of the DNA results if the DNA originated from the individual in question rather than if it had originated from another unrelated individual selected at random from the general New Zealand population. The LR is favoured over the "exclusion percentage", a result which suggests, for example, that 99.9% of people would not be expected to share the same DNA profile as the defendant and crime scene sample. The exclusion percentage is dangerous in that it invites a "subconscious rounding up to 100, and the Crown should not have the advantage of the 'subliminal impact' of statistics to enhance the probative value of the evidence."[144]

The statement made in court will contain a description of the statistical evaluation of the DNA evidence, followed by a final opinion regarding its strength. A standard presentation format for DNA evidence in New Zealand is set out below, but may vary depending on the circumstances of the case (for example, where there are mixed or partial profiles):[145]

> The DNA profiling results obtained from the sample indicated that the DNA could have originated from Mr X or from another male with the same DNA profile as Mr X at the ten DNA sites tested.

[141] cl 2.
[142] cl 3.
[143] cl 4 and.5. Conclusiveness is particularly relevant to DNA evidence, when it comes to expressing an opinion about a profile match.
[144] *Aytugrul v R* [2010] NSWCCA 272, [2010] 205 A Crim 157 at 159 per McClellan CJ.
[145] Victoria Grace and others *Forensic DNA Evidence on Trial: Science and Uncertainty in the Courtroom* (Emergent Publications, Arizona, 2011) at 34.

> A statistical evaluation of the scientific weight of these DNA profiling results has been undertaken. I have compared the likelihood of two possible alternatives:
> **Either:** The DNA present in this sample originated from Mr X,
>
> **Or:** This DNA originated from another male, unrelated to Mr X, selected at random from the general New Zealand population.
>
> Following statistical analysis it has been determined that the likelihood of obtaining these DNA profiling results is at least one million million ($1x10^{12}$) times greater if the DNA in this sample originated from Mr X rather than from another male, unrelated to Mr X selected at random from the general New Zealand population.
>
> In my opinion the DNA evidence provides extremely strong scientific support for the proposition that the DNA detected in the sample originated from Mr X.

It must be acknowledged that while this evidence gives the likelihood of obtaining the profiling result, it does not say that Mr X. is one million million times more likely to have *committed the crime* than anyone else unrelated to him selected at random from the New Zealand population. To draw such an inference is to commit a logical error known as the "Prosecutor's Fallacy."[146] This type of reasoning is problematic as it overstates the prosecution's position by failing to consider all the other evidence in the case.[147] Fallacious interpretation of DNA evidence by all parties should be avoided as it can render a defendant's conviction unsafe and constitute grounds for a retrial.[148]

2 The Bayesian approach to evidence interpretation

Because the prosecution and defence propositions are considered simultaneously, the LR is regarded as the "most appropriate foundation for assisting the court in the weight that should be assigned to the evidence."[149] It forms part of what is termed the "Bayesian" approach to evidence interpretation. Bayes' Theorem provides a methodology in which propositions based on the evidence are liable to change based on the introduction of new evidence in the case:[150]

Bayes' Theorem: Posterior odds = likelihood ratio x prior odds

---

[146] Peter Donnelly and David Balding "The prosecutor's fallacy and DNA evidence" Crim LR 1994, Oct, 711-721 at 716. To give a more general example, the probability that an animal with four legs is a cow is not the probability that a cow has four legs – this is a transposition of the conditional: Bernard Robertson, GA Vignaux and Charles EH Berger "Extending the Confusion About Bayes" (2011) 74 MLR 444 at 444.
[147] Similarly, the "Defendant's Fallacy" consists of ignoring identification evidence involving a trait on the grounds that a number of individuals share the trait: Donnelly and Balding, above n 97, at 719.
[148] *Pringle v R* [2003] UKPC 9 at [17]–[24].
[149] Colin Aitken and others "Expressing evaluative opinions: a position statement" (2011) 51 Sci. Justice 1-2.
[150] Adam Wilson "Away from the Numbers: Opinion in the Court of Appeal" (2011) 75 The Journal of Criminal Law 503 at 505.

As the DNA analyst is only concerned with the LR when presenting their evidence, an opinion will be expressed about the strength of the evidence but not about the likelihood of guilt. It is for the fact-finder to make this evaluation after their assessment of the prior and posterior odds in the case (ie the prosecution proposition before and after the DNA evidence is introduced).

3 Conflicts between the Bayesian approach and juror decision-making

The Bayesian approach has attracted strong criticism for its assumption that the fact-finder is able to "assign prior probabilities to hypotheses and accomplish incredibly complex calculations."[151] There is a sufficient body of research which indicates that laypeople struggle with probabilistic reasoning. In reality, most jurors will reach a general conclusion about what the DNA evidence means and incorporate it into their overall trial narrative.[152] If they find it difficult to imagine other possibilities for a match occurring when assessing the strength of the evidence, then it is likely to be given a high probative value.[153] A DNA profile that is "approximately one hundred and fifty quadrillion times more likely to have originated from [the defendant] than…from another person chosen at random"[154] is likely to be treated as overwhelmingly persuasive in the eyes of a juror. There becomes a risk of DNA evidence causing "ceiling effects" in which the fact-finder becomes firmly convinced of the defendant's guilt based on the information conveyed by the numbers alone.[155] Alternatively, jurors can be inclined to disregard an incomprehensibly large LR altogether if they feel the expert is "exaggerating [their] statistics" or "blow[ing the data] out of proportion."[156]

D Verbal Equivalents and Alternative Approaches

Due to the perceived difficulties encountered by the trier of fact in their assessment of numbers, LRs are now routinely expressed in accordance with a graduated verbal scale. DNA evidence is still presented in court as a LR, but the analyst will also use a verbal equivalent to describe the strength of the evidence in support of the prosecution's proposition.[157]

---

[151] Mike Redmayne "Bayesianism and Proof" in Michael Freeman and Helen Reece (eds) *Science in Court* (Aldershot, Ashgate, 1998) at 71.
[152] The "story model" of juror decision-making: Lisa Smith and others "Understanding Juror Perceptions of Forensic Evidence: Investigating the Impact of Case Context on Perceptions of Forensic Evidence Strength" (2011) 56 Journal of Forensic Sciences 409 at 409.
[153] Also known as "exemplar-cuing theory": Jonathan J Koehler and Laura Macchi "Thinking about Low-Probability Events: An Exemplar-Cuing Theory" (2004) 15 Psychological Science 540.
[154] *Donnelly v R*, above n 72, at [16].
[155] Jonathan J Koehler "The psychology of numbers in the courtroom: How to make DNA match statistics seem impressive or insufficient" (2001) 74 South California Law Review 1275 at 1295.
[156] Grace and others, above n 145, at 68.
[157] William C Thompson and Eryn J Newman "Lay understanding of forensic statistics: Evaluation of random match probabilities, likelihood ratios, and verbal equivalents" (2015) 39 Law and Human Behaviour 332 at 333.

The scale adopted in New Zealand by ESR is as follows:[158]

Likelihood ratio	Verbal equivalent
1	Inconclusive
1 to 10	Slightly supports (the prosecution proposition)
10 to 100	(Moderately)[159] supports
100 to 1,000	Strongly supports
1,000 to 1,000,000	Very strongly supports
Greater than 1,000,000	Extremely strongly supports

This scale has been recommended for use by forensic practitioners worldwide.[160] What is concerning, however, is the extent to which the scale favours the prosecution case in instances where the LR provides less than extremely strong support for the prosecution's proposition. For example, in *Manoharan* the results from LCN DNA testing gave a LR of 20. Though this was saying essentially the same thing as it being likely that 200,000 other New Zealanders would share the profile found (when considered independently of other evidence),[161] it still indicated "moderate scientific support" for the proposition that the DNA originated from the defendant – potentially overstating the position. There is perhaps a slight disparity between the increase in order of magnitude of the LR and the semantics of the verbal scale. A LR of 1 may suggest a *highly* inconclusive result, 1-10 somewhat inconclusive, 10-100 in slight support of the prosecution proposition, and so on.

Given the current scale's universal acceptance within the forensic community, adjustment to a more conservative approach is unlikely. Yet it may be unnecessary where judges and lawyers can mitigate the effects of the scale through adequate directions and cross-examination; successful reception of DNA evidence presupposes effective communication between all trial actors in the courtroom.[162] This was displayed in *Manoharan*. Although the expert did not comply with defence requests to express the evidence in an alternative way (a proposition which she should have "unreservedly assented to" in her role as an expert witness), any risk of a miscarriage of justice resulting from the presentation of the DNA evidence was sufficiently reduced through concessions elicited in cross-examination, Crown and defence closing, and the trial judge's directions.[163]

[158] Sally Coulson "The New Zealand Perspective: Evidence Reporting using Bayesian Statistics" (Institute of Environmental Science and Research, 2009).
[159] The analyst will often add this extra adjective in to describe the strength of the evidence, as was the case in *Manoharan v R*, above n 55, at [39].

[160] Association of Forensic Science Providers Forensic Science "Standards for the formulation of evaluative forensic science expert opinion" (2009) 49 Science & Justice 161 at 163.
[161] *Manoharan v R*, above n 55, at [53].
[162] Roberts, above n 9, at 49.
[163] At [55]. These safeguards are further elaborated upon in Chapter IV.

It is clearly incorrect to assume that a verbal scale "will automatically and reliably result in a specific desired interpretation" of DNA evidence.[164] How the fact-finder assesses the credibility of the DNA will be influenced largely by other non-DNA evidence as well as the individual knowledge and presumptions they bring to the case.[165] Sensitivity to DNA evidence may therefore occur irrespective of whether LR or verbal descriptions are used. Moreover, it is unclear whether the mode of presentation of DNA evidence even contributes to the final verdict one way or another.[166]

The English Court of Appeal has recognised that DNA findings may be admissible even in the absence of LR and verbal equivalents. In *R v Dlugosz*, the Court ruled that "where there [is] some other sufficiently reliable scientific basis for it to be given," statements of evaluative opinion are an acceptable presentation format so long as the opinion is qualified and explained to the fact-finder.[167] This has not been tested in New Zealand to date, and one can imagine that rigorously trained ESR experts would be reluctant to diverge from the standard format when giving evidence in the courtroom setting.

