AAS/AAL Symposium
'Juries, Judges, and Junk Science — Expert Evidence on Trial'
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Introduction

1 The rules governing opinion evidence were once fairly straightforward. At common law, the opinions of 'skilled witnesses' were admissible whenever the subject was one upon which the competency to form an opinion could only be acquired by a course of special study, or in some cases, experience. Non-expert opinion evidence could be given if the facts from which a witness received an impression were 'too evanescent in their nature' to be recollected,[1] or too complicated to be separately and distinctly narrated. It was well understood that opinion had to be separated from fact, though the distinction between the two was not always easy to discern.

2 In criminal cases, expert opinions were considered necessary in order to assist jurors in properly drawing inferences from established facts, particularly where laypersons could not reasonably be expected to perform that task without help.

3 Standard legal texts on evidence dealt with the subject of expert evidence in barely a few short pages.[2] Fingerprint evidence was considered to be the 'gold standard'. That meant that the word of a fingerprint expert was considered holy writ. Beyond evidence of that kind, other forms of scientific expertise came to be recognised.

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1 *Cornell v Green* 10 Serg & Rawle 14, 16 (Pa Sup Ct, 1823), quoted in *Lithgow City Council v Jackson* (2011) 244 CLR 352, 371 [46] (French CJ, Heydon and Bell JJ). See also, Professor J H Wigmore, *Evidence in Trials at Common Law*, (1978) Chadbourn Revision Vol 7, 12 §1918.

2 The English edition of Professor Rupert Cross, *Evidence* (Butterworth and Co., 3rd ed, 1967), 363–7, dealt with the entire body of law relating to expert evidence in only four pages. Sidney Lovell Phipson et al, *Phipson on Evidence* (Sweet & Maxwell, 13th ed, 1982) stretched this to seven pages. Contrast Dr I R L Freckelton's massive tome, *Expert Evidence* (Law Book Co, 6th ed, 2019), which runs for about 1,400 pages.

So, for example, handwriting evidence assumed virtually definitive status. Bloodstain analysis developed into a science which enabled a crime scene to be reconstructed, almost exclusively from the shape and pattern of the bloodstains left close to where a body was discovered. Ballistic experts were considered to be able to assert, with absolute reliability, whether a particular bullet, or other ammunition, had been fired from a designated weapon.[3] Later, there developed a series of new 'sciences'. These included voice identification, linguistic speech patterns (stylometry), forensic odontology, shoeprint analysis, and even facial and gait recognition.

'Junk science'

4 We now know that some of what passes for expert evidence merits the title 'junk science'.[4] Our newfound scepticism has, by now, even reached the point of casting doubt upon the hitherto assumed infallibility of fingerprint evidence.[5]

5 The introduction into criminal trials of DNA evidence, both overseas and in this country, has given rise to a host of new problems. Doubts have been expressed as to the capacity of lay jurors to comprehend the strengths, and weaknesses, of such evidence. Questions have arisen as to whether trial judges ought act as 'gatekeepers'[6], both in relation to some of the more exotic forms of DNA evidence that have recently

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3 See generally, Vincent J M Di Maio, *Gunshot Wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques* (Elsevier, 1985).

4 See generally, Judge Jed S Rakoff, 'Jailed by Bad Science', *The New York Review of Books* (New York, 19 December 2019) 79, 80, 85. The term 'junk science' has been in use since the mid-1980s. It was popularised by Peter W Huber, in his book *Galileo's Revenge: Junk Science in the Courtroom* (Basic Books, 1991). By 1997, Justice John Paul Stevens had adopted the term, using the example of phrenology as a form of 'junk science' that would be excluded under the '*Daubert* test', to which I shall return. See, generally, *General Electric Company v Joiner* 522 US 136 (1997), 153.

5 See generally, Professor Gary Edmond 'Latent Science: A History of Challenges to Fingerprint Evidence in Australia' (2019) 38(2) *University of Queensland Law Journal* 301. Contrast the near veneration accorded to fingerprint evidence in some of the classic texts on the subject, even those written as recently as the 1980s. See, for example, James F Cowger, *Friction Ridge Skin: Comparison and Identification of Fingerprints* (Elsevier, 1983).

6 See, for example, Justice Chris Maxwell, 'Preventing Miscarriages of Justice: The Reliability of Forensic Evidence and the Role of the Trial Judge as Gatekeeper' (2019) 93(8) *Australian Law Journal* 642 ('Preventing Miscarriages of Justice'). See also, Professor Edmond, 'Regulating Forensic Science and Medicine Evidence at Trial: It's Time for a Wall, a Gate and Some Gatekeeping' (2020) 94(6) *Australian Law Journal* 427 ('Regulating Forensic Science and Medicine Evidence at Trial').

come into use, and other areas of 'junk science' in order to avoid, or at least minimise, the risk of wrongful convictions.

6 Certain forensic techniques, such as mitochondrial DNA (usually undertaken as a form of hair analysis), tool mark identification, and fibre analysis, some of which are utilised by 'experts' in the evidence that they are permitted to give in criminal trials, are increasingly regarded as unscientific and highly subjective. It is said that, far from being 'scientific', these techniques often involve nothing more than opinions based on conjecture.[7]

7 In the United States, of more than 2,400 proven false convictions since 1989, recorded by the National Registry of Exonerations, nearly 25% involved false or misleading forensic scientific evidence.[8] It would not be unreasonable to think that, whatever the percentage might be in this country, there have been a significant number of wrongful convictions based upon flawed evidence of that kind.[9]

8 The precursors of many of the forensic techniques routinely used today were originally developed by police laboratories. These were initially regarded as nothing more than helpful investigative tools, with no claim to being hard science.[10] However, over time, the data gathered came to be introduced as substantive evidence in criminal cases. Often, that evidence was adduced through laboratory technicians, many of

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7 See, for example, National Academy of Sciences, *Strengthening Forensic Science in the United States: A Path Forward* (2009) ('*Strengthening Forensic Science*'). Chapter 5 of that report provides a devastating critique of a number of forms of forensic science that the authors regard as essentially unscientific in their methodology. These include shoeprint and tyre track pattern evidence, tool mark and firearms identification evidence, mitochondrial DNA hair evidence, fibre evidence, handwriting evidence, forensic odontology, as well as some forms of paint and coatings evidence, and certain types of bloodstain pattern analysis. In some cases, the complaint is not so much that this evidence is admitted, but rather that it is presented to juries in a manner that significantly overstates its reliability.

8 Judge Rakoff, 'Jailed by Bad Science' (above n 4), 79.

9 There are, of course, the usual well known examples. These include the case of Lindy Chamberlain, who was eventually shown to be innocent of the death of her daughter, Azaria. They also include the case of Andrew Mallard, wrongly convicted of murder in Western Australia, and, more recently, David Eastman, whose conviction was quashed after it became clear that it was based, in part, on bogus forensic science.

10 Judge Rakoff, 'Jailed by Bad Science' (above n 4), 79. See also, National Academy of Sciences, *Strengthening Forensic Science* (above n 7), 42.

whom lacked the technical expertise to provide the information to the Court in a manner that could be relied upon. Sometimes, it was police investigators themselves, who were wrongly portrayed as highly qualified 'forensic experts'.[11] Few had any scientific training, in the true sense. Yet, in the United States, their testimony often went uncontested. Defence lawyers simply lacked the scientific and technical training enabling them effectively to challenge such testimony.

