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# Latent science: A history of challenges to fingerprint evidence in Australia

Gary Edmond<sup>†</sup>

## Abstract

Through a review of reported challenges this article explains how latent fingerprint evidence was routinely admitted and relied upon as proof of identity in criminal proceedings before its value and limitations were studied and understood. That it was admitted and used in ways that were disengaged from scientific research reveals a great deal about our system of pleas, rules of admission, trial safeguards, and the technical competence of lawyers and judges. This article draws on contemporary research to explain how more than a century of routine legal reliance along with quite a few admissibility challenges produced few meaningful responses and no apparent endogenous understanding of the limitations of latent fingerprint comparison among lawyers. Trial personnel and trial safeguards did not lead to the identification, recognition and communication of limitations and uncertainties. Given the long and widespread use of latent fingerprint evidence there are few challenges focused on the actual value of the evidence. Latent fingerprint evidence continues to be presented in ways that are not based on scientific research, are inconsistent with the mainstream scientific advice, and exaggerate the value of opinions in ways that systematically advance the state and threaten both rectitude and fairness in criminal proceedings.

**Keywords:** forensic science; trial safeguards; criminal procedure; cross-examination; admissibility; expert; reliability

## 1. Introduction

This article surveys the record of legal challenges to latent fingerprint evidence in Australian criminal proceedings.<sup>1</sup> Starting with the first appeals at the beginning of the twentieth century and continuing up to the present day it documents both the way lawyers sought to impugn fingerprint evidence and the way trial judges and appellate courts responded.<sup>2</sup> Through reference to contemporary scientific research, the article explains how our admissibility rules and procedure, and even our oft-celebrated trial safeguards, did not apprise decision-makers – whether judges or juries – of the many uncertainties, risks and limitations associated with latent fingerprint evidence.<sup>3</sup> Legal responses to latent fingerprint evidence reveal that Australian courts allowed latent fingerprint examiners to make categorical assertions about identity from the very beginning. This permissive disposition persisted as new technologies were adopted, as rules of evidence and procedure were reformed, and as controversies and criticism slowly emerged beyond the courts. Today, the epistemological limitations of latent fingerprint evidence and criticism of legal responses to this evidence remain (almost) unknown to law.

Drawing on the long history of reported decisions, the number of cases involving serious epistemological challenges – engaged with the validity and scientific reliability of latent fingerprint evidence – is tiny.<sup>4</sup> Indeed, for the period from 1900 to 2017 there appears to be

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<sup>1</sup> Latent fingerprints are those that are not visible to the naked eye. Most fingerprints are latent - visualised through powders, chemical processes and/or special lighting. Some fingerprints, such as those left in blood or oil, or from inked fingers, are not latent.

<sup>2</sup> The article covers the twentieth century and concludes with the appeal in *R v Parry* [2017] SASFC 66.

<sup>3</sup> This article is concerned with latent fingerprints, not identification by ten print sets, which is a very different activity that is now practically automated.

<sup>4</sup> This study focuses on reported decisions and those available on the electronic databases such as Austlii and Westlaw. Databases were searched using terms such as 'finger! w/20 expert' and 'finger! w/20 admiss!' as well as through cross-

just one. Rather than facilitate engagement with scientific research in order to make fingerprint examiners accountable and their opinions comprehensible for judges and juries, oft-celebrated legal protections have been overwhelmingly focused on non-epistemic issues and epiphenomena. Perhaps the most revealing and disconcerting dimension of this account is the apparent failure of any judge to ever require a latent fingerprint examiner to provide independent evidence of the accuracy of latent fingerprint comparison. Australian judges are yet to receive an indication of the error rate, or information about limitations and uncertainties that have come to be notorious among attentive scientists.

This research is revealing because the record demonstrates that trial safeguards did not encourage or enable lawyers to identify, explore or convey epistemological problems with latent fingerprint evidence and the procedures used by latent fingerprint examiners. This failure was not some isolated mistake or aberration. It has persisted for more than a century, while latent fingerprint evidence was presented (by prosecutors and fingerprint examiners) and understood (by defence lawyers, judges, jurors and perhaps defendants) as inviolable proof of identity. It persisted as authoritative scientific organisations began to question latent fingerprint evidence and its legal reception as categorical evidence of identity. Scientific research exposes unremitting credulity in response to forensic science evidence adduced by the state in criminal proceedings. Simultaneously it illustrates the institutional and social repercussions of not imposing some kind of reliability criterion on the reception of forensic science and forensic medicine evidence (routinely) adduced by the state.

### *Some notes on my methods*

This article is focused on challenges to latent fingerprint evidence that were recorded in law reports or ‘published’ on electronic databases.<sup>5</sup> While some of the challenges to latent fingerprint evidence will be lost through this orientation, it offers the tangible benefit of presenting and reviewing materials that were readily available to generations of lawyers and judges.<sup>6</sup> These decisions embody legal authority and legal knowledge. There may have been sophisticated methodological challenges to latent fingerprint evidence that were not reported but that seems unlikely; for reasons that will become apparent. Moreover, to the extent that insights or sophistication were not reported they appear to have been lost. We might reasonably wonder about the existence of insights and knowledge that are not conspicuous in the reported decisions and seem to be unknown to generations of lawyers and judges. There is no evidence of it in the reported decisions.<sup>7</sup>

Secondly, this article moves beyond the law reports and draws upon mainstream scientific research in order to enhance understanding of latent fingerprint evidence. Fortunately, the last decade has generated a wealth of materials following a series of independent reviews – discussed in Section 3. These scientific reviews are vitally important because they expose serious discrepancies between legal representations of latent fingerprint comparison evidence and scientific understanding and expectations. Prominent here is the fact that the first rigorous scientific studies of latent fingerprint comparison were finally conducted during the last decade – i.e. *since* 2009. This is revealing because latent fingerprints comparison has been in routine use for more than a century, and yet many of those producing and relying upon it were oblivious or indifferent to the absence of scientific foundations. The results of

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referencing from these decisions. In some cases searches were focused on specific terms, such as ‘ACE-V’ or ‘superglue’ or ‘points’.

<sup>5</sup> Many of the earliest trials were reported in contemporaneous newspapers.

<sup>6</sup> This is not an attempt to comprehensively document the historical record, but an attempt to consider what the accessible legal record reveals.

<sup>7</sup> These might be located in writings, speeches and submissions. This article has generally relied on reported decisions, for the reasons explained.

the emerging scientific research provide a standard (or benchmark) that enables us to evaluate both latent fingerprint evidence and the legal responses.

Thirdly, in this article the challenges to latent fingerprint evidence are characterised as either *legal* (or non-epistemic) or *epistemological*.<sup>8</sup> For the entire twentieth century challenges to latent fingerprint evidence were overwhelmingly legal in focus. With very few exceptions they were directed toward legal criteria, such as (non-)compliance with collection and reporting procedures, the admissibility of photographs, the role of the jury in the evaluation of fingerprint evidence, and whether judicial directions were appropriate. While there is nothing remarkable about lawyers and judges engaging with relevant legislation, legal criteria and case law, persistent insensitivity to the validity of the underlying procedures and the abilities of latent fingerprint examiners is an issue that demands attention. This essay is fundamentally concerned with epistemology.<sup>9</sup> It focuses attention on methods (and assumptions) and the *known* value of fingerprint evidence – drawn from scientific research. As we shall see, remarkably few historical challenges to the admission and use of fingerprint evidence engaged with these fundamental issues.<sup>10</sup>

Fourthly, nor is my intention to suggest that challenges on predominantly *legal* grounds were without value or inappropriate. Some challenges, focused on procedural irregularities – surrounding collection and use, for example – were successful and may have improved out-of-court investigative behaviours.<sup>11</sup> Indeed, in the absence of legal engagement with epistemological issues – such as validity and scientific reliability (including accuracy) – this focus is comprehensible *as one strategy*. However, qualified success with *legal* challenges to fingerprint evidence should not be conceived as adequate given the persistent failure to engage with the value of latent fingerprint evidence.

Fifthly, it is not my intention to whiggishly judge past legal practice by contemporary standards.<sup>12</sup> Contemporary knowledge does, however, enable us to consider the institutional costs of ignorance, including an apparently slavish commitment to trial safeguards and protections that were, as the following study demonstrates, mis-used, ineffective or dormant. It also allows us to observe the impact of new rules (e.g. UEL s 79) and procedures (e.g. Code of Conduct for Expert Witnesses), legal responses to emerging technologies (e.g. electronic databases and search algorithms), and the recalcitrance of legal attitudes and impressions as scientific research and advice emerged. Together, the cases reviewed for this article suggest that courts accepted the beliefs and assumptions of latent fingerprint examiners and persisted with that commitment even as it became untenable with respect to reviews and recommendations produced by peak scientific organisations. Remarkably, this

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<sup>8</sup> These are working definitions and the boundaries may not always be clear. There are, for example, a few challenges that focus on fingerprint examiners testifying about activity (rather than source) or the age of prints and these are challenged on the basis of transgression of legal categories. To the extent that some lawyers raised and/or courts considered the reliability of latent fingerprint evidence, there are no sophisticated legal pronouncements. See T. Gieryn, *Cultural boundaries of science* (Chicago, 1999); G. Bowker and S. Star, *Sorting Things Out: Classification and Its Consequences* (London: MIT, 1999).

<sup>9</sup> See e.g. E. Beecher-Monas, *Evaluating Scientific Evidence: An Interdisciplinary Framework for Intellectual Due Process* (New York, Cambridge University Press, 2007); M. Saks and B. Spellman, *The Psychological Foundations of Evidence Law* (New York University Press, New York, 2016); K. Martire and G. Edmond, 'Rethinking expert opinion evidence' (2017) 41 *Melbourne University Law Review* 967.

<sup>10</sup> Apart from a challenge in the Children's Court of NSW in 2015, and some comments in the Victorian Court of Appeal more than a century earlier, there is no evidence of legal engagement with scientific knowledge, the reliability of latent fingerprint evidence, the effectiveness of legal procedures, the appropriateness of the form of opinions proffered by examiners, and so on.

<sup>11</sup> Although, there is limited evidence of appellate decisions substantially reforming the behaviours of investigators. See e.g. R. Leo, 'The impact of *Miranda* revisited' (1996) 86 *Journal of Law & Criminology* 621.

<sup>12</sup> H. Butterfield, *The Whig Interpretation of History* (1932, reprinted New York: W.W. Norton & Co, 1965); G. Edmond, 'Whigs in Court: Historiographical Problems with Expert Evidence' (2002) 14 *Yale Journal of Law & the Humanities* 123. See also R. Proctor and L. Schiebinger (eds), *Agnostology: The Making and Unmaking of Ignorance* (Stanford, Stanford University Press, 2008).

position persists in relation to latent fingerprint evidence and almost every other type of forensic science and medicine, perhaps with qualification in relation to DNA profiling and some interpretations of image evidence.<sup>13</sup>

Finally, and importantly, this article recognises that latent fingerprint comparison is basically a valid and scientifically reliable procedure.<sup>14</sup> The problem, that arises through this diachronic analysis, is that this position has only become *known* – in the sense of being supported by scientific research – recently. This raises questions about what lawyers and courts were doing for a century and unresolved issues concerning the conditions regulating the admission and use of latent fingerprints (and other forensic science) evidence in modern criminal proceedings. For, while latent fingerprint evidence is a procedure that is potentially quite powerful in assisting with the identification of persons of interest, it is not as probative as latent fingerprint examiners, prosecutors and judges have all suggested. And, there is no sense that other types of forensic science and forensic medicine, such as image, voice, footwear, hair, fibre, document, bitemark, firearm and toolmark comparison, for example, are likely to be anywhere near as accurate. That is, to the extent that they turn out to be valid and scientifically reliable. Self-evidently, the article has destabilizing implications for the legal reception of other types of forensic science and forensic medicine evidence.

## 2. Latent fingerprint comparison

Most modern latent fingerprint examiners use a procedure known by the acronym ACE-V.<sup>15</sup> Following the detection and collection of one or more fingerprints connected to a suspected criminal offence, this involves *analysing* the suitability of the prints. Does the quantity and quality of detail in the print make it suitable (or sufficient) for *comparison*.<sup>16</sup> Suitable prints may be marked-up and searched against a database (where known and unknown prints are stored) using one of a range of proprietorial algorithms to select prints that are deemed sufficiently similar to undergo comparison by a latent fingerprint examiner. Algorithms assemble a ‘pool’ of prints (usually ranking them with some kind of score) from among the very large number of prints stored on criminal databases.<sup>17</sup> The way latent fingerprints are prepared for searching the database and the choice of fingerprints selected for comparison (from among the pool) are subjective decisions made by the fingerprint examiner. In some cases – e.g. where there is police intelligence or perhaps an admission – the identity of the persons whose (reference) fingerprints should be compared to the crime scene latent prints might be suggested directly by investigators. Such comparisons, where they produce ‘matches’, may circumvent the need for database searches.