E Improving Jury Understanding of DNA Evidence

1 Simplification of DNA evidence

Findings from a recent New Zealand study suggest that there is a greater potential for DNA evidence to be understood by the layperson if it is considerably simplified and reduced.[168] While there is merit in a minimalist approach to presenting DNA evidence in court, there is also a subsequent risk of oversimplification. Referring back to the discussion in Chapter II, experts are permitted to proffer their opinions because the subject matter is intended to assist the jury in fact-finding. If DNA evidence was stripped back to the extent that it represented "truth" rather than opinion, any grounds for uncertainty would be eliminated.[169] Consequently, jurors could fail to engage in a deeper understanding of the evidence and simply rely upon the expert. Neither party serves this function in the courtroom. Some deference is expected but it is for the jury to make their own evaluation of the evidence once it is given. Furthermore, it would compromise the defendant's position for an expert to take a front end approach and make an essentially confirmatory statement of guilt with no statistical basis (when this is what underlies DNA interpretation).

[164] KA Martire and others "On the interpretation of likelihood ratios in forensic science evidence: Presentation formats and the weak evidence effect" (2014) 240 Forensic Science International 61 at 62.
[165] Haack, above n 10, at 60. This theory is referred to in psychological terms as "explanatory integration."
[166] Wheate, above n 4, at 142.
[167] [2013] EWCA Crim 2.
[168] Grace and others, above n 145, at 72.
[169] Ibid.

Simplifying DNA evidence beyond the standard format above will not increase jury understanding in the desired manner. The simplicity and clarity of the evidence should be addressed by counsel in pre-trial preparation, and examined or cross-examined accordingly where they feel certain details have not been communicated adequately in the courtroom.[170]

2 A "full-throated" Bayesian analysis

At the other end of the spectrum are those strongly in favour of adopting a "full-throated Bayesian analysis" of DNA evidence.[171] As well as presenting a LR to the fact-finder, experts should report the prior odds of a suspect match in statistical form, because giving only one part of the equation is "akin to telling someone how many eggs to include in a cake recipe without telling them how much flour to use or the serving size."[172] A stronger Bayesian approach is plausible in theory but likely to be inappropriate in practice. To supply what is often a probabilistically challenged jury with even more statistics may exacerbate their confusion and deflect them from their proper task.[173] As Balding and Donnelly advise, "the assessment of the other evidence is a matter for the jury, not the expert witness."[174] Jury decision-making driven by an intuitive approach to the evidence should determine the allocation of probative value, rather than unduly complex and statistical theories expounded by the expert. If there are dangers of misinterpretation, then this can be addressed by the judge in their closing directions or in an explicit warning given to the jury.

3 Visual and written aids

Juries cannot be expected to evaluate the validity of DNA evidence without some additional assistance. In its report *Juries in Criminal Trials*, the New Zealand Law Commission identified a number of reforms to improve juror understanding of evidence, including the use of notebooks, charts, glossaries and a summarised list of issues presented by DNA evidence in the case.[175] Subsequent experimental research has confirmed that jurors do find such innovations helpful, particularly where the case is long and complex.[176] Judges are permitted to give written material to the jury, including logically arranged "question trails" relating to the specific facts of the case.[177] To increase the likelihood of information retention, jurors are

[170] But note, as discussed in Chapter IV, cross-examination may be of limited effectiveness in some cases.
[171] Barry Nalebuff and Ian Ayres "The Rule of Probabilities: A Practical Approach for Applying Bayes' Rule to the Analysis of DNA Evidence" (2015) 67 Stanford Law Review 1447 at 1500.
[172] Ibid.
[173] *R v Doheny and Adams* [1997] 1 Cr. App. R. 369 at 369.
[174] David J Balding and Peter Donnelly "How Convincing is DNA Evidence?" (1994) 368 Nature 285 at 286.
[175] Law Commission *Juries in Criminal Trials* (NZLC R69, 2001) at 134-136.
[176] See generally Michael Dann, Valerie P Hans and David H Kaye "Can jury trial innovations improve juror understanding of DNA evidence?" (2006) 90 Judicature 152; and J Holmgren "DNA Evidence and Jury Comprehension" (2005) 38 Canadian Society of Forensic Science Journal 123.
[177] Justice Susan Glazebrook "Streamlining NZs Criminal Justice System" (Criminal Law Conference 2012: Reforming the Criminal Justice System of Hong Kong, 17 December 2012) at 2. In a study conducted in 2006, 40.8% of judges surveyed provided the jury with flow charts or lists of questions to assist them in reaching their

also actively encouraged to take their own notes throughout the duration of the trial.[178] What is of utmost importance is that jurors freely participate in the courtroom by asking questions where they are unclear about aspects of the DNA evidence. Collaborative interactions and an active learning environment are necessary for enhanced juror understanding of complex scientific evidence. Having a well-informed jury far exceeds any possible increases in length to the trial process that may result from authorising such innovations.[179]

4 Empirical jury studies

There is little research documenting the experiences of the New Zealand jury with DNA evidence. The last significant research conducted on jury trials in New Zealand was in 1999, where the findings of the New Zealand Law Commission indicated that only a minority of jurors had difficulty understanding expert evidence – most were able to weigh and reject it where necessary.[180] Nevertheless, these conclusions may be somewhat outdated in that science has progressed demonstrably in 16 years. The findings also only related to expert evidence generally and did not concentrate on DNA.

Unfortunately, due to actual jury research being problematic in terms of time, cost and empirical validity (since the composition of each jury is unique),[181] the New Zealand Law Commission is unlikely to fund a study on jury reception of DNA evidence in the near future. An Australian-based study which has comprehensively examined juries across Commonwealth jurisdictions is expected to be released in early 2016, and hence the New Zealand legal sector should await these findings with great anticipation.[182]

F Conclusions

The format in which DNA evidence is presented to the fact-finder will undoubtedly have an effect on how it is received. In New Zealand and other jurisdictions, the expert commonly presents their opinion on the DNA evidence in the form of a LR, accompanied by a verbal equivalent stating to what degree the evidence supports the prosecution's proposition. This standardised presentation format aims to achieve procedural consistency between cases,[183]

verdicts: James Ogloff and others *The Jury Project: Stage 1 – A Survey of Australian and New Zealand Judges* (Australian Institute of Judicial Administration Incorporated, Melbourne, 2006) at 30. This is becoming increasingly common, especially in long and complex cases.

[178] James Ogloff and others, above n 177, at 12. In this study, 84% of New Zealand judges surveyed covered the issue of note-taking during the trial, and 41% provided the jury with additional instructions.

[179] Holmgren, above n 176, at 133.

[180] Law Commission *Juries in Criminal Trials: Part II* (NZLC PP37, 1999) at 26.

[181] Mark Findlay "Juror comprehension and the hard case - making forensic evidence simpler" 36 (2008) IJLCJ 15–53 at 18.

[182] Ian Freckelton and others *Expert Evidence and Criminal Jury Trials* (Oxford University Press, in press, 2015) (Also available as: eBook, 2016).

[183] Jessica Ritchie "Probabilistic DNA evidence: the layperson's interpretation" [2015] Australian Journal of Forensic Sciences 1 at 9.

upholding the defendant's right to receive a fair trial.[184] Though there are risks that the LR and verbal equivalent scale may unfairly favour the prosecution's case, they can usually be dealt with in cross-examination and summing up – safeguards which will be elaborated upon in the next chapter.

How jurors use the information provided by the LR will differ according to their own perceptions and expectations of the evidence, and so there is no "best" way of gaining one consistent interpretation of the results.[185] Nonetheless, the criminal trial process accounts for the consequences of subjective human interpretation. Jurors only need to agree broadly and not precisely about the strength of the evidence; unanimity is required solely in regards to the issue of whether the prosecution has proved its case beyond reasonable doubt.[186]

[184] In accordance with s 25 of the New Zealand Bill of Rights Act 1990.
[185] Thompson and Newman, above n 157, at 347.
[186] Sallavaci, above n 7, at 156, citing Robertson and Vignaux "Bayes Theorem in the Court of Appeal" (1997) 70 The Criminal Lawyer 4-5.

Chapter IV
Critiquing the Face of the Criminal Trial: Traditional Adversarial Safeguards against Misuse of DNA Evidence and Options for Reform

A Introduction

To compensate for the fact that juries are usually not well-placed to evaluate complex or conflicting DNA evidence, a number of strategies are employed throughout the criminal trial process to "safeguard" against its misuse. Nevertheless, claims exist that they tend to be "weak and inconsistent in their operation," and that therefore an invested confidence by the legal profession in the capacity of these precautionary measures is not warranted.[187] This chapter will evaluate the efficacy of existing safeguards in the adversarial system, such as cross-examination, judicial directions and the use of independent experts. Drawing on prior research, it will also consider how other measures, if implemented, could improve the way in which DNA evidence is received in the courtroom.

B Cross-examination

A keystone feature of the adversarial system is "its ability, through properly resourced and informed cross-examination…to best reveal and illuminate areas of scientific controversy."[188] Moreover, the opportunity to cross-examine is a fundamental right of anyone charged with an offence in New Zealand law.[189] Cross-examination is thus conventionally relied upon to expose inconsistencies and improprieties in expert opinion DNA evidence, and has been alluded to in previous chapters. Effective deconstruction of the evidence requires the advocate to have a reasonable scientific knowledge of the concepts and methodologies underpinning DNA, so that enquiries can be made into the following areas:[190]

- How the expert opinion was formed (eg the likelihood ratio);
- What assumptions were made in forming it;
- What the expert decided not to rely on and why (eg the exclusion of individuals from the calculation based on ethnicity, gender or geographic location);
- Whether there is disagreement in the field; and
- Any ethical constraints and who decided which materials to review and rely upon.

[187] Gary Edmond and others, above n 121, at 99.
[188] Nayha Acharya "Law's Treatment of Science: From Idealization to Understanding" (2013) 36 Dalhousie LJ 1 at 35, citing Ontario, *Report of the Inquiry into Pediatric Forensic Pathology in Ontario,* vol 3 (Toronto: Queen's Printer, 2008) (Chair: Stephen T Goudge) ch 18 [Goudge Inquiry] at 506.
[189] New Zealand Bill of Rights Act 1990, s 25.
[190] Yvette Tinsley "Science in the Criminal Courts: Tool in Service, Challenge to Legal Authority or Indispensable Ally?" (2013) 25(4) NZULR 844 at 859. More specific challenges to DNA evidence can be found in the suggested list of questions in Appendix C.