9 DNA testing began to be used as the basis for evidence in the 1980s. DNA evidence was first admitted in a criminal trial in this country in 1989.[12] It soon proved to be far more reliable in establishing guilt, or indeed innocence, than any of the forensic techniques which had preceded it.[13]

10 In the United States, the Supreme Court in 1993 conferred upon Federal judges the responsibility of acting as 'gatekeepers' for the admissibility of scientific and other forensic testimony. Previously, the admissibility of such evidence had depended upon what was known as the '*Frye* test'.[14] *Frye* held that in order to be admissible, an expert opinion had to be deduced from a well-recognised scientific principle and discovery which was sufficiently established to have gained general acceptance in the particular field to which it belonged.[15]

11 In *Frye*, it was held that evidence of blood pressure changes as a means of detecting deception was not admissible. It was held that such evidence was not sufficiently accepted as reliable to warrant being received by Federal Courts. On the other hand, fingerprint evidence easily passed the *Frye* test. Numerous convictions

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11 Judge Rakoff, 'Jailed by Bad Science' (above n 4), 79.

12 Dr Marcus Smith, 'Three Stages in the Development of DNA Evidence in Australia' (2019) 51(6) *Australian Journal of Forensic Sciences* 705, 705–6.

13 DNA testing utilised through the Innocence Project, created in 1992 at the Cardozo School of Law, has conclusively demonstrated that, at the time of writing this paper, 375 people were wrongly convicted in the United States of offences such as murder and rape. Many of these people were not only wrongly convicted, but were later shown to have been innocent. See 'DNA Exonerations in the United States', *Innocence Project* (Web Page) <https://www.innocenceproject.org/dna-exonerations-in-the-united-states/>.

14 *Frye v United States* 293 F 1013 (1923) ('*Frye*').

15 Ibid 1014.

that were based on nothing more than the opinion of fingerprint experts were sustained.

12 In 1993, in *Daubert v Merrell Dow Pharmaceuticals Inc*,[16] a civil case, the Supreme Court overruled *Frye*. *Daubert* held that in future, Federal judges had to take a far more active approach to the admissibility of scientific testimony.[17] Speaking colloquially, *Daubert's* aim was to eliminate much of so-called 'junk science'. It established that a judge, in determining whether to permit purported expert scientific testimony, had to examine whether the methodology in question was not merely generally accepted, but whether it actually passed muster in terms of scientific testing. So, for example, a judge ought to consider whether the methodology underlying the evidence sought to be adduced had been peer reviewed, in reputable scientific journals. The judge should also consider whether it had a known and low error rate.[18] This was the 'gatekeeper' role which Federal judges were obliged, in future, to adopt, particularly in dealing with juries.

13 In the early years after *Daubert*, the new and more restrictive test for admissibility came to be readily applied in civil cases. However, initially at least, *Daubert* was largely ignored in criminal matters.[19] The explanation was simple. Most criminal defendants, being indigent, could not fund the necessary investigative research which could ground a successful challenge to the admissibility of scientific evidence.[20]

14 The extraordinary number of DNA exonerations that condemned 'junk science'

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16 509 US 579 (1993) ('*Daubert*').

17 Ibid 586–90 (Blackmun J, joined by White, O'Connor, Scalia, Kennedy, Souter and Thomas JJ, Rehnquist CJ, joined by Stevens J, agreeing separately at 599).

18 Judge Rakoff, 'Jailed by Bad Science' (above n 4), 79.

19 Ibid.

20 Judge Rakoff comments that a subconscious bias on the part of judges against excluding such evidence, and a desire on the part of elected judges to avoid being seen as 'soft on crime' provide additional reasons why *Daubert* did not, initially, change the landscape of criminal trials. He also notes that in State courts in the United States, judges' dockets are overloaded to the point that it is almost impossible for them to come to terms with what is required in a truly probing *Daubert* hearing.

eventually produced a legislative response. In 2005, Congress directed the National Academy of Sciences to investigate the subject.[21] In 2009, a committee of scientists, academics, and legal practitioners produced a lengthy report which, as I have indicated, was highly critical of many previously accepted forensic techniques.

15 The report concluded that little or no rigorous scientific testing had been done to determine the validity and reliability of many of these techniques. It noted that, in practice, the evidence given by 'experts' regarding their findings was often highly subjective. To the astonishment of many, the report found that much the same could be said of fingerprint evidence, which had never been the subject of rigorous, independent, scientific testing.[22]

16 The report recommended the creation of an independent National Institute of Forensic Science to test, with rigour, the various methodologies upon which prosecutors, in particular, had come to rely in criminal proceedings. After much debate, and opposition from the Department of Justice, a National Commission on Forensic Science was established in 2013. The Commission had 31 members. These included prosecutors, defence attorneys, scientists, academics, and judges from both State and Federal courts.[23]

17 Between 2013 and 2017, the Commission made more than 40 recommendations regarding the admissibility of expert evidence in criminal matters. For example, it recommended that forensic experts should no longer be permitted to testify that their opinions were given with 'a reasonable degree of scientific certainty'.[24] Language of that kind was said to have no scientific meaning and had the potential to mislead both judges and jurors. Curiously, many of the States declined to accept that recommendation and, even today, that formulation continues to be used.[25]

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21 National Academy of Sciences, *Strengthening Forensic Science* (above n 7), 1.

22 Ibid 136–45.

23 Judge Rakoff, 'Jailed by Bad Science' (above n 4), 80.

24 Ibid.

25 Judge Rakoff comments that many police sponsored forensic laboratories appear to view the Commission's work as an attack on their integrity, rather than an effort to improve their

18 In 2017, the Department of Justice terminated the work of the Commission. It considered that any necessary research could be done within the Department itself. It has been clearly demonstrated since that this was not the case.

19 The data assembled in recent years shows that much modern forensic science is prone to error. For example, in relation to microscopic hair analysis, an FBI review of testimony in over 3,000 criminal cases showed that FBI examiners had provided scientifically invalid testimony in over 95% of cases, leading to many wrongful convictions.[26]

20 Nonetheless, the FBI and local police authorities in the United States have been loath to admit that the forensic science which they regularly utilise is, in any true sense, suspect. According to Judge Jed Rakoff,[27] most Federal judges still do not undertake any appropriate *Daubert* review of the admissibility of forensic scientific opinion.[28]

21 In addition, a number of forensic laboratories in the United States lack the independence from police and prosecutors necessary to enable them to do their work in an impartial and unbiased manner.[29] Some of them are non-accredited. In that respect, the situation in this country is vastly better than that in the United States.

Trial judges as 'gatekeepers'

22 Nonetheless, the position in Australia regarding forensic scientific opinion and its use in criminal trials is problematic. A major difficulty arises from the failure of our laws to recognise the wisdom of *Daubert* and to require trial judges to engage more

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methodology.

26 President's Council of Advisors on Science and Technology, *Report to the President – Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods* (September 2016, 3, 30.