During *comparison* the examiner looks for similarities and differences between latent prints deemed sufficient for comparison and reference prints (or other prints of interest).<sup>18</sup> Because of variation between surfaces, conditions of deposition (e.g. humidity, temperature), pressure of contact, cleanliness of hands, age of latent fingerprints, distortion, injury and

<sup>13</sup> See e.g. *R v Tran* (1990) 50 A Crim R 233, 242; *R v Lucas* [1992] 2 VR 109; *R v Pantoja* (1996) 88 A Crim R 554; *R v Karger* (2001) SASR 1; *R v Gallagher* (2001) NSWSC 462; *Fitzgerald v R* [2014] HCA 28; *Tuite v The Queen* [2015] VSCA 148; *R v Tang* (2006) 65 NSWLR 681; *Murdoch v R* (2007) 167 A Crim R 329; *Morgan v R* (2011) 215 A Crim R 33; [2007] NTCCA 1; *R v Dastagir* (2013) 118 SASR 83; [2013] SASCFC 109; *Morgan v R* (2011) 215 A Crim R 33; *Honeysett v R* [2013] NSWCCA 135; *Honeysett v The Queen* (2014) 253 CLR 122.

<sup>14</sup> President’s Council of Advisors on Science and Technology, *Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods* (Report, 20 September 2016) 95-97.

<sup>15</sup> The procedure is supposed to be applied in order, but not all examiners do so. In recent years the FBI has required examiners to proceed in order in a process described as ‘linear ACE-V’.

<sup>16</sup> B. Ulery et al, ‘Understanding the sufficiency of information for latent fingerprint value determinations’ (2013) 230 *Forensic Science International* 99; A. Hicklin et al, ‘Latent fingerprint quality: a survey of examiners’ (2011) 61 *Journal of Forensic Identification* 385.

<sup>17</sup> The number of prints in the pool, or the extent of the search, is flexible.

<sup>18</sup> In some cases, examiners might match a latent with fingerprints associated with other crimes, but the identity of the source may be unknown. This may have value for investigators, implicating the same person in different crimes.

scarring, size, and so on, the fingerprints to be compared *are never identical*.<sup>19</sup> Comparison leads to an *evaluation*. Evaluation involves detailed assessment of ridge features (e.g. whorls, loops, bifurcations, ridge endings and islands) and perhaps scars and other features – see Figure 1. Following subjective comparison – usually on a computer screen using a variety of tools for manipulation and enhancement – the examiner decides whether the prints match or do not match. The examiner must be subjectively satisfied of enough similarity to conclude that the prints match (i.e. were made by the same person). Alternatively, the examiner might observe one or more differences that lead them to characterise the prints as non-matching or inconclusive. For a match (or identification), any apparent differences are characterised as not meaningful (e.g. artifacts or the result of distortion, a second touch or other interference that can be ‘explained’ away).<sup>20</sup> For an exclusion, apparent differences are considered to be real (rather than artefactual) and so cannot be explained away. Inconclusive determinations reflect an examiner’s inability to declare a match and, often, a reluctance to exclude.<sup>21</sup> They are sometimes expressed in suggestive (i.e. inclusive) language such as ‘cannot exclude’. For reasons of convention, ‘inconclusive’ results, though implicitly probative, are not necessarily relied upon in criminal proceedings.<sup>22</sup>

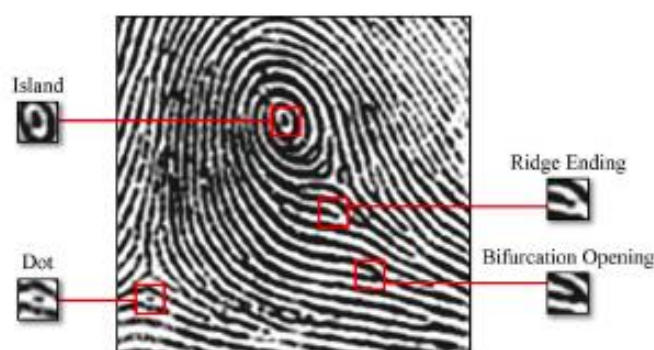


Figure 1: ‘An example of some minutiae locations in a fingerprint’<sup>23</sup>

The range of potential outcomes introduces a range of possible errors.<sup>24</sup> Most obvious are false identifications (false positives) and mistaken exclusions (false negatives). Though, decisions about sufficiency and the reluctance to identify might also be considered ‘errors’.<sup>25</sup> Regardless of the precise classification and nomenclature, they may entail a (systematic) loss of information. All of these decisions (or outcomes) are subjective. Consequently, examiners occasionally disagree.<sup>26</sup> Though, backstage inconsistencies are almost never disclosed in

<sup>19</sup> Though, fingerprints are often characterised as ‘identical’ by examiners and judges, see e.g. *Bennett v Police* [2005] SASC 167.

<sup>20</sup> Though, this is not usually explained, other than being a variation or apparent difference that the examiner does not believe compromises the ability to make a match decision.

<sup>21</sup> For an example, see *R v Burling* [2002] NSWCCA 298, [19].

<sup>22</sup> Though, see *R v Parry* [2017] SASCFC 66, discussed below. The dichotomy, along with the reluctance to report inconclusive entails a loss of probative evidence, mainly for reasons of tradition. Here we can begin to perceive the benefit of probabilistic frameworks that can capture a range of values, rather than relying on categorical claims – i.e. match and non-match.

<sup>23</sup> NIST report, 83. This image is adapted from the Royal Canadian Mounted Police, *Fingerprint Manual* (Royal Canadian Mounted Police, 1990) Ch 2.

<sup>24</sup> Match decisions have become vulnerable to error (through so-called adventitious matches) as databases, and the number of quite similar but different fingerprints has, increased in recent decades. Some databases contain hundreds of millions of prints and algorithms return the most similar prints for subjective comparison.

<sup>25</sup> See I. Dror and G. Langenburg, “‘Cannot Decide’: The Fine Line Between Appropriate Inconclusive Determinations Versus Unjustifiably Deciding Not To Decide” (2018) *Journal of Forensic Science* (forthcoming).

<sup>26</sup> See e.g. B. Ulery et al, ‘Measuring What Latent Fingerprint Examiners Consider Sufficient Information for Individualization Determinations’ (2015) 10 *PLoS One* e0118172.

reports and testimony.<sup>27</sup> Some examiners may be willing to analyse, compare and match latent prints that other examiners would consider ‘insufficient’. Examiners are much more likely to disagree about whether a latent print is of sufficient quality for comparison than whether a particular finger can be matched or excluded.

The final stage of ACE-V is *verification*. Verification stands for a variety of inconsistent practices. These can range from another examiner superficially reviewing the first examiner’s report (usually for technical compliance purposes, that may focus on spelling and pagination) to a full-scale and independent ACE performed in conditions where the first examiner’s findings are not disclosed to the second examiner.<sup>28</sup> Almost all verification in Australia involves a reviewer examining prints in the knowledge that another examiner, frequently named and known to the reviewer, has previously matched them.<sup>29</sup>

ACE-V was first described in print in 1959.<sup>30</sup> The term first appears in an Australian judgment in *R v Ghebrat* in 2011 and in NSW, at least, was not a regular feature of reports before 2015.<sup>31</sup> For most of the twentieth century latent fingerprint examiners did not use the acronym ‘ACE-V’ or describe their process in these terms. And, for most of the century they did not rely on algorithms to search electronic databases for matching prints. Prior to the 1980s, identification by fingerprints was obtained using a range of different processes and methods, not all of which were standardised, scrupulously followed, or described in reports. Before fingerprints were captured, recorded and searched electronically, complex systems of classification enabled examiners to retrieve prints from very large card reference systems sorted according to fingerprint features.<sup>32</sup>

Another aspect of latent fingerprint comparison that is not prominent in the Australian decisions, though is a conspicuous feature in the UK, is the reference to point systems. Up until the last decade of the twentieth century, rules about the number of points of similarity (between ridge features), imposed by police departments and professional organisations, governed the ability and willingness of most examiners to describe two similar prints as a match – and therefore as positive identification.<sup>33</sup> Revealingly, the minimum number of points required for a match varied over time and between jurisdictions. The point system was largely discredited, and formally abandoned, when a review by two British scientists in the 1980s concluded that there was no underlying scientific basis, and that the number of points relied upon by different fingerprint bureaus (and some courts) was arbitrary.<sup>34</sup> Bureaus subsequently adopted more holistic approaches, concerned with whether examiners were

<sup>27</sup> For an interesting, though exceptional, expose, see the English case of *R v Smith* [2011] EWCA Crim 1296.

<sup>28</sup> These may operate in parallel.

<sup>29</sup> In most cases, for resource reasons, only matches are reviewed. Those who responsible for verification know that the prints they are verifying have been matched. See K. Ballantyne et al, ‘Peer review in forensic science’ (2017) 277 *Forensic Science International* 66.

<sup>30</sup> Roy Huber originally described the structure of ACE-V, and proposed it for every forensic comparison discipline, without advancing the acronym. ACE-V was popularized by David Ashbaugh, of the Royal Canadian Mounted Police, from the 1980s. See R. Huber, ‘Expert witness’ (1959) 2 *Criminal Law Quarterly* 276; D. Ashbaugh, *Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology* (Boca Raton, FL: CRC Press, 1999).

<sup>31</sup> *Ghebrat*, 143, 146; *JP*, [78], [79].

<sup>32</sup> Early systems are discussed in Cole, *Suspect identities*.

<sup>33</sup> The IAI, the largest professional society, looms large here. Until recently (influenced by the NRC report), the IAI forbade members from testifying in terms weaker than positive identification, on threat of sanction.

<sup>34</sup> See *R v Buckley* (1999) 163 JP 561 for an English discussion and inoculation of inconsistency. In Australian cases the number of points arises sporadically, and usually in response to prompting in cross-examination. See e.g. *Graham*, [43]; *CZB v Children’s Guardian* [2017] NSWCATAD 208, [86]; *JP*, [27]; *R v Milos* [2014] QCA 314, [132]; *Soutar v Commissioner of Police* [2006] NSWDC 95, [60]; *R v Tang* (2006) 65 NSWLR 681, [144]; *Bennett v Police* [2005] SASC 167, [15], [17], [39]-[40]; *Bennett v Police* [2005] SASC 415, [5]-[7], [22], [23], [28]; *Mickelberg v The Queen* [2004] WASCA 145, [186]-[187], [192], [310], [320]-[322], [328], [329], [337], [487], [526]; *R v Burling* [2002] NSWCCA 298, [19]; *R v Moore* [1982] Qd R 162, 169 (9 points sufficient); *MacDonald v A-G (Cth)* (1980) 24 SASR 294, 299. See also *HZXD v Innovation Australia* (2010) 80 ATR 939, [17]. (Search for ‘fingerprint /20 points’) Westlaw 13 August 2018.)



personally satisfied that the two prints matched. Though not usually referenced in reports, examiners continue to count and refer to points of similarity, particularly if questioned in legal proceedings.<sup>35</sup>

Latent fingerprint examiners base their claims and abilities on the premise (for many of them a fact) that fingerprints are unique. This is an assumption that, with respect to identification, elides a range of quite complex physiological and statistical issues. The main problem is the way the commitment to uniqueness is used to support the ability to positively identify an individual (to the exclusion of all other possible sources of the latent fingerprint). We will return to this issue in the next section, where scientists explicitly question uniqueness and its implications for identification and accuracy.

The assumptions that fingerprints are permanent and unique are used by examiners to support their categorical claims pertaining to the identity of the source (of a latent fingerprint). When expressing their opinions the match decision is usually expressed as positive identification (or individualisation), sometimes *to the exclusion of all other persons*. Although fingerprint examiners believe this italicized qualification to be redundant; given assumptions about uniqueness and permanence. Historically, regardless of the specific procedure they employed (or the precise number of points identified), fingerprint examiners claimed and were usually allowed to testify that the results of fingerprint comparison (or the particular procedure, such as ACE-V) identified a specific person and was error-free. Occasionally an examiner might concede that errors are possible, the result of examiner incompetence or mistake, rather than an intractable feature of the subjective method(s).<sup>36</sup> In the few cases where examiners were called and asked about error they typically testified that there was no error in the specific case and in general ‘the possibility of error’ was remote or, more commonly, theoretical or hypothetical.<sup>37</sup>

In *JP v DPP*, a case heard in 2015 (and discussed below), a senior NSW Police fingerprint examiner testified in the following terms:

A. If the ACE-V methodology is done correct I don’t agree that there’s potentially error rates there.<sup>38</sup>

...