However, the effectiveness of cross-examination in exposing unreliable aspects of DNA evidence may be limited in some cases. Where the science is especially technical, cross-examination is "likely to be limited to credibility and the chain of custody rather than more fundamental methodological and statistical issues."[191] A lack of understanding by the fact-finder may also limit their ability to fully appreciate contestable aspects of the evidence or appreciate the significance of any concessions by the expert.[192]

From the expert's standpoint, the question and answer format of cross-examination is not necessarily well-suited to presenting narrative accounts of scientific findings.[193] This goes back to the differing objectives of science and law discussed in Chapter I. While cross-examination aims to reveal truths, it is not the overarching objective as in science. Because of the law's concern for promptness and finality, experts may feel adversarial trials do not allow them to give a balanced or comprehensive account of their evidence.[194] Worse still, the interrogative nature of cross-examination may serve to distort their evidence and take it out of a context not expected by the expert. Yet it would be hugely detrimental to the legal system if experts declined to testify in court. Just as the legal profession should be educated in the science of DNA, it is imperative that experts receive background training on adversarial procedure to allow them to anticipate the sorts of questions addressed in cross-examination.

Though the aforementioned concerns are valid, cross-examination will usually be successful in communicating issues about DNA evidence to the fact-finder in simple and non-technical language.[195] In *Manoharan v R*, the Court of Appeal was satisfied that cross-examination of the LCN DNA expert sufficiently mitigated any risk of a miscarriage of justice resulting from the presentation of DNA evidence:[196]

> [47] In cross-examination Ms Simon made appropriate concessions about some of the limitations of LCN testing including its sensitivity, the fact it was not universally accepted by all DNA experts, the fact it was not known when where or how the DNA in this case was deposited, and whether it was from a male or female. She accepted the possibility of transference, the possibility that the DNA was unconnected to the crime and the possibility that it was a mixed sample. She also acknowledged that the likelihood ratio reflected the amount of DNA profiling information obtained and that the sorts of numbers juries normally hear about can be in the tens or hundreds of millions, not 20 as in this case.

[191] Edmond, above n 122, at 51.
[192] Gary Edmond and Mehera San Roque "The Cool Crucible: Forensic Science and the Frailty of the Criminal Trial" (2012) 24 Current Issues Crim Just 51 at 56.
[193] Roberts, above n 9, at 56.
[194] Ibid.
[195] *R v Hetherington* [2015] NZCA 248 at [65]-[66].
[196] *Manoharan v R*, above n 49.

Failure to cross-examine witnesses on pivotal aspects of DNA evidence has not yet formed grounds for a successful appeal in the New Zealand courts, and should continue to be the case provided the legal profession continues to receive specialised training in criminal procedure and DNA evidence.[197]

C Judicial Guidance and Directions

1 Judicial guidance and the operation of bench books

(a) The purpose and function of bench books

Since judges cannot be expected to retain knowledge on all areas of the law, they are usually supplied with bench books which guide them in the crafting of their directions at trial. Bench books are a useful but non-binding starting point of reference for judges, and reliance on them will vary with judicial experience.[198] The remainder of this section will look at how bench books address DNA evidence, and how their accessibility varies across jurisdictions.

(b) The United Kingdom

Published by the Judicial Studies Board[199] in March 2010, the objective of the UK Crown Court Bench Book is to "move away from the perceived rigidity of specimen directions towards a fresh emphasis on the responsibility of the individual judge, in an individual case, to craft directions appropriate to that case."[200] The online document is freely accessible to the public, and is undoubtedly the most extensive judicial guide on DNA evidence in the Commonwealth. The section on DNA (as a means of identification evidence) begins with a glossary of commonly used terms in the field. It then describes the process of obtaining, interpreting and presenting DNA profiles, similar to the content in the preceding chapters of this dissertation. Finally, the Bench Book addresses procedural requirements and directions relating to DNA, and specifies that, in light of modern science, trial judges should be aware that "controversy is more likely to arise in expert assessment of the significance of mixed and incomplete profiles."[201] Each provision contains the relevant precedent in the area, so judges

---

[197] At tertiary level, the University of Otago is the only law school in New Zealand to offer a paper in forensic science. The New Zealand Law Society does not yet offer a specialised training course on DNA evidence, but offers an online course on expert witnesses generally: <www.lawyerseducation.co.nz>. The Institute of Judicial Studies also offers workshops on evidence and procedure which take place biannually: <www.ijs.govt.nz>. For specialised education on the types of issues presented by DNA, scientists will usually give seminars to judges, lawyers and other members of the legal profession.

[198] A study which included a survey of New Zealand judges' use of bench books found that 4.1% cut and paste the relevant aspects of the bench book; 36.7% tailor directions to the individual case; 30.6% do both and 14.3% do neither: James Ogloff and others, above n 177, at 87.

[199] The Judicial Studies Board changed its name to the Judicial College in 2011.

[200] Judicial Studies Board "Crown Court Bench Book: Directing the Jury" (March 2010) – Foreword.

[201] UK Crown Court Bench Book at 142.

have the benefit of a single reference source of case law when forming their directions about DNA evidence.[202] At the conclusion of the chapter, the Bench Book illustrates an example of placing inconclusive DNA evidence into the context of a circumstantial case.[203] This model direction is useful for judges to see how important concepts about DNA may be combined to allow the jury to understand its limitations in a case. However for more experienced judges, and especially in cases where an admissibility hearing has already taken place, the Bench Book may simply serve as a reminder of the principles of DNA and be of limited use.

(c) Other jurisdictions

Some Australian states have allowed their bench books to be widely accessible as in the UK. However these versions do not contain the same level of detail on DNA evidence. The New South Wales Criminal Trial Courts Bench Book simply contains one paragraph on DNA as a subset of expert evidence. Suggested directions are provided in relation to expert evidence as a whole.[204] The Queensland Supreme and District Courts Benchbook is more comprehensive, incorporating as an amendment a separate section on DNA and suggested directions in relation to its statistical format of presentation.[205] As per judicial recommendation, it has been made available to all participants in the trial process.

Conversely, the United States and Canada do not address DNA evidence within bench books per se, but as part of separate manuals on scientific evidence. Not designed to be read in their entirety, the manuals are a quasi-encyclopaedic reference for judges requiring guidance on the science arising before them in any given case. In the United States, the Reference Manual on Scientific Evidence was formulated "to provide the tools for [American] judges to manage cases involving complex scientific and technical evidence."[206] This publication was subsequently used by the National Judicial Institute of Canada in the production of its own science manual, created as a means of allowing judges to "continue to engage with science in the courtroom in a way that strengthens [Canada's] legal system and its fundamental values."[207]

The specific mechanism by which information about DNA evidence is given to judges (whether in a bench book or science manual) is ultimately less important than the education

[202] Only one supplement has been added to the Bench Book in October 2011. Of course, the Bench Book is not the sole source of case law on DNA evidence – it contains the leading cases but judges retain the discretion to refer to other cases where necessary.
[203] UK Crown Court Bench Book, above n 199, at 143-147.
[204] NSW Criminal Trial Courts Bench Book at 355.
[205] Queensland Supreme and District Courts Benchbook No. 53.1 (May 2013 Amendments)
[206] Federal Judicial Center, above n 8, at xv.
[207] *Science Manual for Canadian Judges* at 14. This manual gives detailed information on DNA and the Bayesian approach to evidence interpretation, and includes as an appendix the application of probabilities to forensic DNA profiling: Appendix 2, p 129-132.

and guidance they receive from it. Bench books are beneficial in that model directions are often provided, but even then it will vary from judge to judge as to the extent they are relied upon. More often than not, cases involving complex DNA evidence will require directions tailored to the particular facts and issues in order to promote juror understanding[208] – therefore making bench books of somewhat limited assistance.

(d) New Zealand

The New Zealand Institute of Judicial Studies publishes a number of online judicial bench books to enable judges to gain the skills and knowledge they require to operate effectively in generalist and specialist jurisdictions.[209] They are compiled by judges for their own exclusive use and are revised as necessary by members of the Governing Board.[210] However, as the New Zealand Bench Book relates to the management and administration of judicial affairs, it is not made publicly available except on a case-by-case basis.[211] This is remarkably different to the transparency of the UK approach (and some Australian states). Some parts of the Bench Book are being developed by the Institute of Judicial Studies for release on the Courts of New Zealand website, but the directions on DNA evidence "are not [currently] in a form to be made publicly available."

Even if the Bench Book directions on DNA were accessible, it would be unlikely to have a great effect given the necessity of tailoring directions to the particular facts of each case. Advocates can anticipate the route a judge is likely to take with DNA evidence simply by referring to directions given in prior judgments.

2 The ambit of judicial directions about DNA evidence

There is no provision in the EA which requires the judge to give the jury a warning about DNA evidence.[212] However, judges recognise that it is "unrealistic to leave the jury to grapple unaided with complex evidence in unfamiliar areas,"[213] and so will usually give a warning or general direction about DNA evidence in summing up. Before doing so, they will

[208] Glazebrook, above n 177, at 2.
[209] NZ Institute of Judicial Studies "Institute of Judicial Studies Strategic Plan: 1 July 2010 - 30 June 2015 (January 2011) at 15.
[210] Email correspondence with Tina Pope (New Zealand Bench Book Editor), regarding the accessibility of the New Zealand Judicial Bench Book: 1 September 2015.
[211] Email correspondence with Tina Pope 17 September 2015 – issuing the Chief Justice's Office response.
[212] Section 122 of the Act provides that the judge may warn the jury about evidence which he or she thinks may be unreliable. However, this is unlikely to be exercised in relation to DNA evidence, given that reliability is a prerequisite to admission under s 25 (as part of the substantial helpfulness test). It would be highly contradictory if the evidence were to be let in under s 25 and then a s 122 reliability warning was given at the conclusion of the trial. Compare this to hearsay, a class of evidence in which a warning must be considered under s 122(2), where there must only be a "reasonable assurance" that the statement is reliable – leaving a larger scope for concerns about reliability.
[213] *R v Hutton* [2008] NZCA 126 at [143].

often ask counsel whether there are any matters which require correction to ensure that an inaccurate description of the evidence does not go to the jury.[214]