27 Senior United States District Judge of the United States District Court for the Southern District of New York.

28 Judge Rakoff, 'Jailed by Bad Science' (above n 4), 80.

29 Ibid.

meaningfully with some of the newer forms of expert evidence, including those in the field of 'hard science'.[30]

23 In order to develop this 'gatekeeper' thesis, which I derive to a considerable degree from commentators such as Professor Gary Edmond, and my colleague, Justice Chris Maxwell, President of the Victorian Court of Appeal, it is necessary to say something briefly about our current rules regarding the role that trial judges are to play, vis-à-vis that of juries. I focus mainly upon the rules of evidence as they apply under the *Uniform Evidence Law*, with which I am now most familiar.

24 In recent years, both appellate judgments and some legislation have developed a degree of deference towards the role of juries, which some might think is a step too far. I should say that I strongly believe in trial by jury in serious criminal cases. I have said before that I agree with the widespread sentiment among criminal lawyers that juries almost always 'get it right'. The caveat is that the key word is 'almost'. Rarely, but sometimes, juries simply get it badly wrong. We can, and must, tolerate the occasional wrongful acquittal, which is the price we pay for ensuring that we minimise the chance of a wrongful conviction.

25 That takes me to one of the main themes in this paper. Historically, the rules of evidence developed in an ad hoc manner and many had no rational basis. In particular, evidence that was of little worth was regularly admitted and evidence of high probative value was often excluded.

26 It was not until well into the 19th century that trial judges began, systematically, to filter out evidence that they considered to be essentially worthless. So, for example, the hearsay rule, which had, by then, been in existence for more than a century, began

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30 There is a great deal, it seems to me, of 'junk science' in the field of 'soft science' as well. For example, some of the reports prepared by psychologists, which endeavour to predict future recidivism, based on 'tests' that appear to be grounded in validated studies, are little more than surmise and conjecture. This paper does not concern itself with expert evidence of that kind, which may be described as 'pseudo-science'.

to be applied with greater rigour and, in many cases, inflexibly.[31] Many commentators observed that the common law of evidence could fairly be described as irrational.

27 The general distrust exhibited by trial judges of the jury's capacity to deal appropriately with questionable evidence continued well into the 20th century. That distrust was, to some degree, reflected in the host of judicial warnings that had to be given regarding evidence that was thought to be suspect. However, it went further.

28 For example, it had been understood for a very long time that trial judges in criminal matters could and should direct acquittals in cases that they considered to be particularly weak. A trial judge who believed that any conviction would be unsafe or unsatisfactory was expected to direct the jury to acquit.

29 By the 1980s, this power of directed acquittal was thought by many to have been overused.[32] Eventually, in *Doney v The Queen*,[33] the High Court held that in a criminal trial, if there is evidence (no matter how tenuous, inherently weak or vague it might be) that is capable of being taken into account by a jury, a trial judge has no power to direct an acquittal.[34] More specifically, a trial judge cannot direct an acquittal merely because that judge considers that any conviction would be held, on appeal, to be unsafe or unsatisfactory.[35]

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31 The law requiring the exclusion of confessions or admissions that were brought about after even the mildest of inducements was said to have been unduly tender to accused persons. See *R v Baldry* (1852) 2 Den 430, where Parke B observed that there had been too much tenderness towards prisoners in relation to inducements that vitiated confessions. See further, Professor Cross, *Evidence* (above n 2), 446.

32 There was a widespread perception at the time that this was particularly the case in relation to certain judges of the District Court of New South Wales. The Supreme Court of the Australian Capital Territory also acquired a reputation for directing acquittals all too frequently.

33 (1990) 171 CLR 207 ('*Doney*').

34 Ibid 214–5.

35 If I may respectfully say so, *Doney* seems to me to have gone too far in this respect. I think I can say this because I appeared in that case on behalf of the prosecution. The Court's ultimate decision went considerably beyond the submissions that were put forward on behalf of the Crown. As a result of *Doney*, there have been a number of convictions which have had to be overturned by intermediate appellate courts because it was clear that those convictions were unsafe or unsatisfactory. Properly speaking, these cases should have been filtered out at a much earlier stage, first by prosecutors discharging their responsibilities correctly, and then by trial judges taking extremely weak cases away from juries.

30 There are other manifestations of this greater deference towards juries on the part of appellate courts. These can be seen through some of the limitations imposed by the High Court upon intermediate appellate courts when considering whether convictions should be set aside as unsafe or unsatisfactory. The High Court has made it clear that this power should be exercised most sparingly, bearing in mind the 'constitutional' role of the jury in determining questions of guilt or innocence.[36]

31 In addition, the High Court has stated that intermediate appellate courts should generally defer to juries in circumstances where the advantage that they enjoy in having seen and heard the testimony given at trial can overcome any doubts that the appellate judges feel.[37]

32 The trend towards judicial deference towards juries in criminal trials can be seen in other areas. The recent decision by the High Court to abolish what was known as the '*Prasad* direction' reflects that trend.[38] So too do the limitations imposed upon the granting of permanent stays, based upon undue delay,[39] and most recently, the restrictions upon trial judges commenting on facts.[40]

33 The philosophy which underlies the *Uniform Evidence Law* clearly favours the admissibility of all relevant evidence, with far fewer exclusions than the common law allowed. So, for example, evidence that would traditionally have been regarded as unduly prejudicial to warrant admissibility is now frequently permitted to be led in criminal trials. Some commentators regard the rules governing the admissibility of tendency and coincidence evidence to have been watered down to the point where it can be said that the trial of sexual offences is subject to quite different rules of

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36 *R v Baden-Clay* (2016) 258 CLR 308, 329 [65].

37 *M v The Queen* (1994) 181 CLR 487, 494–5 (Mason CJ, Deane, Dawson and Toohey JJ). The contrast between the Australian approach, and that taken in England, where convictions are set aside if there is a 'lurking doubt' as to guilt, is stark. Cf, *R v Cooper* [1968] 3 WLR 1225, 1228.

38 *DPP Reference No 1 of 2017* (2019) 93 ALJR 424.

39 In Victoria, there have been instances where prosecutions have proceeded in relation to sexual offences that are said to have been committed as far back as 40, or even 50, years ago. See, for example, *McGee (a pseudonym) v The Queen* [2020] VSCA 146.

40 *McKell v The Queen* (2019) 264 CLR 307, 324–6 [49]–[55] (Bell, Keane, Gordon and Edelman JJ).

admissibility than other criminal trials.[41]

34 How then does this shift towards greater deference to the role of juries, in decision making in criminal trials, relate to the question of how to deal with 'junk science'? The short answer is that there is a connection.

35 The gatekeeper debate illustrates this point. Section 79 of the *Evidence Act 2008*, which is, of course, the key provision governing the admissibility of expert opinion evidence, relevantly provides as follows:

> (1) If a person has specialised knowledge based on the person's training, study or experience, the opinion rule does not apply to evidence of an opinion of that person that is wholly or substantially based on that knowledge.