Q. So you would say that the ACE-V method is infallible is that what you say?

A. In the correct - used in the correct method and way and by myself yes.<sup>39</sup>

The following exchange captured his confidence about the identification:

Q. What’s your level of confidence in relation to that opinion?

A. 100 per cent.

Q. You’re a hundred per cent certain about that conclusion?

A. Yes I am.<sup>40</sup>

As we shall see, it makes no sense to speak of an infallible method when each stage of ACE-V requires an examiner to engage in subjective assessments – i.e. interpretation.<sup>41</sup> The fact that interpretation is predicated upon untestable and somewhat misleading assumptions about

<sup>35</sup> Consider the reference in *Bennett*, below.

<sup>36</sup> S. Cole, ‘More than Zero: Accounting for Error in Latent Fingerprint Identification.’ (2005) 95 *Journal of Criminal Law & Criminology* 985.

<sup>37</sup> See the extract from *Reg. v O’Callaghan* [1976] VR 676 reproduced in Section 5. The ‘possibility of error’ is taken from a contemporary NSW police pro forma.

<sup>38</sup> Transcript of Proceedings, *R v JP* (27 January 2015) 10.

<sup>39</sup> Transcript of Proceedings, *R v JP* (27 January 2015) 12-13.

<sup>40</sup> Transcript of Proceedings, *R v JP* (13 January 2015) 12-13, 25. See also *R v Graham* (2017) 325 FLR 21, [43] where the expert is reported as being ‘100 per cent confident that the print was that of the accused.’

<sup>41</sup> S. Cole, ‘Forensics without uniqueness, conclusions without individualization: the new epistemology of forensic identification’ (2009) 8 *Law, Probability & Risk* 233.



uniqueness, the fact that examiners were not historically sensitive to the frequency and inter-relatedness of fingerprint features (see Figure 1), or concerned with cognitive bias (e.g. suggestion), only compounds the problems.

At this point we turn to consider what attentive scientists have to say about latent fingerprint evidence and its underpinnings. The perspectives of scientists are revealing because notwithstanding latent fingerprint examiners presenting themselves and being recognised as forensic scientists, and referring to the ‘science of fingerprints’ from its very inception, before the twenty first century hardly any fingerprint examiners possessed formal scientific qualifications.<sup>42</sup>

### 3. Scientific insight into latent fingerprint comparison

This article is possible because during the last decade scientists have finally begun to study latent fingerprint examiners and their evidence. These studies were undertaken in response to high profile mis-identifications, wrongful convictions and innocence projects, scholarly criticisms, and the first-ever independent reviews of the forensic sciences. For the first time in more than a hundred years we now have a reasonably good idea of the validity of the (modern) procedure and its scientific reliability – including its accuracy. This is important because now that we have access to empirically-based knowledge we can start to consider what courts did in the absence of knowledge. This enables us to reflect on legal awareness (of its absence) and historical performances, as well as gauge whether the availability of scientific knowledge has transformed contemporary practice.

In this section it is my intention to draw attention to research findings and recommendations produced by attentive scientists in a range of recent reports and reviews – notably *Strengthening Forensic Science in the United States: The path forward* (2009), *Latent Print Examination and Human Factors* (2012), *Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods* (2016) and *Forensic Science Assessments: A quality and gap analysis – Latent fingerprint examination* (2017).<sup>43</sup> These reports were produced by prestigious scientific and technical organisations, respectively the National Research Council of the National Academy of Sciences (NRC), the National Institute of Standards and Technology (NIST), the President’s Council of Advisers on Science and Technology (PCAST) and the American Association for the Advancement of Science (AAAS). In addition, inquiries in the US and Scotland, following prominent mis-identifications (e.g. Brandon Mayfield and Shirley McKie), led to reports, prepared by the Department of Justice (US) and a Scottish judge – now Lord Campbell.<sup>44</sup>

The first point to make is that all of the independent scientific reviews insist on the need to *validate* the procedures (or methods) used by latent fingerprint examiners. Validation is a process of formal evaluation (or testing), conducted in circumstances where the correct answer is known (by those evaluating the procedure), in order to determine whether the procedure does what its proponents claim.<sup>45</sup> It determines the conditions in which a procedure

<sup>42</sup> *R v Amatto* [2011] NSWDC 194, [2].

<sup>43</sup> National Research Council, *Strengthening Forensic Science in the United States: A Path Forward* (National Academies Press, 2009); Expert Working Group on Human Factors in Latent Print Analysis, *Latent Print Examination and Human Factors: Improving the Practice through a Systems Approach* (US Department of Commerce, National Institute of Standards and Technology, 2012); PCAST report; W. Thompson et al, *Forensic Science Assessments: A quality and gap analysis – Latent fingerprint examination* (AAAS, Washington DC, 2017).

<sup>44</sup> United States Department of Justice, *A Review of the FBI’s Handling of the Brandon Mayfield Case* (US Department of Justice, Office of the Inspector General, Oversight and Review Division, 2006); Anthony Campbell, *The Fingerprint Inquiry Report* (December 2011).

<sup>45</sup> Several of the US reports, attentive to admissibility standards in the United States, even suggested that forensic science procedures that had not been formally validated should not be adduced and relied upon in criminal proceedings. See e.g. PCAST report, 140 (Recommendation 8.3) and 145 (Recommendation 9.4)

is known to work as well as how well it works. PCAST explained it in the following way:

For a metrological method to be scientifically valid and reliable, the procedures that comprise it must be shown, based on empirical studies, to be *repeatable*, *reproducible*, and *accurate*, at levels that have been measured and are appropriate to the intended application.<sup>46</sup>

PCAST insisted that ‘methods [such as ACE-V] must be presumed to be unreliable until their foundational validity has been established based on empirical evidence.’<sup>47</sup> Revealingly, the NRC Committee, in the first and most influential of the reports, concluded that as of 2009 no validation research had been conducted on latent fingerprint comparison.<sup>48</sup> Exempting DNA profiling, the NRC infamously concluded that none of the remaining comparison procedures ‘has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source.’<sup>49</sup> In response, the multi-disciplinary committees responsible for the NRC, NIST and PCAST reports called for much greater disclosure and more modest forms of expression by latent fingerprint examiners and many other forensic scientists. NIST recommended replacing ‘[c]laims of “absolute” and “positive” identification’ with ‘more modest claims about the meaning and significance of a “match”.’<sup>50</sup>

On ACE-V, the modern incarnation of the procedure, the NRC, NIST, PCAST and AAAS all expressed concerns. Rather than a method grounding error-free identification, as suggested in the earlier extracts, assessment by the NRC was restrained.

ACE-V provides a broadly stated framework for conducting friction ridge analyses. However, this framework is not specific enough to qualify as a validated method for this type of analysis. ACE-V does not guard against bias; is too broad to ensure repeatability and transparency; and does not guarantee that two analysts following it will obtain the same results. For these reasons, merely following the steps of ACE-V does not imply that one is proceeding in a scientific manner or producing reliable results.<sup>51</sup>

In the wake of critical appraisal by the NRC in 2009 scientific research commenced. The first rigorous attempts to evaluate latent fingerprint comparison were published a century *after* Australian appellate courts, including the High Court, accepted that latent fingerprint evidence was not only admissible but sufficient to support conviction in a case where there was no other evidence. On the basis of recent validation research, what do we *now* know about modern latent fingerprint comparison? Well, scientists found that fingerprint examiners are ‘exceedingly accurate compared with novices, but are not infallible.’<sup>52</sup> When examiners were tested in controlled conditions resembling casework, they were found to make small numbers of errors. Reviewing the available research, all conducted in the aftermath of the NRC review, PCAST summarised the studies as follows.

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<sup>46</sup> PCAST report, 47.

<sup>47</sup> PCAST report, 32.

<sup>48</sup> NRC report, 142-45. The Council endorsed the following assessment by Haber and Haber: ‘We have reviewed available scientific evidence of the validity of the ACE-V method and found none.’ See L. Haber and R. Haber, ‘Scientific validation of fingerprint evidence under *Daubert*’ (2008) 7 *Law, Probability & Risk* 87.

<sup>49</sup> NRC report, 7-8.

<sup>50</sup> NIST report, 130; NRC report, 142. See J. Mnookin, ‘The Validity of Latent Fingerprint Identification: Confessions of a Fingerprinting Moderate’ (2008) 7 *Law, Probability & Risk* 127.

<sup>51</sup> National Research Council, *Strengthening Forensic Science in the United States* (National Academies Press, 2009) (‘NAS Report’) 142-3; National Institute of Standards and Technology, *Latent Print Examination and Human Factors: Improving the Practice through a Systems Approach* (US Department of Commerce, 2012) (‘NIST report’) 8-9; PCAST report, 66-81. See G. Edmond, ‘What lawyers should know about the forensic ‘sciences’?’ (2015) 36 *Adelaide Law Review* 33.

<sup>52</sup> J. Tangen, M. Thompson and D. McCarthy, ‘Identifying Fingerprint Expertise’ (2011) 22 *Psychological Science* 995-7; B. Ulery et al., ‘Accuracy and reliability of forensic latent fingerprint decisions’ (2011) 108 *Proceedings of the National Academy of Sciences* 7733.

Study	False Positives			
	Raw Data	Freq. (Confidence bound)	Estimated Rate	Bound on Rate
<b>Early studies</b>				
Langenburg (2009a)	0/14	0% (19%)	1 in $\infty$	1 in 5
Langenburg (2009b)	1/43	2.3% (11%)	1 in 43	1 in 9
Langenburg et al. (2012)	17/711	2.4% (3.5%)	1 in 42	1 in 28
Tangen et al. (2011) (“similar pairs”)	3/444	0.68% (1.7%)	1 in 148	1 in 58
Tangen et al. (2011) (“dissimilar pairs”)	0/444	0% (0.67%)	1 in $\infty$	1 in 148
<b>Black-box studies</b>				
Ulery et al. 2011 (FBI)**	6/3628	0.17% (0.33%)	1 in 604	1 in 306
Pacheco et al. 2014 (Miami-Dade)	42/995	4.2% (5.4%)	1 in 24	1 in 18
Pacheco et al. 2014 (Miami-Dade) (excluding clerical errors)	7/960	0.7% (1.4%)	1 in 137	1 in 73

**Table 1: Error rates in studies of latent print analysis.**<sup>53</sup>

Of this research, only the ‘black-box studies’ were characterised as appropriate for determining the incidence of error. On the basis of the available empirical research – ‘only two properly designed studies of the accuracy of latent fingerprint analysis have been conducted’ – PCAST recommended that these results should inform the way latent fingerprint examiners report their results.<sup>54</sup>

PCAST finds that latent fingerprint analysis [has] *a false positive rate that is substantial* and is likely to be higher than expected by many jurors based on longstanding claims about the infallibility of fingerprint analysis. The false-positive rate could be as high as 1 error in 306 cases based on the FBI study and 1 error in 18 cases based on a study by another crime laboratory. In reporting results of latent-fingerprint examination, it is important to state the false-positive rates based on properly designed validation studies.<sup>55</sup>

This information would ‘appropriately inform jurors that errors occur at detectable frequencies, allowing them to weigh the probative value of the evidence.’<sup>56</sup> This recommendation stands in stark contrast to the longstanding presentation of an opinion as positive identification that, if questioned, was defended as certain and infallible.<sup>57</sup>

Scientific review exposed other issues. Attentive scientists expressed concerns about the way the various stages of ACE-V were described and performed. They found that there were few meaningful standards in place. There were, for example, no empirically-informed standards around the quality and sufficiency of latent fingerprints used for comparison and identification. Moreover, they found that examiners did not agree on the sufficiency of prints or the number of points (ridge detail) that could be observed – inter-examiner inconsistency. They also found that the same examiners responded inconsistently when presented with the same prints on separate occasions – intra-examiner inconsistency.<sup>58</sup>

In addition, latent fingerprint examiners had historically ignored the risks posed by human factors.<sup>59</sup> Empirical studies demonstrated that fingerprint examiners, like other humans, were

<sup>53</sup> PCAST report, 98. Full references and descriptions of all the studies are provided in the PCAST report.