Generally in cases involving DNA, the judge will address the strength of the likelihood ratio, without delving into the conclusions to be adduced from it (the task of which is reserved for the jury). In most instances they will emphasise that as only "one link in the chain", proof of the incriminating DNA evidence does not have to be established beyond reasonable doubt – it is only the overall chain of evidence which must amount to the criminal standard of proof.[215] A rare case where the Crown would be required to prove the fact of the DNA beyond reasonable doubt would be, for example, where it was the sole piece of evidence linking the accused to the crime.[216]

Particularly where there is conflicting opinion about DNA evidence, the judge may be obliged to give additional directions on the critical points on which the experts differ, and suggest a means by which the jury might address the evidence (for example, indicating topics for consideration or suggesting a decision tree).[217] The extent of such a direction will be determined by factors such as the importance of the evidence, its complexity, the way the witnesses have presented it and its treatment by counsel.[218]

In *Manoharan v R*, the defence submitted that the LCN DNA evidence (found on cable ties used to tie up the victim) had been presented unfairly to the jury at trial.[219] Rejecting this ground of appeal, the Court of Appeal held that, in the context of the warning as a whole, the jury would not have been misled as to the strength of the evidence:

> [62] …The warning the Judge gave before the ESR scientists testified was not a standard DNA warning. It was specific to the trial. The Judge told the jury to be "very careful" about the evidence they were about to hear. He told them it was not to be regarded as a "silver bullet" and that in the circumstances of this particular case it could not and they "must not" regard it as in any way conclusive. He specifically mentioned television programmes like CSI where DNA solves a case and said such an approach in the circumstances of the evidence they were about to hear was "all wrong." He further told them that it was only one part of the evidence and that after hearing it they "might well think" it was of very limited weight in itself. He concluded by saying that they were to be on their guard.

[214] *W (CA705/2014) v R* [2015] NZCA 302 at [17].
[215] *McLaughlin v R*, above n 71, at [34]; see also *R v Guo* [2009] NZCA 612 at [49].
[216] As without the evidence, there would be no case against the accused. To illustrate using *McLaughlin*, if no other evidence was available linking the accused to the crime of sexual assault, the Crown would have had to prove beyond reasonable doubt that his DNA had been deposited under the victim's fingernails by direct transfer in order to secure a conviction.
[217] *R v Hutton*, above n 213, at [143].
[218] Ibid.
[219] *Manoharan v R*, above n 55, at [19].

> [63] Secondly, the Judge returned to the topic again in his summing-up commencing a very strongly-worded and detailed discussion with the observation that the reasons for his earlier warning would now be obvious to the jury. The Judge not only reiterated some of the points made by defence counsel about the DNA evidence, but he personally endorsed the view that it was "fairly weak" DNA evidence. He told them commonly in cases the likelihood ratio is expressed in hundreds or millions but not here and that it was "a very low probability ratio obtained from a very small piece of DNA." He reminded the jury of the shortcomings of the LCN technique and that the risk of obtaining a mixed DNA profile had not been able to be discounted.

This is an exemplary direction on DNA in that it is describes important principles about the individuality and limitability of DNA evidence. Though judges will not usually go as far as telling the jury that they "must not" regard DNA evidence as conclusive, Judge Davidson in *Manoharan* was entirely justified in doing so given the extremely small likelihood ratio in that case.[220] The factual matrix will invariably determine the scope of judicial directions about DNA.

The trend emerging from previous cases is that, as a whole, New Zealand judges seem to be sufficiently competent when it comes to directing juries on DNA evidence. There has been no successful appeal to date on the grounds of inadequate jury directions.[221] This can be attributed to the New Zealand Law Society's focus on continuing professional development in addition to active communication between judges and advocates – as summing up will often reflect Crown and defence counsel's closing addresses.

3 Judge-alone trials

To circumvent the risks of juror misevaluation of DNA, an alternative in cases involving difficult evidence is to relinquish the jury altogether and proceed by a judge-alone trial. Section 102 of the Criminal Procedure Act 2011 (CPA) provides that a judge may order a judge-alone trial in cases likely to be long and complex. However, it does not apply where the defendant is charged with an offence for which the maximum penalty is more than 14 years imprisonment.[222] As DNA evidence is most often introduced in sexual violation or murder cases,[223] this provision will not usually apply.

---

[220] *R v Manoharan* DC Wellington CRI-2011-032-2216, 3 October 2012.
[221] *Ratana v R* [2013] NZCA 109; *Manoharan v R*, above n 55; *McLaughlin v R*, above n 71. Compare *R v Broughton*, above n 49, where the English Court of Appeal concluded that the judge fell into error in directing the jury that they could reach their own conclusions on the DNA evidence. In allowing them to do so, the jury may have embarked upon a task of evaluation for which they were not equipped, meaning their verdict could not be regarded as safe. The Court determined that the judge ought to have directed the jury that if they did not accept the expert's interpretation about the composition of the DNA profile, they should acquit as there was no basis on which they could assess the evidence themselves: at [48]-[49].
[222] Criminal Procedure Act 2011, s 102(1)(a).
[223] For which the maximum penalties are 20 years imprisonment and life imprisonment respectively: Crimes Act 1961, s 128B(1) and s 172(1).

Moreover, the jury system should not be undervalued. Juries have advantages over a judge in that they are likely to bring greater diversity in size, social class, experience and societal views to the trial. By involving community members in the justice system, the jury also has an educative role.[224] The common-sense approach juries bring to fact-finding thus "equips them in a unique capable manner to comprehend novel and complex scientific evidence,"[225] and serves as a check on state power.[226] Rather than abolishing the jury trial in cases involving complex DNA evidence, the more appropriate solution is to aim to enhance jury understanding through different means of education suggested in Chapter III.

D Court-appointed Experts and Advisory Panels

1 Court-appointed experts

To reduce scepticism about the impartiality of expert witnesses at trial, suggestions have been raised that court-appointed experts could assist with admissibility determinations and jury understanding of DNA evidence in criminal cases.[227] Before the evidence-in-chief, a court-appointed expert would provide the jury with a tutorial on DNA evidence, "introduc[ing] them to the terminology and concepts of the relevant discipline in an abstract way, without embarking at all on the actual facts or merits of the case."[228] Alternatively, he or she would assist throughout the trial process by providing advice on complex or technical evidence.

While perceived as the "most obvious way of mitigating the distorting influence of adversarial procedure on scientific evidence,"[229] the feasibility of court-appointed expertise is limited for a number of reasons. Court-appointed expertise would undoubtedly add to the expense and length of the criminal trial and may detract from its adversarial nature.[230] Given that many experts on novel DNA techniques are already sourced from overseas, it may be difficult to locate an expert within the small pool of those who possess the relevant knowledge.[231]

---

[224] Sallavaci, above n 7, at 172.
[225] Robert D Myers, Ronald S Reinstein and Gordon M Griller "Complex Scientific Evidence and the Jury" (1999) 83 Judicature 150 at 192.
[226] Andrea Roth "Defying DNA: Rethinking the Role of the Jury in an Age of Scientific Proof of Innocence" (2013) 93 BUL Rev 1643 at 1698.
[227] Emily Henderson and Fred Seymour *Expert witnesses under Examination in the New Zealand Criminal and Family Courts* (New Zealand Law Foundation, March 2013) at 112. It is worth noting the difference between court-appointed and independent experts: while the latter are appointed by the court, independent experts are employed by counsel for the purpose of reviewing aspects of forensic casework, such as the possibility of contamination and interpretation of DNA test results.
[228] Law Commission, above n 175, at 142.
[229] Roberts and Zuckerman, above n 24, at 504.
[230] Ibid.
[231] For example, the evidence on RNA organ typing in the *Lundy* case was given by an expert from the Netherlands Forensic Institute, the only facility in the world to conduct such testing.

Furthermore, court-appointed expertise may be unnecessary if counsel and their experts are doing their jobs properly. As the first to be called in giving evidence, it will be the prosecution's task to introduce the jury to the principles of DNA in addition to any written information already provided.[232] Because all experts have an overriding duty to the court, compliance with the code of conduct arguably renders them all de facto court appointees.[233] Hence there should be no need for a further source of information to guard against the risks of a "hired gun." Finally, employing court-appointed experts would not directly address the issues that judges and juries have in understanding DNA evidence.[234] The problem could even be magnified if the opinion was not presented in a simple and effective format.

2 Multidisciplinary advisory panels

For some critics, many reforms do not focus on the most fundamental matters for procedural accuracy: the validity and reliability of DNA evidence itself.[235] Rather than relying upon each party's expert witness or court-appointed experts, a specialist committee or "multidisciplinary advisory panel" (MAP) could provide guidance for judges making initial admissibility determinations. The panel – composed of specialist members[236] and appointed on an ad hoc basis – would produce a consensus statement focused on the reliability and limitations of a particular technique or opinion.[237] It would not be adversarial and therefore the panel members would not be subjected to credibility challenges via cross-examination. However, the MAP would have to operate within a recognised statutory framework to ensure it did not encroach on the function of the court. It would not be permitted to comment on any legal issues surrounding the evidence, such as the evidential threshold for reliability. Instead, the MAP's published advice would invite a degree of "principled deference" from judges and lawyers, easing the burden on them to understand the scientific complexities of the evidence.[238] The advice would essentially be a supplementary, non-binding resource for judges at the voir dire stage.

The implementation of an MAP raises apparent cost concerns, both in the regulation of the panel and remuneration of its members. To reduce expenditure, it has been suggested that panel members would be selected and employed on a pro bono basis, similar to the NAS[239]

[232] Law Commission, above n 175, at 142.
[233] Henderson and Seymour, above 227, at 33.
[234] Tinsley, above n 190, at 861.
[235] Edmond and Roberts, above n 63, at 389.
[236] Gary Edmond, a strong advocate for the MAP, envisages the panel as consisting of between 8-12 members in total, consisting of experts from established fields such as the biosciences and forensic sciences, as well as representatives from the legal sector and judiciary. However, the "precise composition of the panel is less important than membership being dominated by highly qualified (non-forensic) scientists of demonstrated ability": Edmond, above n 121, at 273.
[237] Edmond, above n 121, at 274. Refer to this article generally for a comprehensive discussion on the proposal, where the author situates the MAP within its broader socio-legal context.
[238] At 266, 292-293.
[239] National Academy of Sciences.

committee in the United States. The number of MAP references would thereby be restricted to a few cases per year, in consideration of the excessive caseloads often already carried by the specialist members.[240] This is unlikely to be an issue in the New Zealand context, where there is a relatively low number of cases requiring expert opinion on novel scientific evidence.