36 Professor Edmond, who has written extensively on the subject of expert evidence and 'junk science' understands the implications of this area as well as anyone I know. In his latest paper, he comments:

> [I]t has become increasingly obvious over the past decade that the manner in which Australian courts admit, present and evaluate scientific, technical and medical evidence is in many ways inconsistent with the recommendations and advice of peak scientific and technical organisations. The failure of legal institutions to engage with scientific, technical and medical evidence on terms recommended by peak scientific organisations requires explanation. But there has been no explanation and there are no principled reasons for the current legal derogation.[42]

37 Professor Edmond regards it as remarkable that Australian judges, though many may be aware of *Daubert*, have drawn upon that decision for the limited purpose of assisting with the meaning of the term 'specialised knowledge' in s 79, but have not taken the judgment further. Indeed, he comments that the High Court has effectively repudiated reliability as a criterion of admissibility under that section.[43]

38 Professor Edmond singles out the High Court's decision in *Dasreef Pty Ltd v*

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41 See, for example, Professor David Hamer, 'Current Issues: The Case for Principled and Practical Propensity Evidence Reform' (2020) 94(4) *Australian Law Journal* 239, 240.

42 Professor Edmond, 'Regulating Forensic Science and Medicine Evidence at Trial' (above n 6), 428 (citations omitted).

43 Ibid 429.

Hawchar[44] for particular criticism in that regard. He notes that *Dasreef* took the view that the requirements of s 79 can, in most cases, be satisfied quickly and easily, once the witness has described his or her qualifications and experience, and identified the subject matter about which the opinion is offered. In his view, that approach, though no doubt open as a matter of textual interpretation, is seriously flawed and is likely to lead to miscarriages of justice.[45]

39 Professor Edmond illustrates his point by noting that bite mark evidence of the kind that is sometimes led in criminal trials represents an example of bogus science, rendering such evidence unfit to be presented to a jury. Yet, he legitimately asks whether demonstrably weak evidence of that kind is nonetheless admissible under s 79, as that section is currently interpreted. He observes that any dentist claiming to be able to identify bite marks would presumably pass the *Dasreef* test. That is so, despite the fact that such evidence has never gone through a proper formal evaluation process, and that it has been shown to be unreliable in a number of overseas cases. Indeed, he goes further, and suggests that there is no evidence at all that dentists can reliably identify features said to be similar, let alone interpret their significance.[46]

40 Professor Edmond is also critical of aspects of the reasoning of the High Court in *Honeysett v The Queen*.[47] In that case, the question to be determined was whether a professor of anatomy, who had viewed CCTV images of an offender, was able to identify the accused as that offender merely from his examination of a number of points of alleged similarity. The High Court held that the evidence in question ought to have been excluded because it was not based on any specialised knowledge on the part of the witness.[48] The criticism levelled by Professor Edmond at the judgment is that it failed to engage with the question of the validity, reliability, and proficiency of

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44 (2011) 243 CLR 588 ('*Dasreef*').

45 Professor Edmond, 'Regulating Forensic Scientific and Medicine Evidence at Trial' (above n 6), 429–30.

46 Ibid.

47 (2014) 253 CLR 122.

48 Ibid 137–8 [42]–[46].

the opinion itself. As he comments, we still do not know whether the witness, or any other specialist in that field, could accurately compare persons in images, or accurately interpret features to describe similarities. In other words, evidence which may actually have been highly probative was never assessed for reliability.[49]

41 Professor Edmond is also critical of appellate courts for having disarmed what might otherwise be a viable method of allowing trial judges to play a gatekeeper role through the use of s 137 of the *Evidence Act*. That section, of course, requires a trial judge to balance the probative value of the evidence sought to be led against the danger of unfair prejudice to the accused.

42 However, when determining the probative value of the evidence in order to undertake the balancing exercise, judges have been instructed that they are not to consider its reliability, still less the credibility of the witness in question. Rather, they are to take the evidence 'at its highest' (whatever that may mean). In carrying out the balancing exercise, judges are to consider the capacity of the evidence to assist the prosecution case as if that evidence were to be accepted by the jury. They are not to act upon their own assessment of the worth of the evidence in question.

43 In Professor Edmond's opinion, this effectively means that the admission of the expert evidence becomes contingent on 'judicial guesses', rather than being based on the proper evaluation and understanding of its true reliability.[50] He argues that, at least where the evidence in question is scientific in nature, the balancing exercise mandated by s 137 ought to be carried out having regard to the judge's assessment of its potential reliability.

44 I must confess to having been party to the very heresy that Professor Edmond

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[49] It seems that recent scientific studies have identified two groups, forensic facial examiners, and those known as 'super-recognisers', who have demonstrated exceptional ability in accurately identifying persons viewed in images. Professor Edmond makes the entirely valid point that evidence of this kind might, paradoxically, be admissible as lay opinion under s 78, though inadmissible under s 79.

[50] Professor Edmond, 'Regulating Forensic Science and Medicine Evidence at Trial' (above n 6), 434.

decries. I sat as a member of the Court of Appeal in *Tuite v The Queen*.[51] We held, effectively contrary to *Daubert*, that the exercise of the power under s 79 to permit expert opinion evidence to be led did not permit reliability to be taken into account as a precondition of admissibility under that section.

45 To compensate, however, we held that reliability should be taken into account when the balancing exercise under s 137 was being undertaken. Though he is critical of *Tuite*, Professor Edmond is at least kind enough to describe the judgment as a 'virtuous exception' to the disarming of the gatekeeper role of the trial judge,[52] which he sees as having been brought about, largely, by the High Court's decision in *IMM v The Queen*.[53]

46 *IMM* concerned the admissibility of tendency evidence and its interplay with s 137. The case itself had nothing to do with the admissibility of expert scientific evidence. Our decision in *Tuite* was not mentioned in *IMM*, but it seems to me that *Tuite* has clearly been overruled. That is because *IMM* adopted the New South Wales approach to s 137, in preference to that always previously taken in Victoria. *IMM* was a 4–3 decision, with the majority French CJ, Kiefel, Bell and Keane JJ following the New South Wales approach, while Gageler, Nettle and Gordon JJ all preferred the Victorian mode of analysis.[54]

47 The difficulty with *IMM*, so far as scientific expert evidence is concerned, is that it may have effectively put to an end any gatekeeper role at all for trial judges. It would, therefore, have had the perhaps unintended consequence of preventing trial

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51 (2015) 49 VR 196 ('*Tuite*').

52 Professor Edmond, 'Regulating Forensic Science and Medicine Evidence at Trial' (above n 6), 434 n 54.

53 (2016) 257 CLR 300 ('*IMM*'). See also, Professor Edmond, 'Icarus and the *Evidence Act*: Section 137, Probative Value and Taking Forensic Science evidence 'At Its Highest'' (2017) 41(1) *Melbourne University Law Review* 106.

54 The New South Wales view of s 137 essentially reflected the view that had been taken by Gaudron J in *Adam v The Queen* (2001) 207 CLR 96, 115 [60] while her Honour was on the High Court. In essence, she held that it was necessary to read the definition of 'probative value' as if it included an assumption that the evidence would be accepted. The Victorian approach to the section largely reflected the view of McHugh J in *Papakosmas v The Queen* (1999) 196 CLR 297, 323 [86]. Namely, that the definition of 'probative value' would necessarily involve considerations of reliability.

judges from applying a reliability criterion to scientific evidence, as a condition of admissibility, although, as I have said, *IMM* itself was not concerned with evidence of that kind. All this at a time when radical new developments in areas of forensic science have given rise to legitimate questions as to the validity of the opinions sometimes expressed by experts, and where there may be a real need to filter out what is pejoratively, but accurately, called 'junk science'.