<sup>54</sup> PCAST report, 9. These are likely to change, and probably improve, as more studies are conducted and revised procedures (and technologies) put in place.

<sup>55</sup> PCAST report, 9-10, 26, 74.

<sup>56</sup> PCAST report, 74, 26.

<sup>57</sup> Many reports in other jurisdictions refer to the very thin line between the evidence being understood as opinion or fact. Indeed, the SFI report, 740, recommended that this should be made clear.

<sup>58</sup> I. Dror et al, ‘Cognitive issues in fingerprint analysis: inter- and intra-expert consistency and the effect of a “Target” comparison’ (2011) 208 *Forensic Science International* 10.

<sup>59</sup> ‘Human factors’ are psychological and physiological factors that threaten forensic science practices and results.

vulnerable to cognitive bias, particularly suggestion. One small, though notorious, study by Dror and colleagues, led four of five experienced latent fingerprint examiners to reverse their decisions on whether two prints matched by priming them with domain irrelevant information.<sup>60</sup> The work of latent fingerprint examiners was, and in many bureaus remains, awash in information that is not required to undertake comparison work. That is, examiners are routinely exposed – through contact with detectives, crime scenes, fellow examiners, their documentation and databases – to information that is not required to undertake ACE-V and may actually subvert interpretation. The verifier being exposed to the result of the original examination is yet another example. Historically, like many other forensic scientists, latent fingerprint examiners considered themselves immune to cognitive biases because of their training and experience. Scientists, in contrast, recommended studying current practices and where possible shielding examiners from gratuitous information (e.g. about the crime or the suspect) and suggestive processes (e.g. non-blind verification).<sup>61</sup>

The various scientific reports also challenged the significance attributed to uniqueness (and permanence) by latent fingerprint examiners.<sup>62</sup> There is no doubt that fingerprints are highly variable. They might even be unique, though we cannot actually test this. Uniqueness is an assumption. Regardless, notwithstanding their marked variability (or uniqueness) latent fingerprint examiners occasionally make mistakes – not identifying fingerprints that match (false negatives) and sometimes matching fingerprints from different sources (false positives). The asserted uniqueness of prints does not prevent fingerprint examiners from making mistakes. Claims about certainty and infallibility and the implications of fingerprints being unique (or appearing identical) are misguided. The more appropriate issues are the frequency of errors (especially false positives) made in similar conditions and the empirical insight into the frequency (and inter-relatedness) of features.<sup>63</sup> This is why PCAST recommended that fingerprint examiners should provide an indicative error rate with their match decisions and should aim to develop probabilistic forms of expression and reporting – as with DNA profiling.<sup>64</sup>

The most recent of the scientific reviews, a gap analysis by the AAAS, concluded that historical over-claiming by latent fingerprint examiners would be difficult to correct:

Public perceptions of latent print examination have undoubtedly been shaped by decades of overstatement. One of the problems that examiners now face when attempting to convey a more realistic and appropriate sense of the value of latent print evidence is that people generally think a reported association between a latent print and reference print constitutes a virtually infallible identification. In our view latent print examiners should take affirmative steps, when reporting their findings, to address these common misconceptions.<sup>65</sup>

Courts, including Australian courts, would seem to be implicated in this state of affairs and consequently would seem to be obliged to assist in its remediation.

We might also note that latent fingerprint examiners did not identify the problems and have not pro-actively disclosed fundamental epistemological deficiencies. Indeed, rather than evaluate their procedures and abilities, most relied upon their (collective) impressions and experience, assumptions about uniqueness and its significance handed down by earlier generations of examiners, along with the accommodating responses of courts. Fingerprint examiners did not study their performance or go looking for errors or vulnerabilities. Most

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<sup>60</sup> I. Dror et al, ‘Contextual Information Renders Experts Vulnerable to Making Erroneous Identifications’ (2006) 156 *Forensic Science International* 74.

<sup>61</sup> NIST report; National Commission on Forensic Science, <https://www.justice.gov/ncfs> (accessed 1 June 2018).

<sup>62</sup> PCAST report, 61-2. See also NRC report, 145.

<sup>63</sup> Or, the frequency of similar features in other fingerprints, leading to some kind of probabilistic formulation.

<sup>64</sup> DNA profiling evidence is expressed in probabilistic terms but no error rate is included.

<sup>65</sup> AAAS report, 71.

fingerprint examiners and bureaus were not capable of undertaking the remedial validation work themselves. In the wake of the reviews they continued to report in categorical terms and were apparently satisfied by the alignment of their opinions with confessions, legal admission, and convictions. The problem with these and other forms of ‘evidence’ is that they are at best proxies.<sup>66</sup> The correct answer – whether the prints are actually from the same source, and whether an error has been made – is usually unknown. Convictions, for example, may be driven by other evidence (often known to the examiner) and are not infrequently factually wrong.<sup>67</sup>

There are marked discrepancies between how latent fingerprint evidence is understood and used in criminal justice settings and how it is understood by attentive scientists. Importantly, legal institutions did not generate a sophisticated endogenous response to latent fingerprint (and other types of forensic science) evidence and, perhaps as troubling, appear to be resistant to contemporary scientific knowledge and authoritative scientific advice. Legal rules and procedures have never been interpreted in ways that direct attention to epistemic issues such as validity and scientific reliability. There is, for example, no expectation as a condition of admission, that fingerprint examiners will disclose empirically-derived error rates.

Scientific research provides a means of assessing legal responses to latent fingerprint evidence – past and present. This, as we shall see, is illuminating. The following study illustrates how no Australian court ever required latent fingerprint examiners to independently demonstrate their abilities or explain limitations and uncertainties – even when their opinion evidence was contested. There was no requirement to show that latent fingerprint evidence was valid and no consideration of its actual accuracy. There was no expectation that fingerprint examiners would present an indicative error rate. There was no attention to the existence of meaningful standards, on sufficiency, quality, agreement, the number of points required and so forth. No court, and this is very important, required latent fingerprint examiners to present their evidence in a way that was consistent with their known ability and in a form that would assist with rational evaluation (as opposed to deference). Courts allowed fingerprint examiners to positively identify persons without qualification or caveat. Courts also allowed latent fingerprint examiners to testify about their ‘method’ and ‘the science’ – as in the example in Section 2 – in ways that were misguided, misleading and sometimes simply wrong. Police fingerprint examiners testified about their impressions and beliefs (what we might call fingerprint dogma) that was not based on scientific knowledge or consistent with what attentive scientists expected and recommend.<sup>68</sup>

#### **4. Admissibility assumed: *Rex v Blacker* (1910) and *R v Parker* (1912)**

Our survey begins at the close of the first decade of the twentieth century. By that stage fingerprint bureaus had already been established within most of the Australian police departments, and fingerprint evidence had already been used in investigations and criminal prosecutions.<sup>69</sup> The first indication of an issue, for those reviewing the record, is the absence of a reported decision addressing (a challenge to) the admissibility of latent fingerprint evidence in Australia.<sup>70</sup> The first two reported Australian cases, from NSW and Victoria, indicate how quickly the primary focus seems to have moved beyond any question of admissibility to practices surrounding the use of fingerprint evidence – specifically the use of

<sup>66</sup> See Martire and Edmond, ‘Rethinking expert opinion evidence’.

<sup>67</sup> More problematically, decision makers rely on fingerprint evidence to convict and assess convictions on appeal.

<sup>68</sup> Australian courts relied heavily on examiners’ experience and earlier admissibility decisions.

<sup>69</sup> It was sometimes used to obtain confessions – or that is how police investigations were presented to the public.

<sup>70</sup> If there was a serious challenge at trial then it has not been remembered. Even *R v Blacker* [1910] SR (NSW) 357 appears to have been quickly forgotten. There were quite a few investigations and prosecutions relying on fingerprint evidence reported in the major metropolitan newspapers in the decade preceding *Blacker*.

photographs and whether a fingerprint alone could support proof (of identity) beyond reasonable doubt. As in England and Wales (the first reported English decision is reproduced in full in the Appendix), in just a few short years the admissibility of latent fingerprint evidence seems to have been taken for granted by Australian courts. Though, the absence of sustained legal, and conspicuously appellate, engagement with the foundations is revealing when we appreciate that the validity and accuracy were not known (at that stage).<sup>71</sup>

The prosecution in *R v Blacker* followed a serious assault on a Chinese market gardener, the ransacking of his hut and the theft of cash from a box therein. A fingerprint on the cash box was matched to the thumb of Blacker. Using a ‘strong magnifier’ police sub-inspector Childs identified 14 points of similarity and opined that the print on the box was made by Blacker’s thumb.<sup>72</sup> Blacker was tried and, on the basis of fingerprint evidence, convicted. The issue reserved in this case was whether enlarged photographs of the latent fingerprint and reference (or known) fingerprints from Blacker had been properly admitted. The defence challenged the admissibility of the particular enlargements on the ground that neither of the enlarged images captured the ‘whole’ of the latent or the reference print. Rather, they reproduced only that part of the print relied upon by Child for his comparison. Photographs of the full prints – that had not been enlarged – were admitted along with the partial enlargements.

On appeal, the Chief Justice of New South Wales had no doubt about the admissibility of the fingerprint evidence.<sup>73</sup>

This new *science of identification* by fingerprints is *based on experiments* which show that the portion of the body most likely to be identified without probability of mistake is the bulbous portion of the thumb, and if similarity is found to exist *the test is a very reliable one*. In the present case the evidence of the expert showed that the similarity was sufficiently strong to justify the admission of evidence upon the point.<sup>74</sup>

Upon inspection of the photographs, the Chief Justice and his colleagues were satisfied that the fingerprints were made by the same person.<sup>75</sup>

In relation to the partial enlargements, the Court accepted that ‘all the markings upon which the evidence as to the identification was based were represented’.<sup>76</sup> The enlargements were necessary ‘to illustrate and explain what otherwise the jury could not see for themselves’ and to enable ‘the evidence of the expert ... to be tested’.<sup>77</sup> This required ‘the expert’ to ‘illustrate and explain what otherwise the jury could not see for themselves’ by ‘something visible to the eye.’<sup>78</sup> The omission of some surrounding markings, apparently blurred and not used for the comparison, was said to be immaterial in the absence of the defendant calling evidence to show that the portion used ‘was insufficient’ or not ‘accurately prepared under the supervision of the expert’.<sup>79</sup> The Chief Justice insisted that the fingerprint evidence ‘was carefully given and thoroughly tested’. In particular, the jury was ‘very

<sup>71</sup> If there are substantial challenges they are not reported. It would seem unlikely that serious challenges pass without record.

<sup>72</sup> *R v Blacker* [1910] SR (NSW) 357, 358. That is, ‘the two marks were made by the same thumb’. See also *Blacker v The King* (1910) 10 CLR 604, 605.

<sup>73</sup> *Blacker*, 360.

<sup>74</sup> *Blacker*, 360. (italics added) Neither the experiments nor evidence supporting the bulbous part of the thumb being of most use for comparison are referenced.

<sup>75</sup> This personal assessment appears inconsistent with *R v Lawless* [1974] VR 398 and *Reg. v O’Callaghan* [1976] VR 676, discussed in Section 5.

<sup>76</sup> *Blacker*, 361.

<sup>77</sup> *Blacker*, 361. Contrast *Bennett v Police* [2005] SASC 167 (discussed below), where there is no requirement for the provision of images or the examiner’s markings.

<sup>78</sup> *Blacker*, 361.

<sup>79</sup> *Blacker*, 361-2.

carefully directed by the learned Judge as to the risk of error to which evidence of this class is open' and 'every precaution was taken to guard against any wrongful impression being conveyed to the jury'.<sup>80</sup>

The appeal in *R v Parker* generated a more detailed appellate response to issues attending the introduction of fingerprint evidence. Though, once again, it had 'not been suggested that this evidence was wrongly admitted'. The appeal in *Parker* is concerned with the value of the evidence and the ability of a single latent fingerprint to support criminal proof.<sup>81</sup> *Parker* is exceptional, among our sample, because notwithstanding the majority finding the fingerprint evidence admissible and compelling, the Chief Justice of Victoria voiced a forceful dissent.