Notwithstanding these cost factors, establishing an MAP would require substantial investment in terms of developing an appropriate framework to ensure the transparency of its advice, and "to enable the selection of appropriate issues and the writing and updating of opinions."[241] A suggested report format may also be necessary to prevent advice of undue complexity and length being presented to the court. Even if given appropriately, the effectiveness of advice proffered by an MAP would ultimately hinge on the judge's competence to understand expert evidence.[242] This issue exists regardless of whether opposing experts or an MAP report are introduced at the voir dire.

Aside from Edmond's view, there is little compelling evidence to justify the effectiveness of an MAP over traditional adversarial expertise. If a panel was to be introduced, then given New Zealand's size it would most likely be an Australasian body to coincide with the existing Australian and New Zealand Forensic Science Society.[243] From a cost-benefit perspective, however, the institution of an MAP does not seem likely in the near future.

E Order of Giving Evidence

1 The codified order for giving evidence at trial

Under s 84(1) of the EA, the usual order in which witnesses will be questioned at trial is by examination-in-chief, followed by cross-examination and re-examination. However, the section allows the judge to deviate from this sequence if the EA (or any other enactment) requires or permits such variance, or where the court exercises its discretion. Departure from the conventional order of examination may be desirable in respect of expert opinion evidence which is long and complex – such as some forms of DNA evidence. Expert evidence heard both consecutively or concurrently may increase juror comprehension of evidence and has been suggested as a conceivable means of reforming the trial process. In New Zealand, this is

[240] Edmond, above n 121, at 274.
[241] Henderson and Seymour, above 227, at 32.
[242] Ibid.
[243] The ANZFSS is not in itself a specialist body which provides advice to the courts; its objectives are simply to "enhance the quality of forensic science by providing symposia, lectures, discussions and demonstrations encompassing the various disciplines within the science" : <www.anzfss.org>.

likely to be relevant to only the most serious criminal cases as trials involving opposing experts are in the minority.[244]

2 Consecutive evidence

Section 107(4) of the CPA legislatively endorses the use of consecutive evidence in criminal proceedings, stating that the court may give the defendant leave to call one or more witnesses immediately after the prosecutor has called a particular witness or witnesses.[245] Allowing the jury to hear all of the relevant evidence on an issue in succession reduces the interval between experts being called, during which jurors may forget the testimony presented by the first expert.[246] Consecutive evidence does not diverge from the traditional adversarial process to the same extent as concurrent evidence, as it upholds the conventional order of examination prescribed in s 84(1) of the EA.

The jury could understandably become overwhelmed by the large abundance of evidence when given consecutively, but these concerns could largely be alleviated by scheduled trial adjournments. Yet consecutive evidence does not aim to reduce the length of the trial process. It is this feature which makes concurrent evidence a more favourable means of reform.

3 Concurrent evidence

(a) Overview

The second proposed alternative to the order of giving evidence, concurrent evidence or "hot-tubbing," was first introduced in Australia and has been described by McClellan CJ as:[247]

> …[E]ssentially a discussion chaired by the judge in which the various experts, the parties, advocates and the judge engage in an endeavour to identify the issues and where possible at a common resolution of them. In relation to the issues where agreement is not possible a structured discussion, with the judge as chairperson, allows the experts to give their opinions without constraint by the advocates in a forum which enables them to respond

[244] Henderson and Seymour, above n 227, at 142. Due to a lack of resources, it will often only be the Crown who calls an expert witness. The defence can make a legal aid application to engage the services of an expert, but the application will only be approved where they demonstrate how the attendance of an expert will contribute to a successful outcome for their client, *and* confirm that any potentially less expensive sources of evidence have been considered (e.g. an interim report to ascertain the expert's initial views): *Criminal Legal Aid Disbursement Policy* (2014) at 13.

[245] Unlike its predecessor, s 367(1C) of the Crimes Act 1961, s 107 of the CPA is not restricted to expert evidence – although this is the most likely scenario in which it will apply: *Adams on Criminal Law – Procedure* at [CPA107.03].

[246] Henderson and Seymour, above n 227, at 36.

[247] Justice Peter McClellan "Concurrent Expert Evidence" (Medicine and Law Conference: Law Institute Victoria, 29 November 2007) at 19.

> directly to each other. The judge is not confined to the opinion of one advisor but has the benefit of multiple advisors who are rigorously examined in a public forum.

Concurrent evidence is thus a fairly radical reform in that it directly challenges the traditional order of adversarial procedure. While each party's right to scrutinise the other's expert witness is preserved, there is no conventional examination-in-chief, cross- or re-examination. Pre-trial discussions between experts seek to identify the issues in dispute and produce a joint statement to the court. Consequently, experts engage only in a "battle focused on the relevant"[248] when called to give evidence at trial. Each expert, standing in the witness box simultaneously, is given the opportunity to present and explain their interpretation of the evidence as well as comment upon the other expert's account.[249] Lawyers and judges can freely question either expert and turn to the other where they feel clarification or further response is needed.

The benefits of concurrent evidence are extensive. In addition to saving court time and resources, concurrent evidence also condenses the volume of information imparted to the jury and the level of partisanship and distortion in expert opinion (or "adversarial bias").[250] Experts may refrain from commenting beyond the critical and genuine points of difference where they know their colleague is available to expose any "outlandish" answers given.[251] Ongoing peer review is facilitated and communication enhanced in what is a structured discussion designed to inform trial actors rather than intimidate experts.[252] Concurrent evidence is therefore more inquisitorial in that it does not permit the same degree of confrontation as traditional adversarial procedure.

Scepticism about concurrent evidence revolves around a fear that if experts are left to "duel it out" in the witness box, lawyers and judges may lose control over the examination process.[253] Furthermore, it may allow the more persuasive and confident expert to dominate the trial, thereby encouraging the judge and jury to place undue weight on their opinion.[254] From the accused's perspective, concurrent evidence may therefore conflict with their right to offer an effective defence if their expert is not properly heard.[255]

---

[248] Hugh Selby "When science comes to court" (2010) 42 Australian Journal of Forensic Sciences 159 at 163.
[249] Henderson and Seymour, above n 227, at 36. The theory of concurrent evidence clearly presupposes that both experts will be available at the same time to give evidence. Of course, this may not be possible where an expert is restricted by travel issues (as many leading experts in the DNA field are based abroad) or other case commitments.
[250] Gary Edmond "Secrets of the 'hot tub': expert witnesses, concurrent evidence and judge-led law reform in Australia" (2008) 27(1) CJQ 51 at 59.
[251] Steven Rares "Using the 'Hot Tub' - How Concurrent Expert Evidence Aids Understanding Issues" (2012) 31(1) CJQ 30 at 36; see also Macdonald, above n 127.
[252] Edmond, above n 250, at 60-61.
[253] Henderson and Seymour, above n 227, at 38.
[254] Rares, above n 251, at 39; Tinsley, above n 189, at 863.
[255] New Zealand Bill of Rights Act 1990, s 25(e).

Such apprehensions are however largely unfounded. Reports from the Australian experience (albeit in civil cases) indicate that where hot-tubbing is implemented, experts generally "co-operate with one another and freely and respectfully exchange their views."[256] The risk of charismatic experts dominating proceedings remains an issue regardless of whether hot-tubbing or normal trial process is adopted.[257] Provided that the judge is competent to chair the process and appropriate controls are in place,[258] concurrent evidence is likely to "produce more ounces of merit which will be worth more to a judge than pounds of charisma or demeanour."[259]

With the arguments tipped in favour of concurrent evidence, the discussion will now examine New Zealand's legislative provisions in order to ascertain whether the process is a permissible option for our criminal trial.

(b) The scope for concurrent evidence in New Zealand criminal proceedings

Concurrent evidence is permitted in civil proceedings by r 9.46 of the High Court Rules, which allows the court to "direct [as an act of judicial discretion under s 84(1) of the EA] that the evidence of expert witnesses is given after all or certain factual evidence is given or in a sequence the court thinks best suited to the circumstances of the proceeding." The discretion has only been exercised on one occasion,[260] which is most likely a reflection of the lack of cases in New Zealand with opposing experts and a judicial reluctance to move away from accepted procedure.

There is no equivalent provision which expressly allows for the use of concurrent evidence in criminal proceedings. Yet no section in the evidence or criminal procedure legislation operates to preclude it. While s 107(4) of the CPA specifically provides for consecutive evidence, its effect is not to limit s 107(3), which provides that the court has a discretion to direct otherwise. Allowing concurrent evidence would promote consensus between experts[261] and their parties and soften the rigidity of the criminal trial.

[256] Rares, above n 251, at 36.
[257] Henderson and Seymour, above n 227, at 38.
[258] The experts must give their evidence within a limited timeframe and, as a rule, the expert who has the microphone has the floor: Rares, above n 251, at 36.
[259] At 42.
[260] *Commerce Commission v Cards NZ Ltd (No 2)* (2009) 19 PRNZ 748 (HC). Concurrent evidence was notably used in the Kahui inquest, but as this is an inquisitorial not adversarial process it has limited applicability in the present context: Henderson and Seymour, above n 226, at 38 (citing personal communication with Simon Mount reflecting on the Kahui inquest).
[261] Upholding their duty to confer under Clause 6 of the Expert Witness Code of Conduct (which as noted previously applies to experts in criminal as well as civil cases) and s 9 of the Evidence Act 2006 – the admission of evidence by agreement.

During the *Lundy* retrial, evidence on the mRNA organ typing analysis of the tissue recovered from Mr Lundy's shirt was given in accordance with the normal adversarial process. The jury heard the opposing experts a week apart, and became bored with the evidence because it was complicated and took a long time[262] – one or two of the jurors even "appeared to enter a zone which wasn't exactly sleep, more a kind of oblivion."[263] Had the evidence been given concurrently, for example, these problems created by the complexity of the evidence may have been alleviated to an extent. Unfortunately, one can only speculate about the effectiveness of hot-tubbing in criminal cases until the process is trialled in New Zealand courts. With concurrent evidence only routinely used in Australian civil proceedings to date, it appears highly unlikely that New Zealand judges will shift from their conservative stance and trial concurrent evidence anytime soon. The advantages offered by concurrent evidence remain overshadowed by uncertainties about procedural control and the possible impact it could have on the defendant's right to a fair trial.