48 In a recent paper,[55] Justice Maxwell observed that the case for 'reinstating' the gatekeeper role of trial judges rested upon three propositions.[56] First, eliminating unreliable forensic evidence, the danger being that expert evidence will be misused and distort the fact-finding process.[57] Secondly, the reliability of most branches of forensic science is unproven, the exception being nuclear DNA analysis. Thirdly, jurors are in no position to assess the reliability of the scientific foundation on which an expert's opinion rests, or of the methodology adopted by the expert to arrive at the opinion.

49 Justice Maxwell went on to observe that in both the United Kingdom,[58] and in Canada, courts have ruled that, at common law, reliability is a condition of admissibility. In Australia, by contrast, issues such as these have received comparatively little attention, with no systematic, independent, review having been undertaken into the state of forensic science in this country. He proposed an amendment to s 79 to make reliability a threshold condition of the admissibility of expert evidence in criminal proceedings, and to require trial judges to carry out that assessment. He argued that 'novel science', in particular, should be subject to special

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55 Justice Maxwell, 'Preventing Miscarriages of Justice' (above n 6).

56 Ibid 643.

57 See *R v Mohan* [1994] 2 SCR 9, 21. There, the Supreme Court of Canada noted that when dressed up in scientific language which the jury would not easily understand, and submitted through a witness of impressive antecedents, such evidence is apt to be accepted by the jury as being virtually infallible and as having more weight than it deserves.

58 In 2011, the Law Commission recommended enactment of a provision to the effect that an expert's opinion evidence would be admissible only if it were 'sufficiently reliable'. The UK Government declined to legislate in accordance with that recommendation. That led the Lord Chief Justice to issue a new practice direction on expert evidence in criminal proceedings, effectively adopting a gatekeeper role for trial judges, and setting out the criteria which should be followed in assessing reliability.

scrutiny, and suggested several ways in which that threshold assessment could be carried out.[59]

The problem of dealing with DNA evidence

50 My own experience of dealing with complex forensic scientific evidence, most particularly as both a trial and appellate judge, leads me to conclude that this area is replete with difficulties. I was the trial judge in the well-known case of *McNeill*,[60] which concerned the brutal murder of a young woman, Janelle Patton, on Norfolk Island. The prosecution relied upon a host of expert witnesses. They gave evidence regarding paint and glass identification, as well as fingerprint analysis. Importantly for present purposes, the prosecution also sought to call an expert from the United States in the field of mitochondrial DNA testing. Many months after the victim's body had been discovered, several hairs were detected in the boot of a car that could be linked to the accused. The prosecution sought to establish that these hairs came from the victim.

51 Mitochondrial DNA is very different to the kind of DNA to which we are now accustomed. That form of DNA is sometimes termed 'nuclear DNA'. For reasons that I need not go into at present, mitochondrial DNA is far less discerning.

52 In *McNeill*, the expert witness took what Dr Ian Freckelton describes as a 'purist position'.[61] She would go no further than to say that she could not exclude the deceased, and her maternal relatives, as being donors of the two hairs that had been tested. She acknowledged, in the course of a lengthy voir dire, that the database against which she compared the samples came from North America, and included

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59 These included a '*Daubert* hearing', of the kind which the trial judge in *Tuite* conducted into low-copy DNA. That pre-trial hearing occupied some 22 days. Another possibility would be for a judge to seek the assistance of a court appointed expert. A third possibility would be the use of a multidisciplinary advisory panel. In addition, Maxwell P observed that it would be desirable to establish a body such as a forensic science regulator to establish and maintain quality standards relating to forensic science techniques. Professor Edmond, in his most recent paper, cited above at n 6, supports most of Maxwell P's suggestions.

60 *R v McNeill (Ruling No 2)* [2007] NFSC 3 ('*McNeill*').

61 Dr Freckelton, *Expert Evidence* (above n 2), 1151.

sequences from many mixed racial groups. She agreed that there was no mitochondrial DNA database available in either Australia or New Zealand. When asked why she persisted in speaking of an inability to exclude, rather than explaining in language that a jury might understand what she actually meant, she refused to depart from that strict formula. She would not say, for example, whether it was likely that the hairs came from the same maternal line. She could not, and would not, produce any statistics of the kind typically presented in nuclear DNA cases. She was only prepared to say that mitochondrial DNA was nowhere near as discriminating as nuclear DNA.

53 After the voir dire, I excluded the expert's evidence, and her reports. I described them, perhaps unkindly, as 'all but incomprehensible',[62] and therefore unfairly prejudicial to the accused. I characterised her reports as 'misleading and confusing',[63] thereby invoking one of the limbs of s 135 of the *Uniform Evidence Law*, which enables a trial judge to exclude evidence of that kind. I acknowledge that whether my reasoning was correct at the time is problematic.[64] The same can be said with regard to whether that reasoning could withstand the effect of *IMM*.

54 My other encounters with DNA evidence have led me to question not so much its reliability, but the manner in which such evidence is generally presented to juries in criminal trials.

55 In most cases involving such evidence, defence counsel do not even attempt to challenge the reliability of the opinions being expressed, so far as the profiling process is concerned.

56 It is important, however, to note that DNA technology has undergone

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62 *McNeill* [2007] NFSC 3, [47].

63 Ibid [45], [49].

64 In *Aytugrul v The Queen* (2012) 247 CLR 170, the High Court dismissed an appeal against conviction where it was contended that mitochondrial DNA evidence involving a single hair ought to have been excluded pursuant to ss 135 and 137 of the *Evidence Act* on the basis that it had been presented in a manner that was misleading or confusing. It could be argued, however, that the High Court's reasoning turned largely upon the very clear manner in which the expert opinion had been proffered in that case. The very opposite was true in *McNeill*.

enormous development since it was first used in criminal proceedings. Although I have had the science behind DNA explained to me on a number of occasions, through expert evidence led in trials that I have conducted, I confess that my understanding of the science remains rudimentary.

57 According to Dr Freckelton, two main forms of nuclear DNA testing are short tandem repeat (STR) analysis, and Y-chromosome analysis. He notes that a further and developing aspect of DNA technology, which is likely to present admissibility issues in the short term, is rapid DNA technology.[65]

58 We know that DNA is a relatively stable substance which can survive for many years. We also know that every human being sheds DNA and it can be deposited or transferred by primary or secondary means.[66]

59 Dr Freckelton comments, correctly in my respectful opinion, that one of the greatest challenges facing both the prosecution and defence in DNA cases is to elicit evidence and conduct cross-examination in such a way that the evidence is comprehensible to a judge and jury, without unfairly distorting what is said. DNA profiling has the potential to overwhelm juries simply by the persuasive power of the extraordinary probabilistic formulations produced.[67]

60 It is usual for probabilities to be expressed in the form of a likelihood ratio. Appellate courts have warned of the dangers that statistical expressions, in the form

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65 Dr Freckelton, *Expert Evidence* (above n 2), 1133.