*Parker* was convicted of breaking into a warehouse and stealing jewelry from a safe. A latent fingerprint was obtained from a bottle of ginger beer located adjacent to the safe. A photograph of the latent print as well as a photograph of Parker's middle fingerprint were both enlarged and admitted at trial. Detective Potter, in charge of the fingerprint identification branch, gave evidence about the resemblance and 'pointed out to the jury nine points of similarity' as well as scars said to appear in both images.<sup>82</sup> His evidence was summarised as follows:

... he was of opinion that the prisoner's finger must have made the print on the bottle. He had examined tens of thousands of finger-prints, and never found two alike. The markings on a person's fingers remain the same through life. Inspector Child, of the New South Wales police, gave evidence to the same effect. No two individuals had the same finger-prints.<sup>83</sup>

The jury convicted, the Court of Appeal was asked to consider: '[w]hen the only evidence against an accused person depends upon the resemblance between finger-prints ... whether such evidence is sufficient to support a conviction?'<sup>84</sup>

Three judges considered this question and two found that it could. In reflecting on fingerprint evidence, Justice Hodges considered that in terms of identification, and in comparison to eyewitness evidence, fingerprints:

would be the strongest, the most satisfactory, and the most conclusive proof of identity that could be produced, and therefore ... finger-print evidence of identity may be undoubtedly sufficient to justify the conviction of the accused.<sup>85</sup>

He continued,

In my opinion, it may be the safest of all evidence, as it does not depend upon the impressions caused by a momentary glance, but the impression is put on record, and the jury can see and judge for themselves as to the identity of the finger-marks and the expert be merely a help to enable the jury to use the evidence of their own eyes.<sup>86</sup>

In terms of the respective role of fingerprint examiner and jury, provided the jury 'were satisfied with the witness under examination and cross-examination to arrive at the conclusion' for Hodges 'that was sufficient to justify a conviction.'<sup>87</sup>

<sup>80</sup> *Blacker*, 360.

<sup>81</sup> Compare DNA only prosecutions. See A. Ligertwood, 'Can DNA Evidence Alone Convict an Accused?' (2011) 33 *Sydney Law Review* 487.

<sup>82</sup> *Parker v The King* (1912) 14 CLR 681, 682. We can see observe claims about permanence and uniqueness, mobilized as though they provide a warrant for individualisation.

<sup>83</sup> *R v Parker* [1912] VR 152, 153.

<sup>84</sup> *Parker*, 156-157.

<sup>85</sup> *Parker*, 158.

<sup>86</sup> *Parker*, 158.

<sup>87</sup> *Parker*, 159: Though, because Hodges had neither seen nor heard the cross-examination he would not say 'whether ... I would have agreed' with the result.



In his concurrence, Justice Cussen explained: ‘[i]t now seems that this much is established—that there is a very high degree of probability that a finger-print corresponding with that of the prisoner was made by his finger’.<sup>88</sup> There was no requirement that the fingerprint evidence be corroborated by another class of evidence, and so he affirmed the conviction. Cussen drew support from two English cases, namely *R v Castleton* and another, along with *R v Rudiwick* (an unreported Victorian case), and the appeal to the Supreme Court of Illinois in *People v Jennings*.<sup>89</sup> Justice Cussen’s decision seems to suggest that with respect to similarities between fingerprints, examiners ‘are not, in one sense, speaking as experts ... but merely pointing out to the jury matters which they jury could determine for themselves.’ In his words examiners ‘are simply convenient helpers of the Court.’<sup>90</sup> (Questions around the division of responsibility between experts and juries would be an ongoing issue for Australian courts).

In a spirited dissent Chief Justice Madden adverted to the ‘extreme danger’ of allowing fingerprint evidence to satisfy criminal proof.

The extreme danger of arriving at such a conclusion warrants me in not deferring to their opinions. We are asked to accept the theory that the correspondence between two sets of finger-prints is conclusive evidence of the identity of the person who made those prints as an established scientific fact, standing on the same basis as the proposition of Euclid or other matters vouched for by science and universally accepted as proved. If this finger-print theory were generally recognized by scientific men as standing on this basis, there would be no more to be said. It is said that the markings on the fingers of any individual retain their special characteristics from the cradle to the grave, and also that the markings on the fingers of no two individuals are the same, so that absolute correspondence between a finger-print and the markings on a man’s hand is unmistakable evidence that he is the person who made such print.

My difficulty arises from the fact that the subject of finger-prints has not been sufficiently studied to enable these propositions to be laid down as scientific facts. Finger-prints have been studied by Monsieur Bertillon in France from an anthropometrical point of view, and by Sir Francis Galton and a few others, doubtless highly intelligent persons, from the standpoint of mere observers. But the matter has not been investigated by scientists generally so that we can say that the propositions relied on by the Crown are accepted scientific facts.<sup>91</sup>

For Madden, the evidence also raised issues of honesty and trust that threatened to undermine legal safeguards. He referred to being dependent on the ‘ipse dixit’ of the examiner: How could the cross-examiner or jury assess whether among the 29 000 sets of prints purportedly examined by the witness that there were ‘no two alike’.<sup>92</sup> And, vitally, how could his evidence be ‘tested’?

... when the detectives swear that no two men’s finger-prints could possibly be alike, I think that that is apt to be accepted by the jury, who have no personal knowledge to test it by ...<sup>93</sup>

The Chief Justice was not personally satisfied that ‘there is any marked similarity’ between the images of the latent fingerprint and Parker’s fingerprint.<sup>94</sup> In the process he characterised the English Court of Appeal’s decision in *R v Castleton* as ‘most unsatisfactory’, noted that those who had bought and delivered the ginger beer were not called, and the possibility that

<sup>88</sup> *Parker*, 161. The judge speaks in terms of probabilities.

<sup>89</sup> See *R v Rudiwick* (Argus 11 December 1909, p.18) (listed as Charles Rudebeck); *R v Castleton* [1909] 3 Cr App R 74; a case cited in *Taylor’s Medical Jurisprudence* (1910 ed.) vol. I, p.127 [to be confirmed] and *People v Jennings*, 252 Ill. 534, 96 N.E. 1077 (1911).

<sup>90</sup> *Parker*, 160.

<sup>91</sup> *Parker*, 154. See J. Ellenbogen, *Reasoned and Unreasoned Images: The Photography of Bertillon, Galton, and Marey* (Penn State University Press, 2013).

<sup>92</sup> *Parker*, 154. This term reappears in *Kumho Tire Co. Ltd v Carmichael* 526 U.S. 127 (1999).

<sup>93</sup> *Parker*, 155.

<sup>94</sup> *Parker*, 155.

the prisoner had innocently touched the bottle had not been excluded (by the prosecutor). The Chief Justice was of the opinion that the case should have been withdrawn from the jury.

Despite the split in the Court, all three judges questioned the claim about the individuality (or uniqueness) attributed to fingerprints. They agreed that ‘the statement made by the expert witnesses that there could not be two finger-prints alike should not have been admitted, because ... their knowledge or the knowledge of anyone else on the subject does not profess to be based on any universal law, but is merely empirical’.<sup>95</sup> That is, it was based on personal experience. Justice Hodges did not think it ‘necessary to say that there could not be any other finger-mark in the world like it’ and agreed ‘with what the learned Chief Justice has said as to the admissibility of that piece of evidence.’<sup>96</sup> Justice Cussen indicated that fingerprint examiners might identify differences (for exclusionary purposes), but as far as similarities were concerned they could merely point these out to the jury for their consideration.<sup>97</sup> The headnote in the *Argus Law Reports* summarised the Courts’ position in the following terms:

*Semble, per Curiam*,—Evidence by experts that no two finger-prints can be identical is not admissible as being the statement of a scientific fact based upon a universal law.<sup>98</sup>

Blacker and Parker each sought review by the High Court of Australia. Both requests were refused. During the oral application in *Blacker*, counsel raised the issue of the enlargement of part of the fingerprint and the possibility that ‘the portion omitted might have shown the prints were dissimilar.’ The issue was left hanging.<sup>99</sup> The High Court appeared to accept the claim that ‘if within a small radius around the bulb certain characteristics were found to coincide, that would identify the print irrespective of the outlying portions’.<sup>100</sup> Chief Justice Griffith suggested that if enlargements were not admissible ‘you might as well object to a witness using a microscope’.<sup>101</sup> Justice Isaacs indicated that the enlargement of one part of the print ‘goes to the weight of the evidence, but not its admissibility.’<sup>102</sup>

Subsequently, dismissing the application in *Parker*, Griffiths drew an analogy between fingerprints and signatures.<sup>103</sup>

Signatures have been accepted as evidence of identity as long as they have been used. The fact of the individuality of the corrugations of the skin on the fingers of the human hand is now so generally recognized as to require very little, if any, evidence of it, although it seems to be still the practice to offer some expert evidence on the point. A finger print is therefore in reality an unforgeable signature. That is now recognized in a large part of the world, and in some parts has, I think, been recognized for many centuries. It is certainly now generally recognized in England and other parts of the British Dominions.<sup>104</sup>

Notwithstanding concerns in the Court of Appeal, the individuality (or uniqueness) of fingerprints is here presented as notorious. The High Court seems to have been satisfied about ‘the individuality of the corrugations of the skin on the fingers’.

<sup>95</sup> *Parker*, Madden CJ at 155, Cossens J at 159, and Hodges J at 158.

<sup>96</sup> *Parker*, 158.

<sup>97</sup> *Parker*, 161. This seems similar to the approach to image interpretation subsequently adopted in *R v Tang* (2006) 65 NSWLR 681.

<sup>98</sup> *Rex v Parker* in *The Argus Law Reports*, Vol. xviii (14 May 1912).

<sup>99</sup> *Blacker v The King* (1910) 10 CLR 604, 606.

<sup>100</sup> *Blacker*, 605.

<sup>101</sup> *Blacker*, 606. This statement seems to conflate the issue of enlargement, live in the application for leave, with the separate issue of the validity and accuracy of latent fingerprint comparison.

<sup>102</sup> *Blacker*, 606.

<sup>103</sup> Counsel questioned whether *Castleton* was authority for fingerprint only conviction.

<sup>104</sup> *Parker v The King* (1912) 14 CLR 681, 683 (per Griffith CJ).

*Blacker* and *Parker* were not admissibility challenges, per se. Though they support implicitly, the admissibility of latent fingerprint evidence. Following *Blacker* and *Parker* fingerprints were not only admissible, but in cases where identity was in issue fingerprint evidence alone could sustain proof beyond reasonable doubt.

### 5. A century of consolidation: Routine reliance and non-epistemic challenges

Between 1910 and the first of the scientific reviews published in 2009, the admissibility and use of fingerprint evidence was challenged in Australian courts in a variety of ways. Reported challenges were not directed at the validity and accuracy of latent fingerprints, the absence of (empirically-based) standards, the categorical identifications, cognitive bias and so on. The history of challenges to latent fingerprint evidence is dominated by *legal* issues, such as: compliance with procedures for obtaining reference fingerprints;<sup>105</sup> the use of fingerprints obtained when the defendant was a minor;<sup>106</sup> the ability to obtain prints from a minor;<sup>107</sup> whether adequate caution was given;<sup>108</sup> whether the disclosure (or implication) of previous offences, through the existence of a fingerprint record, was unfair to the defendant at trial;<sup>109</sup> the hearsay implications of fingerprints on a document;<sup>110</sup> whether prints could sustain proof in particular cases (following *Parker*);<sup>111</sup> the appropriate judicial directions for the jury when fingerprint evidence was in issue;<sup>112</sup> and whether the jury could compare the fingerprints themselves.<sup>113</sup>

Perhaps the most sustained question concerns these last issues – the respective roles of fingerprint examiners, judges and juries in the evaluation of the fingerprint evidence.<sup>114</sup> In *Blacker* (and *Castleton*) the Court of Appeal seems to have been satisfied that the latent fingerprints were those of the appellant on the basis of its own examination. The issue also rose in *Parker*, and more prominently later in the century in *R v Lawless* and *R v O'Callaghan*.<sup>115</sup>

*Lawless* was convicted of murder on the basis of circumstantial eyewitness evidence and a latent fingerprint found on a cigarette packet recovered from the crime scene. He accused the police of planting the cigarette packet.<sup>116</sup> The Crown conceded that the fingerprint evidence in this particular case was insufficient on its own to prove guilt. On appeal *Lawless* questioned the way the latent fingerprint evidence was presented to the jury. The trial judge had indicated that the jury would not be provided with a magnifying (or 'Hendry') glass:

<sup>105</sup> *R v Delgado-Guerra; ex parte Attorney-General*, [2002] 2 Qd R 384; *Director of Public Prosecutions v Morrison*, [1993] 1 VR 573 (consent); *Carr v The Queen* (1973) 127 CLR 662; *Boski v Biffin* [2015] NSWSC 363; *Watkins v Victoria* [2010] VSCA 138, (2010) 27 VR 543; *Maguire v Beaton* [2005] NSWSC 1241; *Bonder v Howell* [1984] WAR 76; *Fullerton v Commissioner of Police* [1984] 1 NSWLR 159; *Coxan v Mazey* [1981] Tas R 209; *Sernack v McTavish* [1971] ALR 441.