F Conclusions

This chapter has explored the range of trial safeguards which collectively aim to prevent misuse of DNA evidence by its actors.[264] Despite concerns about their strength and consistency, cross-examination and judicial directions are actively used in the New Zealand courtroom to great effect. Bench books are a valuable tool for judges requiring guidance on the principles of DNA, but the directions given to juries will inevitably need to be tailored to the facts of the particular case. Because of its limited applicability, the legal profession therefore suffers no great loss by the Bench Book not being publicly available (unlike in the UK). Court-appointed experts and independent panels are unlikely to be a viable option in New Zealand given the cost factors required in implementation. Concurrent evidence is a recommended alternative to the normal adversarial examination process in long and complex cases, and favoured over consecutive evidence because of its aims to reduce trial time and cost. But regrettably, in the absence of solid empirical research demonstrating the extent to which hot-tubbing increases jury comprehension of the evidence, the process seems unlikely to be trialled by criminal court judges in the foreseeable future.

Ultimately, trial safeguards should be viewed as collaborative tools that *aim* to resolve the issues associated with the use of scientific evidence in court.[265] To believe that such safeguards can resolve completely the "perennial epistemological difficulties"[266] created by law and science is far too idealistic. However, improvements are sufficient and are

[262] Email correspondence with Dr Anna Sandiford, above n 100.
[263] Steve Braunias "Mark Lundy retrial: Digging into the details" *The New Zealand Herald* (online ed, Auckland, 5 March 2015).
[264] However, much of the discussion is applicable to the use of scientific evidence generally in criminal proceedings.
[265] Tinsley, above n 190, at 864.
[266] Edmond, above n 250, at 82.

particularly significant when tied to measures of education. Trial safeguards regulate DNA evidence in court most effectively when judges and advocates are well-informed and educated on the science. As officers of the court, they take it upon themselves to become amateur forensic scientists and have a duty[267] to "keep abreast of the major debates on the construction of evidence that are taking place in the scientific community."[268]

[267] This duty of continuing education arises under Rule 3.9 of the Lawyers and Conveyancers Act (Lawyers: Conduct and Client Care) Rules 2008: "A lawyer must undertake the continuing education and professional development necessary to ensure an adequate level of knowledge and competence in his or her fields of practice."
[268] Grace and others, above n 145, at 88.

Conclusion

The law will always welcome scientific advances which assist in the pursuit of justice. DNA evidence has been used in the New Zealand courtroom for over 25 years, with technological precision increasing to the extent that an individual can now be identified by a pinprick of blood. However, there are still reliability concerns pertaining to its use. So as not to compromise the integrity of the evidence through contamination or transference, it is imperative that rigorous quality assurance and control procedures accompany DNA analysis. This is particularly applicable to LCN evidence, a controversial but nonetheless well-established technique in New Zealand casework. Scientists must also interpret mixed or partial DNA profiles in accordance with accredited standards to ensure that a match can be justified.

Expert opinion DNA evidence must be substantially helpful to the fact-finder in order to be admissible, a test which places the judge in a gatekeeper role in determining whether the threshold has been met. As was apparent in *Lundy*, the task is not always straightforward. Regardless of the formal admissibility rules in place, interpretation and evaluation of DNA evidence remains a subjective inquiry.

How jurors use the information provided by the likelihood ratio will also differ according to their own perceptions and expectations of the evidence. To reduce the overwhelming probabilistic influence of the likelihood ratio, the expert will present the evidence in accordance with a graduated verbal equivalent scale. Yet, there are concerns that even this scale may favour the prosecution case too strongly. Rather than seeking to change the wording of this scale (which may just be a matter of semantics, given that jurors can assign different meanings to the same words), the law must rely on safeguards within the adversarial process that operate to reduce the risks of DNA evidence being overweighed by the jury. Cross-examination and judicial directions have been particularly effective in New Zealand in highlighting inconsistencies and limitations of DNA. Concurrent evidence may further enhance understanding of complex evidence, but continues to be overshadowed by uncertainties about procedural control and has thus not been implemented in the criminal trial to date.[269] However, the adversarial process should be prepared to adapt where called for by the particular facts of a case, so that jurors do not have to try and absorb extremely technical evidence over a number of days or weeks.

[269] But one should not lose sight of the fact that because of resourcing issues, opposing experts at trial are relatively uncommon in New Zealand unless the evidence is controversial.

Communication, collaboration and education fundamentally emerge as the most efficacious ways of improving reception of DNA evidence by trial actors. The essence of this communication is counsel and expert familiarity with each other's method of practice and reasoning, with collaborative interactions taking place at all stages of the trial process. Tied to this is the importance of ongoing education, which should not be underestimated. The rationales behind the jury system are too important to forego, but it is crucial that jurors receive a high level of assistance within the trial process to aid their understanding of DNA evidence. Furthermore, lawyers and judges will never be scientists, and scientists will never be legal experts. Were this level of knowledge to be expected, then the justification behind adducing expert evidence would be all but redundant. Nevertheless, lawyers working within the adversarial system have a duty to bring their scientific knowledge on DNA up to a level necessary which enables them to perform effective cross-examination. Judges are arguably required to have more refined scientific knowledge given their gatekeeper duties. Bench books provide a useful point of reference to support judicial understanding of DNA, as do workshops on evidence and a degree of deference on experts. The tensions created between legal, scientific and common-sense reasoning in the reception of DNA evidence will never be completely resolvable. However, aspiring to reduce, rather than resolve these tensions will ensure the rights of defendants in the criminal justice system are not compromised.

Bibliography

A Cases

1 New Zealand

Balfour v R [2013] NZCA 429.

Commerce Commission v Cards NZ Ltd (No 2) (2009) 19 PRNZ 748 (HC).

Donnelly v R [2011] NZCA 660.

Kuru v Police [2015] NZHC 357.

Lisiate v R [2013] NZCA 129.

Lundy v R [2013] UKPC 28, [2014] 2 NZLR 273.

Lundy v R [2014] NZCA 576.

Mahomed v R [2010] NZCA 419.

Manoharan v R [2015] NZCA 237.

McLaughlin v R [2015] NZCA 339.

Milner v R [2014] NZCA 366.

R v Calder HC Christchurch T154/94, 12 April 1995.

R v Dougherty [1996] 3 NZLR 257.

R v Guo [2009] NZCA 612.

R v Hetherington [2015] NZCA 248.

R v Hutton [2008] NZCA 126.

R v Lepper CA334/04, 1 November 2005.

R v Lundy (2002) 19 CRNZ 574.

R v Lundy [2014] NZHC 2527.

R v Pengelly [1992] 1 NZLR 545.

R v Reid [2009] NZCA 612.

Ratana v R [2013] NZCA 109.

Thomas v R [1972] NZLR 34 (CA).

W (CA705/2014) v R [2015] NZCA 302.

Wallace v R [2010] NZCA 46.

2 Australia

Aytugrul v R [2010] NSWCCA 272; [2010] 205 A Crim 157.

3 England and Wales

Buckley v Rice Thomas (1554) 1 Plowden 118, 75 ER 182 (KB)

Pringle v R [2003] UKPC 9.

R v Broughton [2010] EWCA (Crim) 549.

R v Doheny and Adams [1997] 1 Cr. App. R. 369.

R v Reed, Reed and Garmson [2009] EWCA Crim 2698 [2010] 1 Cr. App. R. 23.

R v Turner [1975] QB 834 (CA).

4 Northern Ireland

R v Sean Hoey [2007] NICC 49.

5 United States

Daubert v Merrell Dow Pharmaceuticals Inc. 509 US 579 (1993).

New York v Wesley, 140 Misc 2d 306, 533 NYS 2d 643, 644 (1988).

People v Collins 2015 NY Slip Op 25227.

United States v Grinnage, 486 Fed. Appx. 325; 2012 U.S. App. (11th Cir).

B Legislation and Practice Directions

1 New Zealand

Crimes Act 1961.

Criminal Procedure Act 2011.

Evidence Act 2006.

Judicature Act 1908.

New Zealand Bill of Rights Act 1990.

2 England and Wales

(a) Secondary Legislation

Criminal Procedure Rules 2015.

(b) Practice Directions

Criminal Practice Directions Amendment No. 2 [2014] EWCA Crim 1569 2014 (England & Wales)

3 United States

(a) Secondary Legislation

Rule 702 of the Federal Rules of Evidence.

C Government Publications

1 New Zealand

NZ Institute of Judicial Studies "Institute of Judicial Studies Strategic Plan: 1 July 2010 – 30 June 2015 (January 2011).

Legal Aid Services Commissioner "Legal Aid Disbursement Policy Criminal: Information for Legal Aid Providers" (31 March 2014).

2 Australia

Judicial Commission of New South Wales "Criminal Trial Courts Bench Book" (October 2002 – *revised as necessary*).

Queensland Courts "Queensland Supreme and District Courts Benchbook" (1999 – *revised as necessary, amendments made to Chapter 53 – DNA in May 2013).*

3 Canada

National Judicial Institute "Science Manual for Canadian Judges" (2013).

4 England and Wales

House of Commons Science and Technology Committee *Forensic Science on Trial*: *Seventh Report of Session 2004-5* (House of Commons, 29 March 2005).

Judicial Studies Board "Crown Court Bench Book: Directing the Jury" (March 2010).

D Reports

1 New Zealand

Emily Henderson and Fred Seymour *Expert Witnesses Under Examination in the New Zealand and Family Courts* (New Zealand Law Foundation, March 2013).

Law Commission *Evidence: Evidence Code and Commentary* {NZLC, R55, Volume 2, 1999)

Law Commission *Evidence Law: Expert Evidence and Opinion Evidence* (NZLC, PP18, 1991)

Law Commission *Juries in Criminal Trials* (NZLC R69, 2001).

Law Commission *Juries in Criminal Trials: Part II* (NZLC PP37, 1999).

Law Commission *The 2013 Review of the Evidence Act 2006* (NZLC R127, 2013).

2 England and Wales

Brian Caddy, Graham R Taylor and Adrian MT Linacre *A Review of the Science of Low Template DNA Analysis* (April 2008).