66 *DPP v Paulino* (2017) 54 VR 109. See, particularly, 121 [55] (Priest JA), with whom I agreed in part as to the admissibility of certain DNA evidence in question. It should be noted that the DNA that was sought to be led in that case was excluded on the basis of lack of relevance, since there were so many possible innocent explanations as to how the accused's DNA came to be found on the items in question. See also, *Fitzgerald v The Queen* (2014) 88 ALJR 779, where the High Court quashed a conviction for murder that was largely based upon DNA located on a didgeridoo located at the crime scene, which also had the bloodstains of the victims of the attack upon it. The accused had earlier shaken hands with a co-accused, and it was possible that his DNA had, by that means, found its way onto the didgeridoo.

67 See *DPP v Wise (a pseudonym)* [2016] VSCA 173, [70], for a discussion of the dangers of the 'CSI effect'. In that case, the DNA evidence was excluded at trial because, logically, it had little real probative value, having regard to the agreed amount of contact between the accused and the victim throughout the evening, in ways that were consistent with innocence of the charges brought.

of perhaps billions to one, should not be substituted for proof of guilt beyond reasonable doubt. Juries must be made aware of any inherent limitations in DNA evidence and given sufficient explanation to enable them to evaluate that evidence. Importantly, they must be made to understand that the statistical interpretation of the significance of the DNA match is not direct evidence of the probability that the accused was the source of the incriminating DNA, though it can point to that conclusion. Such evidence must be considered in the light of all the other evidence in the case.

61 It is also generally understood that there is a danger that jurors may be confused or misled by inappropriately expressed references to statistics. This is sometimes termed the 'prosecutor's fallacy'. It was explained in the following terms by Lord Justice Phillips, as he then was, in *Doheny v The Queen*.[68] His Lordship said:

> It is easy, if one eschews rigorous analysis, to draw the following conclusion:
>
> 1. Only one person in a million will have a DNA profile which matches that of the crime stain.
>
> 2. The defendant has a DNA profile that matches the crime stain.
>
> 3. Ergo, there is a million to one probability that the defendant left the crime stain, and is guilty of the crime.[69]

62 Self-evidently, if nothing else is known about the identity of the offender and the size of the group that might include that person is, say, 10 million, the odds that the DNA has correctly identified the offender can be described as one in 10. That presents a somewhat different picture to the one which the prosecution would seek to put forward.

63 In Victoria, we have had recent examples of just how to deal with this type of statistical difficulty. In *Vyater v The Queen*,[70] the accused was charged with various drug offences. His defence was that he knew nothing about the presence of drugs found in an office area of a building that he occupied. In effect, he attributed blame for the manufacture of methylamphetamine, which was going on in that part of the

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68 [1997] 1 Cr App R 369 ('*Doheny*').

69 Ibid 372–3.

70 [2020] VSCA 32 ('*Vyater*').

building, to another person who had been permitted to use that area.[71]

64 The DNA upon which the prosecution sought to rely was found on a glove in a tub that was used as part of the manufacturing process, and also on other equipment. For various reasons that need not presently be explored, the likelihood ratio happened to be extraordinarily low in that case. It was expressed as 26 times more likely that the DNA came from the accused than from a person selected at random from the community at large.

65 In *R v Guingab*,[72] T Forrest J, as his Honour then was, had been confronted with a similarly low likelihood ratio in a trial for murder. His Honour ruled the DNA evidence to be inadmissible, based upon s 137 of the *Evidence Act*. Implicitly at least, he must have had as a central concern the 'CSI effect' of the reference to DNA.[73]

66 In *Vyater*, the Court of Appeal held that the trial judge had correctly permitted the low likelihood ratio of the DNA in question to be led in evidence. Before we come to the reason why that was so, it may be useful to set out the Court's summary of the way in which the DNA evidence had been led at Vyater's trial.

> The DNA evidence was given by an experienced forensic scientist from the Victoria Police Forensic Services Department. The witness ('H') held the position of forensic officer and case manager in the biological sciences group of that Department. In that capacity, she told the jury, she performed biological testing in the laboratory and at crime scenes. In particular, she performed statistical analysis and interpretation of DNA profiles.
>
> At the beginning of her evidence-in-chief, H used a PowerPoint presentation to provide a general explanation of the nature of DNA and of DNA profiling … Asked then to describe the DNA profile obtained from the red glove, H said that it was 'a partial mixture of DNA, originating from three contributors'. Asked to explain what was meant by a 'partial DNA profile', H said:
>
> > The DNA profiles that we look at have 21 sites. If we don't get a result at — at least one of those sites, that is what's called a partial DNA profile.
>
> H told the jury that, when the profile obtained from the glove was compared with the reference sample obtained from the applicant, the result was that the applicant was 'not excluded as being a contributor to that DNA profile'. Asked then about the 'statistical weighting by way of likelihood ratio', H said:

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71 That other person had since died.

72 [2010] VSC 256 ('*Guingab*').

73 Ibid [64].

> The likelihood ratio showed ... that the DNA evidence is 26 times more likely if [the applicant] and two others are contributors than if three unknowns are contributors.[74]

67 H went on to tell the jury that as a result of collaboration amongst experts in the field, a series of verbal equivalents had been developed to express the degree of evidentiary support represented by different likelihood ratios. The table that she produced was as follows:

Likelihood ratio	**Level of evidentiary support**
1	Neutral
1–10	Slight support
10–100	Moderate support
100–1,000	Strong support
1,000–1,000,000	Very strong support
More than 1,000,000	Extremely strong support

68 It followed that the likelihood ratio of one in 26 provided 'moderate support' for the proposition that the accused was the source of the DNA found on the glove and other drug paraphernalia.

69 Unlike the position in *Guingab*, that very low ratio was held to be sufficient to warrant admissibility in the particular circumstances of the case. The reason was simple. *Vyater* did not concern a comparison between the accused's DNA and that of persons selected at random from the wider community. There were really only two individuals who had access to the locked office area where the drugs were being manufactured. Even a ratio of 26 to one pointed positively to the accused in a way that could meaningfully convey to a jury the strength of the prosecution case.

70 In *Vyater*, the Court referred to the decision of the Court of Appeal of England and Wales in *Doheny*, a case to which I have previously alluded. There, the Court of Appeal said:

> If one person in a million has a DNA profile which matches that obtained from the crime stain, then the suspect will be one of perhaps 26 men in the United Kingdom who share that characteristic. If no fact is known about the Defendant, other than that he was in the United Kingdom at the time of the crime[,] the DNA evidence tells us no more than that there is a statistical

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74 *Vyater* [2020] VSCA 32, [35]–[37].

probability that he was the criminal of 1 in 26.[75]

71 The Court went on to say that the task of the expert witness presenting DNA evidence in this form was to:

> explain to the jury the nature of the match ('the matching DNA characteristics') between the DNA in the crime stain and the DNA in the blood sample taken from the defendant. He will properly, on the basis of empirical statistical data, give the jury the random occurrence ratio — the frequency with which the matching DNA characteristics are likely to be found in the population at large. Provided that he has the necessary data, and the statistical expertise, it may be appropriate for him then to say how many people with the matching characteristics are likely to be found in the United Kingdom ...[76]

72 Importantly, so far as *Vyater* was concerned, the Court of Appeal said:

> The significance of the DNA evidence will depend critically upon what else is known about the suspect. If he has a convincing alibi at the other end of England at the time of the crime, it will appear highly improbable that he can have been responsible for the crime, despite his matching DNA profile. If, however, he was near the scene of the crime when it was committed, or has been identified as a suspect because of other evidence which suggests that he may have been responsible for the crime, the DNA evidence becomes very significant. The possibility that two of the only 26 men in the United Kingdom with the matching DNA should have been in the vicinity of the crime will seem almost incredible and a comparatively slight nexus between the defendant and the crime, independent of the DNA, is likely to suffice to present an overall picture to the jury that satisfies them of the defendant's guilt.[77]

73 It was that last passage that was applied in *Vyater* in holding that the evidence of the low ratio DNA had been correctly admitted.