<sup>106</sup> *R v Sarlija* [2006] ACTCA 22.

<sup>107</sup> *Police (NSW) v JC* [2016] NSWChC 1.

<sup>108</sup> *Milner v Anderson* (1982) 42 ACTR 23.

<sup>109</sup> *R v Ahola (No 6)* [2013] NSWSC 703.

<sup>110</sup> *Re Pong Su (No 18)* [2005] VSC 58.

<sup>111</sup> *R v Barbera* (1972) 1 NSWLR 612 (prints on outside of car); *R v Fitzgerald* [2005] SADC 118; *Chahine v The Queen* [2006] NSWCCA 179.

<sup>112</sup> *Reg. v O'Callaghan* [1976] VR 676, 678; *R v Moore* [1982] Qd R 162.

<sup>113</sup> *R v Lawless* [1974] VR 398; *S v Nala* (1965) 4 SA 360, 362.

<sup>114</sup> See e.g. *R v Bornyk* 2013 BCSC 1927 and *R v Bornyk* 2015 BCCA 28.

<sup>115</sup> *R v Lawless* [1974] VR 398; *Reg. v O'Callaghan* [1976] VR 676. See also *R v Amatto* [2011] NSWDC 194, where a puerile legal challenge to the relevance of latent fingerprint evidence was succinctly dismissed.

<sup>116</sup> Discussed in *Report of The Board of Inquiry Into Allegations against Members of the Victoria Police Force* Volume 3 (Government Printer, 1978).

the jury would not be allowed to carry out such an experimentation as it was an expert field of knowledge, and the accused would have to contest the witness's evidence with expert evidence or suggest to the jury that he should not be believed, but the jury could not set themselves up as experts.<sup>117</sup>

The trial judge charged the jury in the following terms:

It is, of course, entirely a matter for you to judge and examine his evidence and to make up your own minds as to whether you are satisfied with it and satisfied that he is accurate and honest, reliable, both in the investigation he made of the print and in the opinion that he expressed that it belonged to the accused man.<sup>118</sup>

The Court of Appeal was satisfied that the trial judge's actions were appropriate and did not interfere with the prerogatives of the jury (or encourage them to become experts):

We are of the opinion that the judge was right in his intervention. It is a matter for expertise not possessed by the ordinary run of mankind to identify characteristics of fingerprints and their patterns in each of two prints and make a comparison and form a conclusion as to whether they are identical or not and the jury could not be invited or allowed to act as experts. That is not to say of course that the jury could be prevented from examining the exhibits for the purpose of determining whether they were satisfied to the necessary degree by the evidence of the witness. The determination was for them, but the provision of evidence was for the experts.<sup>119</sup>

In *O'Callaghan* the fingerprint evidence was challenged on the ground that the jury was invited to undertake its own analysis of the fingerprints. The *O'Callaghan* court endorsed *Lawless*: 'when properly understood there is no conflict between what was said in *Lawless* and the decision in *Parker*.'<sup>120</sup> Both *Lawless* and *Parker* were said to 'make it plain that it is for the jury to decide whether one set of fingerprints is the same as another.'<sup>121</sup> The Court explained that it 'may be misleading to say that it is for the expert to form a conclusion whether two prints are identical but his Honour made it clear that the determination of the question of fact was for the jury and that they had to consider whether they were satisfied with the expert evidence.'<sup>122</sup>

The Court of Appeal was also asked to consider the admission of the following testimony:

Under cross-examination the expert said: "I have never been proved wrong on fingerprint identification, but the problem is it takes five years to train a fingerprint man, and members of the jury can see something in a fingerprint which they would consider makes it not in when in fact it is in." He was led into repeating and re-affirming his view that the impressions shown in Exhibits "B" and "C" were identical. Then after a lengthy cross-examination this question was put to him: "Would you go so far as to say that there are not and never have been any two prints which are the same as each other?" to which he replied, "I will, yes." Not content with that answer counsel persisted and finally these questions and answers were asked and given "You would say that never in the history of the world has there been a person born with the same fingerprint as somebody else? - From my studying of text books and the findings of other as you call scientists, and from my own examination of ridge characteristics occurring in fingerprints I have examined, I would say most emphatically no. "I take it you go a step further and say it is just not possible for such a thing to occur? - I would say yes, unless that impression was made by the same finger."<sup>123</sup>

<sup>117</sup> *Lawless*, 422.

<sup>118</sup> *Lawless*, 423.

<sup>119</sup> *R v Lawless* [1974] VR 398, 423. (references omitted)

<sup>120</sup> *R v O'Callaghan* [1976] VR 676, 679.

<sup>121</sup> *O'Callaghan*, 679.

<sup>122</sup> *O'Callaghan*, 679. See also *R v Dearing, Kenneth George* [1975] VicSC 37, 17-20 (19 February 1975).

<sup>123</sup> *O'Callaghan*, 677.

Rather than treat some of these answers as impermissible, following the prohibition in *Parker* (and later *R v Ghebrat*), and perhaps consider the implications for the probative value (in relation to underlying methodological issues, about validity, errors and the significance of uniqueness) and the credibility of the witness, the fact that they were asked by defence counsel meant that, for the Court of Appeal, leave should not have been given to raise them.<sup>124</sup> To the extent that these answers, made in the absence of scientific support (and against appellate prohibition), are received at trial, responsibility is attributed to the defence.<sup>125</sup> Cross-examination is consistently presented, across the fingerprint cases, as an effective trial safeguard. However, when questions lead to ignorant, exaggerated and misleading answers, from an expert witness called by the state, the defence is blamed.<sup>126</sup>

A handful of further appeals questioned the opinions of latent fingerprint examiners where opinions extended beyond match decisions (conventionally restricted to identity or *source*) to the *activity* associated with deposition of a latent fingerprint or the age of a print.<sup>127</sup> In *Hillstead v The Queen*, the fingerprint examiner testified that fingerprints in blood were deposited contemporaneously with a bloody murder. This testimony, presented without qualification or support, was judged to have been improper – *ipse dixit* that trespassed beyond the scope of legally-recognisable fingerprint expertise.<sup>128</sup> The appeal in *Regina v SMR* was dismissed notwithstanding the examiner having offered an opinion about the age of a latent fingerprint on a library book, in circumstances where the trial judge did not appropriately address the limitations.<sup>129</sup> Expertise in fingerprint comparison for purposes of assisting with identification is not known to extend to the age of a print or the activity being engaged in when the latent print was deposited.<sup>130</sup> Even in *Mickelberg v The Queen*, a series of wrongful convictions involving serious police malfeasance that took decades to unravel, concern with the latent fingerprint evidence was directed to whether it was planted or a forgery.<sup>131</sup> The reliability of identification by latent fingerprint comparison was taken-for-granted throughout, only the intervention of dishonest investigators threatened its integrity.

Overall, the reliability (and probative value) of identification by latent fingerprint comparison appears unquestionable and, significantly, remains unquestioned. We can observe continuity in recently reported decisions where Australian courts demonstrate an abiding confidence in fingerprint evidence and find that it is so self-evidently reliable that there is no particular need for proponents to disclose materials, identify assumptions or explain the method. The appeals in *Bennett v Police*, discussed immediately below, might even suggest liberalization and complacency, as common law judges no longer expect the state – as they had in *Blacker* and *Parker* – to provide photographic evidence, identify points of similarity or explain how the identification was made.

Bennett was identified when a fingerprint located following a break-in was described by a fingerprint examiner as ‘identical to a fingerprint taken from Mr Bennett’ and ‘from the same person’.<sup>132</sup> At trial the examiner testified as follows: ‘[w]hen I say that something is identical, what I mean is that the impressions were made by the one person excluding all others.’<sup>133</sup>

<sup>124</sup> *O’Callaghan*, 677.

<sup>125</sup> This is a consistent pattern in cases, where the defence appears to be considered responsible for asking questions. In *JP*, questions posed in cross-examination were said to somehow repair the non-compliant report and satisfy conditions for admission and use.

<sup>126</sup> This is a problem with the testimony (and its foundations), not the questions.

<sup>127</sup> *Barr v The Queen* [2004] NTCCA 1; *R v SMR* [2002] NSWCCA 258.

<sup>128</sup> *Hillstead v The Queen* [2005] WASCA 116, [50], [52]ff. Contrast *Mahmood v Western Australia [No 2]* [2008] WASCA 259, [55]ff, [225]; *Mansell v Western Australia [No 6]* [2013] WASCA 120, [137]-[139].

<sup>129</sup> Contrast *R v Peel* (1999) 2 Qd R 400, 410.

<sup>130</sup> The scope of the expertise (or ‘field’) is an issue here.

<sup>131</sup> *Mickelberg v The Queen* [2004] WASCA 145.

<sup>132</sup> *Bennett v Police* [2005] SASC 167, [2], [6]. And, on appeal, *Bennett v Police* [2005] SASC 415, [12], [16].

<sup>133</sup> *Bennett v Police* [2005] SASC 415, [16].

Bennett was convicted. On appeal, there was no dispute about the examiner being ‘qualified to express the opinion that he gave.’<sup>134</sup> The judgment insists that there was ‘no suggestion that the process of comparison that he followed is not a recognised and appropriate process.’<sup>135</sup> Rather, Bennett’s counsel complained that the examiner had not supplied images or specified the features he observed. He had, in addition, made no contemporaneous notes.<sup>136</sup> This meant, according to the defence, that it was not in a position to determine the facts on which the opinion was based and so was incapable of evaluating the opinion (and any reasoning) prior to the proceedings.<sup>137</sup>

On appeal, Chief Justice Doyle explained that admissibility was not affected by the ability ‘to describe in detail what the witness observed, or to produce an image or representation of what the witness observed’.<sup>138</sup> ‘It was permissible’, for the examiner, ‘to say that identical features were found, without itemizing them.’<sup>139</sup> Oversights and omissions were cast as issues for weight.<sup>140</sup> The defence was characterised as having ‘had the fullest opportunity to cross-examine’ the witness.<sup>141</sup> Moreover, the failure of the defence to ask for images and cross-examine on them, was a factor Doyle thought ought to be taken into consideration in assessing the merit of the appeal.<sup>142</sup> In the end, the Chief Justice was satisfied with the admission of the evidence and the safety of the conviction because of ‘unchallenged evidence that each fingerprint exhibited features that, taken together, led to the conclusion that they were identical.’<sup>143</sup> It was not considered ‘unfair, in a case like this, to leave it to counsel to cross-examine [the examiner] about the features on which he relied.’<sup>144</sup>

The decision was upheld on a further appeal to the full court. On the issue of jury comparisons, Acting Chief Justice Perry wrote: ‘[i]dentification of similarities in fingerprints is a highly technical matter requiring considerable expertise and experience. I have regularly instructed juries not to attempt to make such as comparison themselves.’<sup>145</sup> This seems to be a succinct summary of the conventional position following *Lawless* and *O’Callaghan* (after Hodges in *Parker*).

The leading judgment in the full court provides a description of the comparison from the trial.

In making a comparison between the images of the negatives and in this case the unknown, and the known print on the ink set, it’s a matter of comparing the impressions or the characteristics which appear in the image on the negative against the characteristics as they appear in sequence and by looking at the flow of the ridges, the quality of the impressions, an opinion may be formed.<sup>146</sup>

This is a caricature of the ‘method’. On appeal, the fact that the examiner had not proactively explained his method or produced the photographs, mark-ups or notes, was again challenged on the basis that ‘the factual basis [of the opinion] had not been established’.<sup>147</sup> It was said to

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<sup>134</sup> *Bennett*, [5].

<sup>135</sup> *Bennett*, [5].

<sup>136</sup> *Bennett*, [11]. During a lunch break at trial, the examiner took another look at the prints and reporting finding ‘more than 20 characteristics that were common and identical’.

<sup>137</sup> Reference was made to the UEL case of *Makita Pty Ltd v Sprowles* (2001) 52 NSWLR 705, [59]-[63]. See also *Davie v Magistrates of Edinburgh* [1953] SC 34.

<sup>138</sup> *Bennett*, [44].

<sup>139</sup> *Bennett*, [49]. Contrast *Blacker*, 361: ‘If the evidence of the expert is to be tested at all it seems to me that it is necessary to allow his evidence of identification to be explained by something which is visible to the eye.’

<sup>140</sup> *Bennett*, [44], [47].

<sup>141</sup> *Bennett*, [16].