Law Commission of England and Wales *Expert Evidence in Criminal Proceedings in England and Wales* (Law Com No 325, 21 March 2011).

3 United States

National Research Council of the National Academies *Strengthening Forensic Science in the United States: A Path Forward* (National Academies Press, August 2009).

E Books and Chapters in Books

John Butler *Forensic DNA Typing: Biology, Technology and Genetics of STR Markers* (2nd ed, Elsevier Academic Press, London, 2005).

Federal Judicial Center (ed) *Reference manual on scientific evidence* (3rd ed, National Academy Press, Washington DC, 2011).

Michael Freeman and Helen Reece *Science in Court* (Aldershot, Ashgate, 1998).

Ian Freckelton and others *Expert Evidence and Criminal Jury Trials* (Oxford University Press, forthcoming 2016).

Victoria Grace and others *Forensic DNA Evidence on Trial: Science and Uncertainty in the Courtroom* (Emergent Publications, Arizona, 2011).

Susan Haack *Evidence Matters: Science, Proof and Truth in the Law* (Cambridge University Press, New York, 2014).

Andrew Jackson and Julie Jackson *Forensic Science* (3rd ed, Pearson Education, Essex, 2011).

Paul Kirk *Crime Investigation: Physical Evidence and the Police Laboratory* (2nd ed, John Wiley & Sons, New York, 1974)

Richard Mahoney and others *The Evidence Act 2006: Act and Analysis* (3rd ed, Brookers, Wellington, 2014).

Don Mathieson *Cross on Evidence* (9th ed, LexisNexis, Wellington, 2013).

Elisabeth McDonald *Principles of Evidence in Criminal Cases* (Brookers, Wellington, 2012).

Erin Murphy *Inside the Cell: The Dark Side of Forensic DNA* (Nation Books, New York, 2015).

James Ogloff and others *The Jury Project: Stage 1 – A Survey of Australian and New Zealand Judges* (Australian Institute of Judicial Administration Incorporated, Melbourne, 2006).

Paul Roberts and Adrian Zuckerman *Criminal Evidence* (2nd ed, Oxford University Press, Oxford, 2010) at 470.

Bernard Robertson and GA Vignaux *Interpreting Evidence: Evaluating Forensic Science in the Courtroom* (John Wiley & Sons, Sussex, 1995).

Oriola Sallavaci *The Impact of Scientific Evidence on the Criminal Trial: The case of DNA evidence* (Routledge, Oxon (England), 2014).

Anna Sandiford *Forensic Science and the Law: A Guide for Police, Lawyers and Expert Witnesses* (Brookers, Wellington, 2014).

Andrei Semikhodskii *Dealing with DNA evidence: a legal guide* (Routledge-Cavendish, Oxon, 2007).

Jane Taupin *Introduction to Forensic DNA Evidence for Criminal Justice Professionals* (CRC Press, Boca Raton (Florida), 2013).

Bart Verheij and others *Legal Evidence and Proof: Statistics, Stories, Logic* (Ashgate Publishing, Farnham, 2013).

F Looseleaf Texts

Bruce Robertson *Adams on Criminal Law – Procedure* (online looseleaf ed, Brookers).

G Journal Articles

Nayha Acharya "Law's Treatment of Science: From Idealization to Understanding" (2013) 36 Dalhousie LJ 1.

Colin Aitken, Charles EH Berger and others "Expressing evaluative opinions: a position statement" (2011) 51 Sci. Justice. 1.

Association of Forensic Science Providers "Standards for the formulation of evaluative forensic science expert opinion" (2009) 49 Science & Justice 161.

David J Balding and Peter Donnelly "How Convincing is DNA Evidence?" (1994) 368 Nature 285.

Stephen Breyer "Science in the Courtroom" (2000) 16(4) Issues in Science and Technology 52.

Angela van Daal, Andrew Haesler and others "DNA evidence: current issues and challenges" (2011) 23 Judicial Officers Bulletin 55.

Michael Dann, Valerie P Hans and David H Kaye "Can jury trial innovations improve juror understanding of DNA evidence" (2006) 90 Judicature 152.

Michael Dean and Marci Wease "Understanding DNA Analysis and Interpretation" (2015) 30 Crim Just 11.

Peter Donnelly and David Balding "The prosecutor's fallacy and DNA evidence" Crim LR 1994, Oct, 711-721.

Gary Edmond "Secrets of the 'hot tub': expert witnesses, concurrent evidence and judge-led law reform in Australia" (2008) 27(1) CJQ 51.

Gary Edmond "Advice for the courts? Sufficiently reliable assistance with forensic science and medicine (Part 2)" (2012) 16 The International Journal of Evidence & Proof 263.

Gary Edmond "Is reliability sufficient? The Law Commission and expert evidence in international and interdisciplinary perspective (Part 1)" (2012) 16 The International Journal of Evidence & Proof 30.

Gary Edmond, Simon A Cole, Emma Cunliffe and Andrew J Roberts "Admissibility Compared: The Reception of Incriminating Expert Evidence (ie, Forensic Science) in Four Adversarial Jurisdictions" [2014].

Gary Edmond and Andrew Roberts "Procedural fairness, the criminal trial and forensic science and medicine" (2011) 33 Sydney L Rev 359.

Gary Edmond and Mehera San Roque "Cool Crucible: Forensic Science and the Frailty of the Criminal Trial, The" (2012) 24 Current Issues Crim Just 51.

Ian Evett "DNA Profiling: A discussion of issues relating to the reporting of very small match probabilities" [2000] Crim LR 341.

Mark Findlay “Juror comprehension and the hard case - making forensic evidence simpler” 36 (2008) 15–53.

Susan Haack “Match Made on Earth: Getting Real about Science and the Law, A” (2013) 36 Dalhousie LJ 39.

J Holmgren “DNA Evidence and Jury Comprehension” (2005) 38 Canadian Society of Forensic Science Journal 123.

Deborah L Kellie “Justice in the Age of Technology-DNA and the Criminal Trial” (2001) 26 Alternative LJ 173.

Jonathan J Koehler “The psychology of numbers in the courtroom: How to make DNA match statistics seem impressive or insufficient” (2001) 74 South California Law Review 1275.

Jonathan J Koehler and Laura Macchi “Thinking about Low-Probability Events: An Exemplar-Cuing Theory” (2004) 15 Psychological Science 540.

Michael Lynch “God’s signature: DNA profiling, the new gold standard in forensic science” (2003) 27 Endeavour 93.

KA Martire, RI Kemp, M Sayle and BR Newell “On the interpretation of likelihood ratios in forensic science evidence: Presentation formats and the weak evidence effect” (2014) 240 Forensic Science International 61.

Erin Murphy “The Art in the Science of Dna: A Layperson’s Guide to the Subjectivity Inherent in Forensic Dna Typing” (2008) 58 Emory Law Journal 489.

Robert D Myers, Ronald S Reinstein and Gordon M Griller “Complex Scientific Evidence and the Jury” (1999) 83 Judicature 150.

Barry Nalebuff and Ian Ayres “The Rule of Probabilities: A Practical Approach for Applying Bayes’ Rule to the Analysis of DNA Evidence” (2015) 67 Stanford Law Review 1447.

Michael Naughton and Gabe Tan “The need for caution in the use of DNA evidence to avoid convicting the innocent” (2011) 15 The International Journal of Evidence & Proof 245.

Steven Rares “Using the ‘Hot Tub’ - How Concurrent Expert Evidence Aids Understanding Issues” (2012) 31(1) CJQ 30.

J Ritchie “Probabilistic DNA evidence: the layperson’s interpretation” [2015] Australian Journal of Forensic Sciences 1.

Bernard Robertson, GA Vignaux and Charles EH Berger “Extending the Confusion About Bayes” (2011) 74 The Modern Law Review 444.

Bernard Robertson and GA Vignaux “Bayes Theorem in the Court of Appeal” (1997) 70 The Criminal Lawyer 4.

Paul Roberts “Renegotiating forensic cultures: Between law, science and criminal justice” (2013) 44 Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences 47.

Andrea Roth "Defying DNA: Rethinking the Role of the Jury in an Age of Scientific Proof of Innocence" (2013) 93 BUL Rev 1643.

Hugh Selby "When science comes to court" (2010) 42 Australian Journal of Forensic Sciences 159.

Lisa L Smith, Ray Bull and Robyn Holliday "Understanding Juror Perceptions of Forensic Evidence: Investigating the Impact of Case Context on Perceptions of Forensic Evidence Strength" (2011) 56 Journal of Forensic Sciences 409.

William C Thompson and Eryn J Newman "Lay understanding of forensic statistics: Evaluation of random match probabilities, likelihood ratios, and verbal equivalents." (2015) 39 Law and Human Behavior 332.

Yvette Tinsley "Science in the Criminal Courts: Tool in Service, Challenge to Legal Authority or Indispensable Ally?" (2013) 25(4) NZULR 844.

Tom R Tyler "Viewing CSI and the threshold of guilt: Managing truth and justice in reality and fiction" [2006] The Yale Law Journal 1050.

Tony Ward "An English Daubert? Law, Forensic Science and Epistemic Deference" (2015) 15 The Journal of Philosophy, Science & Law: Daubert Special Issue 26.

Rhonda Wheate "The importance of DNA evidence to juries in criminal trials" (2010) 14 International Journal of Evidence and Proof 129.

Adam Wilson "Away from the Numbers: Opinion in the Court of Appeal" (2011) 75 The Journal of Criminal Law 503.

H Internet Materials

Australian and New Zealand Forensic Science Society "About the ANZFSS" (2015) <www.anzfss.org>.

Innocence Project "The Cases: DNA Exoneree Profiles" (2015) <innocenceproject.org>.

The Institute of Environmental Science and Research New Zealand "Annual Report 2014" (2014) <www.esr.cri.nz>.

The Institute of Environmental Science and Research "DNA Techniques Available for Use in Forensic Casework" (3 October 2014) <www.esr.cri.nz>.

New Zealand Law Society "Workshop: How to Run a Jury Trial 2015" (2015) Continuing Legal Education: New Zealand Law Society <lawyerseducation.co.nz>.

Terri Sundquist "DNA Evidence: Measuring up to the Frye Standard of Acceptance" (8 April 2015) Promega Connections <www.promegaconnections.com>.