74 *Vyater* is also interesting for the detailed description that it gives of how DNA evidence is typically presented to juries in Victoria. The Court stated:

> In her oral evidence, H explained to the jury what the slides were intended to convey. Part of what she said was as follows:
>
> > Each person will have two copies of the DNA. So one which is inherited from your mother and one from your father. So the diagram there shows the two copies of the DNA and the first line shows seven repeat sequences and the second copy shows nine repeat sequences. So the DNA result for that person at that site would be a seven and a nine. So on a graph these DNA types can be visualised in the form of peaks. So at a particular site you could have two peaks.

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75 *Doheny* [1997] 1 Cr App R 369, 373.

76 Ibid 374.

77 Ibid 373.

> So in this example you've got your seven and your nine peak but if you have two — if you inherited two 12 repeat sequences then you would only have one peak but that would represent both of your DNA types at that site. And this is just a graphical representation of a DNA profile. There are 21 sites and you can see at some of those sites you would have two peaks, so two DNA types present and at some sites you would only have one peak which would indicate you have the same DNA type but two copies of that DNA type.
>
> Okay. So then a DNA comparison is performed. The DNA profile obtained from the evidence sample. So for example, blood on a knife is compared to the DNA profile from your person of interest and that is the graph in a tabular form. So as you can see, if you look — there's 16 sites listed there and you've got your evidence profile and your reference profile and at each of those DNA sites the evidence profile and the reference profile have given the same result and that's what's determined to be a DNA match.
>
> So the DNA — if the DNA matches then the person of interest could be the source of that evidence profile and a calculation known as the likelihood ratio is performed to assess the weight of that DNA profile match. So what that means is ah forensic scientists are trying to look at the evidence in the way that the court looks at the evidence and usually you've got the two opposing parties. One party is saying the DNA detected in the evidence profile did come from that person and then the other party is saying the DNA detected didn't come from that person and in saying that if the DNA detected did not come from that person then it must have come from a different person who by chance has the same DNA profile as our person of interest.
>
> So the probability of a match with the person of interest is compared with the probability of the match by chance. The ratio of these two probabilities is called the likelihood ratio and it describes how likely the DNA profile is if the first proposition was true, then if the second proposition was true. So in order to do this we need to estimate the DNA frequencies and what is the chance that someone else in the population has the same DNA profile.

Understandably, this was a presentation in entirely general terms. Presumably the slides have been developed by the Victoria Police Forensic Services Department for use whenever one of its forensic scientists is giving evidence about DNA profiling. Having reviewed the slides together with the oral evidence, however, we found the technical explanations difficult to understand and we would assume that jurors would have similar difficulties. This prompts us to question whether it is either realistic or necessary to expect a jury to understand the science of DNA profiling, as distinct from the 'evaluative opinion' conveyed as a likelihood ratio or its verbal equivalent.

Relevantly for present purposes, there was nothing in the generic presentation which would have enabled the jury to comprehend how, or why, this particular DNA profile produced the low likelihood ratio of 26 to 1. As noted earlier, H was asked in cross-examination to explain why the likelihood ratio was so low. Her answer should be set out again:

> [T]here's a number of reasons that the likelihood ratio could vary. Firstly, the DNA profile obtained was a partial DNA profile so there were some sites where we obtained no result. So when you're looking at the likelihood ratio you cross multiply the frequency of occurrence across all of those 21 sites. So if you don't have a result at some of those sites that multifactorial sort of — the multifactorial doesn't occur so your value will be lower. It also depends, at the sites where that person does match if those DNA types that are present are more common in the population then the likelihood ratio will be lower.

> In our respectful opinion, this explanation — while scientifically orthodox — would also have been very difficult for a lay juror to understand. It required an appreciation of the process of 'cross-multiplication' of the various likelihoods of occurrence at the various sites in the DNA profile and, more particularly, of how the result of that 'multifactorial' process can be affected both by the number of available sites and by the relative (lack of) frequency of particular DNA types. Even if this technical explanation were capable of being understood, we doubt that it would have assisted a juror to make sense of the difference in probative force between a likelihood ratio of 26 to 1 and a ratio of 100 billion to 1.[78]

75 Unfortunately, the way in which DNA evidence is usually presented to juries can lead to confusion and uncertainty on their part. The expert who is called to give DNA evidence often spends a good deal of time attempting to explain to the jury what lies behind the science, rather than stating a scientifically based and justified conclusion, in ordinary lay terms.

76 For an expert to tell a jury that DNA stands for deoxyribonucleic acid and that it is a long molecule that contains our unique genetic code is unlikely to shed much light. Nor is providing a visual representation of a 'double helix' shape. I have, on a number of occasions, heard experts speak to juries of 'alleles', which are said to be variants of genes which differ from each other. Terms such as 'phenotypes' are sometimes thrown about with abandon. Experts routinely speak of 'likelihood ratios', and sometimes of 'mixed samples'. DNA taken from a mixed sample is said to present its own particular difficulties, though I rather doubt that jurors ever really grasp why that should be so.

77 The matter is made even more difficult when we are suddenly confronted with new forms of scientific discovery and techniques, such as 'low copy DNA'. This is said to be an advanced and more sensitive profiling technique. It emerged less than 20 years ago, and is still the subject of considerable controversy amongst DNA experts.[79] The question can legitimately be asked, how can any group of lay jurors reasonably be expected to decide between the evidence of experts in this field, who express strong disagreement with each other?

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78 *Vyater* [2020] VSCA 32, [72]–[75].

79 Dr Freckelton, *Expert Evidence* (above n 2), 1152–4.

Final observations

78 It seems to me that a number of conclusions can be drawn from the case law and scholarly writing on the subject of expert scientific evidence. I would proffer the following:

(1) Some branches of forensic science that have, in the past, been regarded as almost sacrosanct do not merit that description.

(2) In truth, some criminal trials have been contaminated by the reception into evidence of 'junk science'.

(3) Trial judges should be given greater power to act as 'gatekeepers' so that evidence which does not pass a reasonable threshold of scientific validity and reliability can be excluded.

(4) Assuming that expert evidence that falls short of the 'gold standard' of nuclear DNA is still regarded as admissible, it is essential that it be presented in a manner comprehensible to a jury.

(5) There is a need for trial judges to exercise control over some of the claims that are made for some forms of scientific evidence, bearing in mind what we now know about them.