<sup>142</sup> *Bennett*, [47]. See also *Dasreef Pty Ltd v Hawchar* [2011] HCA 21, [32].

<sup>143</sup> *Bennett*, [53].

<sup>144</sup> *Bennett*, [55].

<sup>145</sup> *Bennett v Police* [2005] SASC 415.

<sup>146</sup> *Bennett v Police* [2005] SASC 415, [17].

<sup>147</sup> *Bennett v Police* [2005] SASC 415, [21].

be unfair because ‘it was not possible ... to test the opinion without access to the information upon which the comparisons had been made.’<sup>148</sup>

Once again, the full court deemed the absence of photographs as a matter for weight.<sup>149</sup> The Court characterised the defence position as strategic: ‘a forensic choice not to ask for production of the image’. As for the factual foundations and the method, the Full Court found that the ‘evidence was admissible’.<sup>150</sup>

... the expert had not been challenged as to his expertise, his expertise had clearly been established, the methodology that he used generally in the comparison of fingerprints was explained to the Court [see the previous extract], the defence called no evidence to the contrary, and the expert gave evidence that he found the comparison showed that the fingerprints were identical.<sup>151</sup>

We might note that there are no references to ACE-V, validation, standards, error rates, human factors, or scientific research in the decision.

In *Parker* and *Blacker* courts referred to the need for the jury to see the photographs of the prints. All of the judges in *Parker* were critical, and against the admission, of claims about uniqueness and therefore, though perhaps implicitly, positive identification (to the exclusion of all other persons).<sup>152</sup> A century later, in *Bennett*, positive identification is not questioned and there is apparently no need for the examiner or prosecutor to produce images, explain the basis of the decision, refer to points of similarity, or even address apparent differences or distortion.<sup>153</sup>

It is not my intention to trivialise these legal (or non-epistemic) challenges. Rather, these examples illustrate how lawyers and courts have taken the reliability of latent fingerprint evidence – in its strongest form, as positive evidence of identity – for granted. A handful of the challenges focused on legal and procedural issues were successful and probably represented the most effective way of advancing the particular client’s interest within the existing paradigm. These cases, however, suggest that lawyers and judges credulously accepted (or were unwilling or unable to question) assertions, advanced by fingerprint examiners and accepted by earlier courts, about latent fingerprint evidence being effectively infallible evidence of identity based on the uniqueness of human fingerprints. The overwhelming concern with legal rather than epistemological issues seems to be the result of legal beliefs – informed by both tradition and personal beliefs – in conjunction with a conspicuous lack of technical sophistication.

## 6. Royal Commissions, new evidence rules and new technologies

A series of prominent mistakes involving forensic science evidence, notably *Splatt* and *Chamberlain* and, more recently, prominent appeals in cases such as *Mallard v The Queen*, *Wood v R*, *R v Gilham* and *R v Keogh* have exerted no discernible impact on the processing and reporting of latent fingerprint evidence.<sup>154</sup> At the time of the Royal Commission into the

<sup>148</sup> *Bennett v Police* [2005] SASC 415, [23]. Drawing upon *Makita (Australia) Pty Ltd v Sprowles* (2001) NSWLR 705. See also *JP*, below.

<sup>149</sup> *Bennett v Police* [2005] SASC 415, [30].

<sup>150</sup> *Bennett v Police* [2005] SASC 415, [31].

<sup>151</sup> *Bennett v Police* [2005] SASC 415, [32]. Here certification and vague description of method stand in for actual ability and override the need for appropriate presentation.

<sup>152</sup> These are the same, even if they are not always represented or understood as such. If fingerprint examiners believe fingerprints are unique, then they are presenting a match as individualisation.

<sup>153</sup> *Blacker*, 361: The enlargements were necessary ‘to illustrate and explain what otherwise the jury could not see for themselves’ and to enable ‘the evidence of the expert ... to be tested’. Contrast *Bennett v Police* [2005] SASC 167 (discussed below), where there is no requirement for the provision of images or the examiner’s markings.

<sup>154</sup> Justice Morling, *Royal Commission of inquiry into the Chamberlain Convictions* (1987); C. Shannon, *Royal Commission of Inquiry in Respect to the Case of Edward Charles Splatt* (Government Printer, Adelaide, 1984); *Mallard v The Queen* (2005) 224 CLR 125; *Wood v The Queen* (2012) 84 NSWLR 581; *Gilham v The Queen* (2012) 224 A Crim



Chamberlain convictions the various Australian jurisdictions were, like other advanced nation states, reforming their latent fingerprint operations through the introduction of computer-based systems for collection, storage and searching. Dramatic changes to the collection, storage, searching and comparison of fingerprints facilitated by the introduction of electronic databases, search algorithms, and electronic programs to facilitate comparison do not appear to have generated interest from lawyers or judges. Even the introduction of new evidence rules – specifically the Uniform Evidence Law (UEL) from 1995 – that included an admissibility standard for expert opinion evidence loosely modeled on r702 of the US Federal Rules of Evidence (1975) exerted no discernible impact on the reception and presentation of latent fingerprint (or other forensic science) evidence.<sup>155</sup>

### ***A. New rules of evidence and procedure***

Prior to 1995, almost all of the challenges to latent fingerprint evidence were based on common law rules of evidence and a range of statutes regulating the collection, storage and use of latent fingerprints. Since 1995, beginning with the Commonwealth (federal courts) and New South Wales, several Australian jurisdictions introduced new evidence legislation. Influenced by the Federal Rules of Evidence (US), these rules were slowly adopted by a majority (though not all) of the states and territories. One reason why forensic science evidence has not received more sustained consideration is the formal rejection, in the most populous jurisdictions (NSW and Victoria), of ‘reliability’ as an admissibility requirement.<sup>156</sup> Unlike the US Supreme Court – in *Daubert v Merrell Dow Pharmaceuticals Inc.* and *Kumho Tire Co v Carmichael* – Australian courts have been unwilling to read the need for validation and reliability into the requirement that opinions must be wholly or substantially based on ‘specialised knowledge’ – under s79(1) of the UEL.<sup>157</sup> Writing for the New South Wales Court of Criminal Appeal in *R v Tang*, Chief Justice Spigelman insisted that ‘the focus of attention must be on the words “specialised knowledge”, not on the introduction of an extraneous idea such as “reliability”’.<sup>158</sup> That s79(1) ‘is not concerned with reliability of the expert’s opinions’ was recently confirmed in *Chen v R*.<sup>159</sup> This disinterest in reliability was endorsed by the Victorian Court of Appeal in *R v Tuite*, and the High Court has been unwilling to provide meaningful guidance on the application of s79(1) to forensic science evidence.<sup>160</sup>

When expert opinion evidence is contested Australian courts subject to the UEL are required to confirm that expert opinions are based on ‘specialised knowledge’ and that the specialised knowledge is based on ‘training, study or experience’. Expert reports (and testimony) are expected to make it possible for courts to determine whether contested opinion satisfies these admissibility conditions.<sup>161</sup> However, when dealing with latent fingerprint evidence Australian courts, whether applying the UEL or the common law (as in *Bennett*), have asked very little of latent fingerprint examiners. The judges in *JP v DPP* and *R v Parry*

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R 22; *R v Keogh [No 2]* (2014) 121 SASR 307. See generally Robert Moles and Bibi Sangha, *Miscarriages of Justice: Criminal Appeals and the Rule of Law in Australia* (LexisNexis, 2015).

<sup>155</sup> There are very few differences in admissibility outcomes between UEL and common law jurisdictions.

<sup>156</sup> *R v Tang* (2006) 65 NSWLR 681, [137]; *Tuite v The Queen* [2015] VSCA 148, [58]-[59].

<sup>157</sup> Interestingly, it was the requirement of ‘knowledge’ in r 702 that led the Supreme Court of the United States to impose a reliability standard on scientific evidence in *Daubert v Merrell Dow Pharmaceuticals Inc.*, 509 US 579 (1993) and extend it to non-scientific forms of expertise in *Kumho Tire Co v Carmichael*, 526 US 137 (1999). Gary Edmond, ‘The admissibility of forensic science and medicine evidence under the Uniform Evidence Law’ (2014) 38 *Criminal Law Journal* 136,

<sup>158</sup> *Tang*, [137]. Remarkably, at [138], the Court drew upon the definition of ‘knowledge’ used by the US Supreme Court in *Daubert* and *Kumho*.

<sup>159</sup> *Chen v R* [2018] NSWCCA 106, [62].

<sup>160</sup> See G. Edmond, ‘A Closer Look at *Honeysett*: Enhancing our Forensic Science and Medicine Jurisprudence’ (2015) 17 *Flinders Law Journal* 287.

<sup>161</sup> *HG v R* [1999] HCA 2.

(both considered below) relied on the following passage from *Dasreef Pty Ltd v Hawchar* conferring some kind of exemption or ‘short cut’.<sup>162</sup>

The way in which s 79(1) is drafted necessarily makes the description of these requirements very long. But that is not to say that the requirements cannot be met in many, perhaps most, cases very quickly and easily. That a specialist medical practitioner expressing a diagnostic opinion in his or her relevant field of specialisation is applying ‘specialised knowledge’ based on his or her ‘training, study or experience’, being an opinion ‘wholly or substantially based’ on that ‘specialised knowledge’, will require little explicit articulation or amplification once the witness has described his or her qualifications and experience, and has identified the subject matter about which the opinion is proffered.” (emphasis added)<sup>163</sup>

They also drew on the appeal in *R v Tang* (an image comparison case) for support specifically in relation to latent fingerprint evidence. There the Court of Criminal Appeal stated:

By long usage, expert evidence is given in the form of an opinion that the fingerprint of the accused is the same as that from the crime scene. Such an opinion is based on the cumulative effect of a number of points of similarity, each of which is itself an expression of opinion.<sup>164</sup>

Chief Justice Spigelman provided this legal rationalisation, confirming the admissibility of categorical identifications based on points of similarity – long after the English and most Australian fingerprint bureaus had formally abandoned point systems.<sup>165</sup> This explanation bears little resemblance to available scientific knowledge and advice.<sup>166</sup> Importantly, the ‘short cut’ referred to in *Dasreef* (and *Tang*), was not intended to exempt evidence from compliance with admissibility rules.<sup>167</sup> Rather, it suggests that some types of evidence obviously satisfy the conditions. The problem is that this ‘exemption’ has discouraged challenges – focused on ‘specialised knowledge’ – even when appropriate scientific evaluation has not been undertaken.

Another explanation for the failure to consider validity and scientific reliability is the proscription on trial judges considering the reliability of evidence or the credibility of the witness when balancing the probative value against unfair prejudice under s137 of the UEL.<sup>168</sup> Unlike most other advanced common law jurisdictions, Australia does not require the proponent of scientific and technical evidence to demonstrate reliability as a condition of admission. The reliability of evidence plays no role in Australian admissibility jurisprudence and practice.<sup>169</sup> The upshot is that limitations, uncertainties and risks are left for the trial and ultimately the tribunal of fact. Australian courts appear to place extreme confidence in trial safeguards.

Tort reform at the turn of the millennium, flowing from empirically tenuous concerns about the performance of civil justice systems, led to the introduction of codes of conduct for expert witnesses to supplement rules of evidence.<sup>170</sup> Revealingly, these were originally

<sup>162</sup> G. Edmond and K. Martire, ‘Knowing experts? Section 79, forensic science evidence and the limits of “training, study or experience”’ in A. Roberts & J. Gans (ed.), *Critical Perspectives on the Uniform Evidence Law* (Federation Press, Sydney, 2017).

<sup>163</sup> *JP*, [32] citing *Dasreef Pty Ltd v Hawchar* (2011) 243 CLR 588, [37].

<sup>164</sup> *Tang*, [144].

<sup>165</sup> See *R v Buckley* (1999) 163 JP 561.

<sup>166</sup> Ian Evett and Robin Williams, ‘Review of the Sixteen Points Fingerprint Standard in England and Wales’ (1996) 46 *Journal of Forensic Identification* 49.

<sup>167</sup> See Edmond and Martire, ‘Knowing experts?’

<sup>168</sup> *IMM v The Queen* [2016] HCA 14, inadvertently overturning *Tuite v The Queen* [2015] VSCA 148. At common law: *R v Christie* [1914] AC 545.

<sup>169</sup> It may not be meaningfully incorporated into judicial directions and instructions.