I Newspaper Articles

Steve Braunias "Mark Lundy retrial: Digging into the details" *The New Zealand Herald* (online ed, Auckland, 5 March 2015).

Nikki Macdonald "How effective are expert witnesses?" *The Dominion Post* (online ed, Wellington, 18 December 2012).

New Zealand Media and Entertainment "Mark Lundy to appeal double-murder conviction" *The New Zealand Herald* (online ed, Auckland, 28 April 2015).

J Conference Papers and Seminars

1 New Zealand

John Buckleton and Craig Ruane *Forensic Evidence* (New Zealand Law Society, 2008).

Sally Coulson "The New Zealand Perspective: Evidence Reporting using Bayesian Statistics" (Institute of Environmental Science and Research, 2009).

Justice Susan Glazebrook "Streamlining NZs Criminal Justice System" (Criminal Law Conference 2012: Reforming the Criminal Justice System of Hong Kong, 17 December 2012).

Arthur Tompkins, Murray Gibson and Simon Walsh *Update on DNA* (New Zealand Law Society, May 2001).

2 England and Wales

Justice Peter McClellan "Concurrent Expert Evidence" (Medicine and Law Conference: Law Institute Victoria, 29 November 2007).

Lord Thomas of Cwmgiedd (Lord Chief Justice of England and Wales) "Expert Evidence: The Future of Forensic Science in Criminal Trials" (The 2014 Kalisher Criminal Bar Association Lecture, 14 October 2014).

K Email Correspondence

Email from Tina Pope (New Zealand Bench Book Editor), regarding the accessibility of the New Zealand Judicial Bench Book (30 August – 17 September 2015).

Email from Dr Anna Sandiford, regarding expert opinion, DNA evidence and the CSI Effect (21 July 2015).

Appendices

Appendix A: English Criminal Practice Directions Amendment No.2 – Expert Evidence

New Practice Direction on Expert Evidence

In CPD V Evidence Part 33A insert:

CPD V Evidence 33A: EXPERT EVIDENCE

33A.1 Expert opinion evidence is admissible in criminal proceedings at common law if, in summary, (i) it is relevant to a matter in issue in the proceedings; (ii) it is needed to provide the court with information likely to be outside the court's own knowledge and experience; and (iii) the witness is competent to give that opinion.

33A.2 Legislation relevant to the introduction and admissibility of such evidence includes section 30 of the Criminal Justice Act 1988, which provides that an expert report shall be admissible as evidence in criminal proceedings whether or not the person making it gives oral evidence, but that if he or she does not give oral evidence then the report is admissible only with the leave of the court; and Part 33 of the Criminal Procedure Rules, which in exercise of the powers conferred by section 81 of the Police and Criminal Evidence Act 1984 and section 20 of the Criminal Procedure and Investigations Act 1996 requires the service of expert evidence in advance of trial in the terms required by those rules.

33A.3 In the Law Commission report entitled 'Expert Evidence in Criminal Proceedings in England and Wales', report number 325, published in March, 2011, the Commission recommended a statutory test for the admissibility of expert evidence. However, in its response the government declined to legislate. The common law, therefore, remains the source of the criteria by reference to which the court must assess the admissibility and weight of such evidence; and rule 33.4 of the Criminal Procedure Rules lists those matters with which an expert's report must deal, so that the court can conduct an adequate such assessment.

33A.4 In its judgment in *R v Dlugosz and Others* [2013] EWCA Crim 2, the Court of Appeal observed (at paragraph 11): "It is essential to recall the principle which is applicable, namely in determining the issue of admissibility, the court must be satisfied that there is a sufficiently reliable scientific basis for the evidence to be admitted. If there is then the court leaves the opposing views to be tested before the jury." Nothing at common law precludes assessment by the court of the reliability of an expert opinion by reference to substantially similar factors to those the Law Commission recommended as conditions of admissibility, and courts are encouraged actively to enquire into such factors.

33A.5 Therefore factors which the court may take into account in determining the reliability of expert opinion, and especially of expert scientific opinion, include:

(a) the extent and quality of the data on which the expert's opinion is based, and the validity of the methods by which they were obtained;

(b) if the expert's opinion relies on an inference from any findings, whether the opinion properly explains how safe or unsafe the inference is (whether by reference to statistical significance or in other appropriate terms);

(c) if the expert's opinion relies on the results of the use of any method (for instance, a test, measurement or survey), whether the opinion takes proper account of matters, such as the degree of precision or margin of uncertainty, affecting the accuracy or reliability of those results;

(d) the extent to which any material upon which the expert's opinion is based has been reviewed by others with relevant expertise (for instance, in peer-reviewed publications), and the views of those others on that material;

(e) the extent to which the expert's opinion is based on material falling outside the expert's own field of expertise;

(f) the completeness of the information which was available to the expert, and whether the expert took account of all relevant information in arriving at the opinion (including information as to the context of any facts to which the opinion relates);

(g) if there is a range of expert opinion on the matter in question, where in the range the expert's own opinion lies and aimed; whether the expert's preference has been properly explained; and

(h) whether the expert's methods followed established practice in the field and, if they did not, whether the reason for the divergence has been properly explained.

33A.6 In addition, in considering reliability, and especially the reliability of expert scientific opinion, the court should be astute to identify potential flaws in such opinion which detract from its reliability, such as:

(a) being based on a hypothesis which has not been subjected to sufficient scrutiny (including, where appropriate, experimental or other testing), or which has failed to stand up to scrutiny;

(b) being based on an unjustifiable assumption;

(c) being based on flawed data;

(d) relying on an examination, technique, method or process which was not properly carried out or applied, or was not appropriate for use in the particular case; or

(e) relying on an inference or conclusion which has not been properly reached.

Schedule 4
Code of conduct for expert witnesses

r 9.43

Schedule 2 Schedule 4: replaced, on 1 February 2009, by section 8(1) of the Judicature (High Court Rules) Amendment Act 2008 (2008 No 90).

Duty to the court

1 An expert witness has an overriding duty to assist the court impartially on relevant matters within the expert's area of expertise.

2 An expert witness is not an advocate for the party who engages the witness.

Evidence of expert witness

3 In any evidence given by an expert witness, the expert witness must—

(a) acknowledge that the expert witness has read this code of conduct and agrees to comply with it:

(b) state the expert witness' qualifications as an expert:

(c) state the issues the evidence of the expert witness addresses and that the evidence is within the expert's area of expertise:

(d) state the facts and assumptions on which the opinions of the expert witness are based:

(e) state the reasons for the opinions given by the expert witness:

(f) specify any literature or other material used or relied on in support of the opinions expressed by the expert witness:

(g) describe any examinations, tests, or other investigations on which the expert witness has relied and identify, and give details of the qualifications of, any person who carried them out.

4 If an expert witness believes that his or her evidence or any part of it may be incomplete or inaccurate without some qualification, that qualification must be stated in his or her evidence.

5 If an expert witness believes that his or her opinion is not a concluded opinion because of insufficient research or data or for any other reason, this must be stated in his or her evidence.

Duty to confer

6 An expert witness must comply with any direction of the court to—

(a) confer with another expert witness:

(b) try to reach agreement with the other expert witness on matters within the field of expertise of the expert witnesses:

(c) prepare and sign a joint witness statement stating the matters on which the expert witnesses agree and the matters on which they do not agree, including the reasons for their disagreement.

7 In conferring with another expert witness, the expert witness must exercise independent and professional judgment, and must not act on the instructions or directions of any person to withhold or avoid agreement.

Appendix C: Suggested cross-examination questions regarding DNA (where not already addressed by the expert in evidence) (Taupin, 2013)[270]

General

- Were the collection policies and practices at the crime scene or medical examination optimal in the analysis of this case?
- Was a rationale for testing explained in the notes and or statement? If not, what was the rationale?
- Was the scientific method used (and what is that?)
- Have alternative hypotheses been considered? What are they?
- Why is DNA profiling so powerful? (It has a high discrimination power and the power to exclude)
- Have the meanings of the scientific terms used been properly explained?
- Was an impact-based priority testing system used?
- What quality assurance procedures were in place?
- Is the examiner aware of observer and/or context effects?
- Does the examiner know the error rates of the tests? Can he or she explain this concept?
- How have the statistics quoted in the report been determined?
- Is there a possibility of transfer (primary, secondary, or higher)?
- Did the positive and negative controls perform as expected?
- Does the laboratory have databases for investigating contamination events including elimination databases for consumable suppliers (where possible), police officers attending crime scenes, crime scene operators, and laboratory staff (scientific and administrative)? What are they specifically?
- Were there issues with the technical review?
- Were there issues with the administrative review?

Single source DNA profiles associated with blood, semen, or saliva

- Can the DNA profile be related to a specific body fluid? If so, how?
- What reference profiles were used and how were they obtained?
- Were all appropriate reference samples taken and profiled?
- Was the evidence profile interpreted and designated as single source before comparison with reference DNA profiles?
- How can we be sure that contamination was prevented?
- What are the limitations of the results?
- Have the appropriate population databases been used?
- Was extra scrutiny applied if there is only one DNA result from many items tested?
- If there is an inclusion, or a match, what is the statistic and what does it mean?

Difficult DNA profiles (partial, low level, mixture, unspecified origin)

- Is this a partial DNA profile and why?
- Does this DNA profile exhibit degradation or inhibition and why?
- Was the sample re-amplified to obtain a better result? If not, why not?
- Are any of the samples mixtures from two or more individuals?
- Can the mixtures be separated into major and minor contributors, and if so why and how?
- What are the possible methods of transfer of the DNA?
- Can the DNA detected be related to a particular time?
- Can the DNA be related to a particular body matter? If so, how?
- Do any profiles exhibit low level DNA and require extra scrutiny?
- Are any of the peaks in the profile below the stochastic threshold?
- How has the witness dealt with this? Would the witness say this profile is suboptimal?
- If the profile is low level, what extra precautions were taken, if any?

[270] Jane Taupin *Introduction to Forensic DNA Evidence for Criminal Justice Professionals* (CRC Press, Boca Raton, Florida, 2013) at 151-153.

- How was the final profile derived—through consensus profiles or the statistical model? What was the rationale?

Expert witness

- Does the witness have an appreciation of DNA interpretation practices internationally?
- Does the witness participate in a continuing education program?