(6) Unless and until the High Court reconsiders *IMM*, trial judges will be unable to filter out some forms of 'junk science'.

(7) Developments in DNA present both opportunities and challenges to our criminal justice system.

(8) DNA experts must learn techniques of communicating effectively to jurors in order to ensure that they can give proper consideration to the strengths and weaknesses of this bourgeoning, and constantly developing, science.

(9) Trial judges need to learn new skills in order to adapt to some of the new forms of expert evidence that are constantly emerging.

(10) In areas of the most advanced science, it may be that new and different methods must be developed for enabling sensible decision making on the part of fact finders. This may require expert evidence to be presented in radically different ways.

79 This paper has been concerned with expert opinion in the area of forensic science. It has focused upon jury trials, with particular emphasis upon DNA evidence.

80 It should not be thought that the problems associated with expert evidence are confined to scientific evidence. A good deal of evidence that is extraordinarily difficult for any judge to grasp is routinely presented in civil cases. When I was a Federal Court judge, I was once confronted with a case in which a number of eminent economists,

and experts in allied fields, were called to give opinion evidence. The case concerned a conclusion on the part of the Payment Systems Board of the Reserve Bank that 'interchange fees' payable under the EFTPOS system were not conducive to the efficiency of the overall payments system.[80]

81 I invite anyone who has difficulty sleeping to read [274]–[438] of my extraordinarily prolix judgment. In particular, I challenge any judge in this country, short of one with a degree in higher mathematics, to explain to me the meaning to be attributed to a number of paragraphs taken from the report of one such acknowledged expert who gave evidence in that case.

82 In my reasons, at [480]–[485], I set out, I confess, somewhat mischievously, some extracts from that expert's prodigiously lengthy and detailed report. Perhaps to give you a taste of how difficult it can be to grasp some of the newer highly specialised forms of expert evidence, I invite you to ask yourselves what you make of the following passages from my judgment:

> If I am wrong in holding that Professor Farrell's evidence[81] was insufficiently relevant to warrant admissibility, I would nonetheless exclude that evidence in the exercise of my discretion. I would do so pursuant to s 135 of the *Evidence Act*, on the basis that, read as a whole, it is confusing. Having attempted, I believe assiduously, to understand the gist of Professor Farrell's evidence, as set out in his various reports, I regret to say that I cannot make a great deal of sense of considerable parts of that evidence.
>
> Two illustrations of the difficulty in comprehending Professor Farrell's evidence will suffice. Under the heading 'Strict Allocative Efficiency', at 5 of 'Technical Appendix A', Professor Farrell observes:
>
> > For strict allocative efficiency, the cardholder *should* choose payment system A over B if and only if:

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80 *Australian Retailers Association v Reserve Bank of Australia* (2005) 148 FCR 446 ('*Australian Retailers*').

81 Professor Farrell is a most distinguished scholar. He is currently a Professor of Economics at the University of California at Berkeley. He is also now the chair of Berkeley's Competition Policy Center. In my judgment, I described him as a Fellow of the Econometric Society, and a former President of the Industrial Organisation Society. He has degrees in mathematics and economics, and a DPhil from the University of Oxford. He has considerable experience in the economic analysis of a wide range of regulatory and competition policy matters, particularly in the field of telecommunications. In 2000 and 2001 he served as deputy assistant Attorney-General in the Anti-Trust Division of the US Department of Justice where he oversaw economic analysis of a wide range of competition and anti-trust matters.

$$b^A_{ch} - b^B_{ch} \geq \left(RC^A_{issuer} + RC^A_{acquirer} + RC^A_{interchange}\right) - \left(RC^B_{issuer} + RC^B_{acquirer} + RC^B_{interchange}\right)$$

where b^1_{ch} represents marginal net cardholders benefits, *RC* represents marginal resource cost.

I have only the vaguest notion of what this means.

Under the heading 'The Ramsey Problem' in 'Attachment B-1' to 'Appendix B', Professor Farrell purports to provide a 'solution' to that problem in the following terms:

Assume for simplicity that:

$$C(x_1, x_2) = F + c_1 x_1 + c_2 x_2 \qquad (4)$$

where F is a fixed cost of production, c_1 is the marginal cost of debit card services and c_2 is the marginal cost of all the other services supplied by the bank. The first-order conditions of the standard Ramsay problem described above can be written as follows:

$$(p_1 - c_1)\frac{\partial D_1}{\partial p_1} + (p_2 - c_2)\frac{\partial D_2}{\partial p_1} = \frac{\lambda - \mu}{\mu} D_1 \qquad (5)$$

$$(p_2 - c_2)\frac{\partial D_2}{\partial p_2} + (p_1 - c_1)\frac{\partial D_1}{\partial p_2} = \frac{\lambda - \mu}{\mu} D_2 \qquad (6)$$

$$(p_1 - c_1)D_1 + (p_2 - c_2)D_2 = F + \pi \qquad (7)$$

Where λ is the marginal utility of income (ie, the Lagrange multiplier associated with the budget constraint (1)) and μ is the consumers' marginal disutility of the bank's required profit (ie, the Lagrange multiplier associated with the profit constraint (3)).

Assume for simplicity that preferences are quasi-linear, ie, $U(x_1, x_2, x_3)$ is of the form $\mu(x_1, x_2) + x_3$. This implies $\lambda=1$ and no income effects, ie, the Marshallian demand functions, $D_1(p_1, p_2)$ and $D_2(p_2, p_1)$, are identical to the Hicksian demand functions. It then follows from Slutsky symmetry that:

$$\frac{\partial D_1}{\partial p_2} = \frac{\partial D_2}{\partial p_1} \qquad (8)$$

We can thus rewrite (5) as follows:

$$(p_1 - c_1)\frac{\partial D_1}{\partial p_1} + (p_2 - c_2)\frac{\partial D_1}{\partial p_2} = \frac{1 - \mu}{\mu} D_1 \qquad (9)$$

Once again, this means nothing to me. In making that observation, I do not intend to cast any doubts upon Professor Farrell's technical expertise. Plainly, I am in no position to do so. To be

> fair, the mathematical formulae set out were in technical appendices. Perhaps Professor Farrell assumed that any judge hearing a matter of this kind would be able to understand material presented in this manner. If so, he was mistaken, at least as far as I am concerned.
>
> I regret to say that evidence presented to a court in this form is likely to be unhelpful, and really should not be adduced. The technical appendices provide a significant part of the rationale for Professor Farrell's conclusions, which are themselves not altogether easy to follow. Having regard to the difficulty that I have in understanding Professor Farrell's reasoning, I propose to exclude his evidence in-chief in its entirety. I am prepared, however, to have regard to those parts of his evidence, under cross-examination, that I was able to understand.[82]

83 Regrettably, one day, a jury may be required, in the absence of judicial intervention, to consider expert evidence expressed in similar terms. Perhaps that day will come sooner than we think. I note, for example, that the first prosecution for a cartel offence, which is currently before the Federal Court, will of course have to be conducted before a jury. My sympathies lie with the judge who will have to ensure that whatever economic evidence is led, it bears little resemblance to that which confronted me in that particular case.

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[82] *Australian Retailers* (2005) 148 FCR 446, [480]–[485].