<sup>170</sup> Following the Woolf report and the *Ikarian reefer*: Lord Woolf, *Access to Justice: Final report to the Lord Chancellor on the civil justice system in England and Wales* (HMSO London, 1996) and “*Ikarian Reefer*” (1993) 20

restricted to civil proceedings and only extended to criminal proceedings in the years following as something of an afterthought.<sup>171</sup> These new codes made the expectations on expert witness explicit. Not only were witnesses required to act impartially, codes explained that their overriding duty was to the court. In addition to these explicit behavioural expectations, codes listed the minimum requirements for expert reports. They require experts to: identify the factual bases of opinions; describe the process and any equipment used; explain the reasoning; identify limitations and uncertainties; refer to literatures; describe tests that have (or have not) been undertaken and qualifications that are necessary, and so on. In principle, expert reports should provide enough information to place a reader in a position to rationally evaluate the opinion and for the trial judge to determine admissibility (should the evidence be challenged).<sup>172</sup> Until very recently, most latent fingerprint reports were just a couple of pages in length. Most simply reported matches and declared that they were in accord with any jurisdictional procedural requirements even when flagrantly non-compliant.<sup>173</sup>

It is remarkable, as authoritative criticism and scientific research began to emerge, that the state's latent fingerprint examiners elected not to disclose any of it. It was not until criticism of grossly deficient reporting was formally raised by defence counsel in *JP v DPP* in 2015 that the NSW Forensic Group began to revise its reporting template. This group had been aware of the NRC, NIST and Fingerprint Inquiry reports for years.<sup>174</sup> Many of the templates in use by state-employed fingerprint examiners remain non-compliant. They are inconsistent with what we might expect from impartial experts.<sup>175</sup> Codes (and the more recent Practice Note from Victoria) may not be rules of admissibility, per se, but judges have been very quick to excuse non-compliance in circumstances where the defendant was not in a position to understand what was done (and by whom), the value of the opinion, and was not referred to the existence of the growing chorus of mainstream scientific research and criticism.<sup>176</sup>

### ***B. Technological innovation, training and personnel***

The paucity – really absence – of epistemological challenges prior to *JP v DPP* is all the more curious because there were dramatic changes to the way latent fingerprints were collected, processed, stored, searched and analysed across the course of the twentieth century. Originally, collection involved tape lifts, wet photography and often times the removal and examination of objects that had been touched. Examination relied on naked eyes and magnifying glasses – such as the Hendry glass discussed in *Lawless*. Reference prints were collected from suspects (often informally, as in *Blacker*). Though card records rapidly expanded as systems were designed to obtain and classify print features for the purposes of searching.<sup>177</sup> By the end of the century, there were a range of new techniques in use, some involving the use of chemicals and lighting to locate and enhance the visibility of latent prints on a wide range of surfaces.<sup>178</sup> While latent prints continue to be lifted, most are now

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FSR 563 at 565-566. See also E. Wright, 'National trends in personal injury litigation: Before and after "Ipp"' (2006) 14 *Torts Law Journal* 233.

<sup>171</sup> This seems to suggest that judges were not especially concerned about the quality of the state's forensic science evidence in criminal proceedings.

<sup>172</sup> See *HG v R* [1999] HCA 2. It was also advocated in the NRC report, 135.

<sup>173</sup> Edmond et al, 'Expert reports in the forensic Sciences'.

<sup>174</sup> Indeed, I have presented on several occasions at conferences organised by the NSW fingerprint group (attended by examiners from all over Australia), as well as at national forensic science conferences, and have co-written papers on the very subject that are routinely used in the training of fingerprint examiners (including those in NSW).

<sup>175</sup> See Evidence-based Forensics Initiative, 'Model forensic science' (2016) 48 *Australian Journal of Forensic Sciences* 496.

<sup>176</sup> See the discussion in *Wood v The Queen* (2012) 84 NSWLR 581, endorsed in *Chen v R* [2018] NSWCCA 106.

<sup>177</sup> See Cole, *Suspect Identities*.

<sup>178</sup> There are, in addition, other ways of analyzing fingerprints, see for e.g. S. Francese et al, 'Beyond the ridge pattern: multi-informative analysis of latent fingermarks by MALDI mass spectrometry' (2013) 138 *The Analyst* 4215; G.

captured by digital camera and stored electronically.<sup>179</sup> Prints are routinely manipulated, enhanced and shared using specialised computer programs, and proprietary algorithms enable rapid searching of massive electronic databases. Notwithstanding these developments, there are few reported references to new visualization, searching and evaluation technologies. Legal references to state based databases (AFIS) and the National Automated Fingerprint Identification System (NAFIS) tend to be both recent and perfunctory.<sup>180</sup>

Toward the end of the twentieth century ACE-V emerged as the dominant ‘method’ used by latent fingerprint examiners. Though, the term appears in few of the decisions reported on Westlaw and Austlii and was not a regular feature in NSW police fingerprint reports before they were revised following the challenge in *JP v DPP*.<sup>181</sup> Adoption of ACE-V as ‘the method’ did not resolve inconsistencies around standards. Similarly, prior to formal adoption of ACE-V, bureaus and departments tended to focus on a minimum number of points of similarity before they were prepared to report a match.<sup>182</sup> Most bureaus formally abandoned point systems before the end of the twentieth century. Curiously, there are no reported decisions discussing the number of points required for an identification (although consider the allusion by the trial judge in *Ghebrat* in Section 7), even after scientists engaged by the Home Office (UK) reported that the point standards were not based on scientific research.<sup>183</sup> Recall that Inspector Childs purported to identify 14 points of similarity in *Blacker* and Detective Potter referred to 9 points in *Parker*.

The organisation of fingerprint bureaus and the training of examiners also changed markedly during the course of the twentieth century and beyond.<sup>184</sup> The tiny groups that formed in the first decades of the twentieth century were consolidated and expanded in police departments and investigative agencies. Simultaneously, training became more formalized from the 1920s and 1930s. In some jurisdictions, notably those influenced by England, training took years as examiners were slowly socialized into fingerprint bureaus and their dogma.<sup>185</sup> Historically, most latent fingerprint examiners were police officers. Very few possessed tertiary qualifications. In more recent years, many police departments have begun to employ civilians with tertiary qualifications in forensic science or the sciences.

In parallel to the expansion of fingerprint bureaus and the routinisation of fingerprint evidence for identification, all Australian jurisdictions enacted legislation that enabled investigators to collect the fingerprints of suspects and store and search those of convicted offenders. This legislation tended to become more permissive, gradually expanding the groups whose fingerprints could be legally collected, stored, searched and shared across state and national borders. Ambiguities and omissions in this enabling legislation – manifesting through alleged breaches of procedures and rights – provided some of the main means of

Groeneveld et al, ‘Detection and mapping of illicit drugs and their metabolites in fingermarks by MALDI MS and compatibility with forensic techniques’ (2015) 5 *Scientific Reports* 11716; L. Deininger, ‘Proteomics goes forensic: detection and mapping of blood signatures in fingermarks’ (2015) 16 *Proteomics* 1707.

<sup>179</sup> Fingerprints from digital images downloaded from the internet have been used to identify persons, including those engaged in child sexual assault.

<sup>180</sup> *R v Hillier* [2010] ACTSC 33; *R v Graham* [2017] ACTSC 267; *R v Parry* [2017] SASFC 66; *R v DD* [2016] ACTSC 149; *Shorrocks v Commissioner of Police (NSW)* [2014] NSWIRComm 1008; *R v Millard* [2006] ACTSC 56; *R v Graham* (2017) 325 FLR 21, [43]; *Shepherd v The Queen* [2011] NSWCCA 245, [133].

<sup>181</sup> A search (of “ace-v” & fingerprint) on Westlaw returned just 3 cases: *Ghebrat*, *JP* and *Wright v WA* [2010] WASCA 199, [253].

<sup>182</sup> Though procedures and points systems were not uniform.

<sup>183</sup> This is discussed in *R v Buckley* (1999) 163 JP 561.

<sup>184</sup> See D. Harris; *Failed evidence: Why law enforcement resists science* (2016); C. Lawless, *Forensic science: A sociological introduction* (2016).

<sup>185</sup> Michael Saks and David Faigman, ‘Failed Forensics: How Forensic Science Lost Its Way and How It Might Yet Find It’ (2008) 4 *Annual Review of Law & Social Science* 149.

contesting latent fingerprint evidence at trial and on appeal. As we saw in Section 5, these represent a considerable portion of the reported historical challenges.<sup>186</sup>

It is not surprising that lawyers focused on legal issues in their attempts to challenge the admissibility and use of fingerprint evidence. What is remarkable, however, is how few of the challenges questioned traditional practices and commitments, ACE-V, revised procedures, new technologies, and the profound epistemic pretensions of positive identification (to the exclusion of all others) and claims of a zero error rate.

## 7. ‘fading palimpsest’: The only epistemological challenge in Australian history

This final empirical section offers a glimpse of the way our courts are responding to the emerging scientific findings.<sup>187</sup> Judicial responses, to some extent ongoing, exhibit inexplicably disengaged, quiescent and even sceptical responses to mainstream scientific research and advice. This section helps us to understand how the exceptional epistemologically-sophisticated challenge may be effectively erased from legal institutional memory and collective experience.<sup>188</sup> Our courts have been remarkably insensitive to the evidentiary and institutional implications of scientific knowledge.

### A. *Ghebrat v R (2011) and JP v DPP (2015)*

Two recent appeals raise issues associated with the NRC and the other reports, namely *Ghebrat v R* and *JP v DPP*.<sup>189</sup> It is unclear whether defence counsel in *Ghebrat* was conversant with the NRC report – it is not cited in the reported decision – but two of the issues raised on appeal overlap with issues identified by the NRC and other reports. *JP* is of a different order. There, trial counsel was aware of the scientific reports and sought to use them to impugn the state’s evidence in a fingerprint-only prosecution. *JP* appears to be the only time that an Australian court has been exposed to the scientific research summarised in Section 3.

*Ghebrat* was convicted of robbing a liquor store. One of three latent fingerprints recovered from a large whisky bottle touched during the robbery was matched to his fingerprint. Among the issues on appeal were the significance of this match – given that *Ghebrat* had previously visited the store as a customer – and the way the fingerprint evidence was explained to the jury by the trial judge. Of particular concern were the failure to convey the potentially innocent explanation for the presence of the print, the implications of the two unmatched latent fingerprints, and the level of certainty associated with the identification. On the level of certainty, the Court of Appeal explained that the fingerprint evidence and trial judge’s explanation to the jury seemed to suggest that once a sufficient number of points of similarity were obtained, the identification evidence was effectively certain. This was criticised. For, while the fingerprint examiner had positively identified *Ghebrat* and ‘denied that error had occurred in this case’ the contention that it ‘established certainty’ was, for the Court of Appeal, ‘not supported by the evidence.’<sup>190</sup> The appellant’s counsel appears to have also raised the issue of cognitive bias, and pointed to the advantages of ‘blind’ verification; but these are mentioned in the judgment only in passing.<sup>191</sup> The Court of Appeal found, in

<sup>186</sup> Such challenges were historically prominent in Scotland.

<sup>187</sup> See also Simon Cole and Gary Edmond, ‘Science without precedent: The impact of the National Research Council report on the admissibility and use of forensic science evidence’ (2015) 4 *British Journal of American Legal Studies* 585.

<sup>188</sup> This is not necessarily intentional. These are much more likely to be the result of rules, institutional dynamics and expectations rather than some kind of conspiracy.

<sup>189</sup> *Ghebrat v The Queen* (2011) 214 A Crim R 140, 143; [2011] VSCA 299.

<sup>190</sup> *Ghebrat*, 146.

<sup>191</sup> *Ghebrat*, 143.

addition, that the trial judge should not have admitted hearsay evidence about the result of the ‘verification’ stage from ACE-V. The Court ordered a re-trial. *Ghebrat* seems to have, unwittingly, resurrected anxiety about uniqueness and its implications expressed all those years ago by the same court in *Parker*.<sup>192</sup>

Perhaps the most interesting feature of *Ghebrat* is that the decision is critical of the trial judge’s failure to adequately summarise the evidence on the ‘process and the risk of mistake’.<sup>193</sup> The trial judge said the following in the charge to the jury:

If the characteristics of the *two patterns of fingerprint samples have been found to match at a sufficient number of points, it is possible to say with certainty that the samples came from the same person* and if you accept that, that evidence can be used to find that the fingerprints were from that person. The consequences of that, of course, would be that it is supportive of the prosecution’s contention that the accused man was the man who entered the store.

...

In this case, the expertise of Mr Gordon was not challenged, in other words, it was not said that he is not an expert, but the suggestion put to him was that like any human being, he can make a mistake; it is a subjective judgment that he makes, *although he said it did not happen certainly in this case*.<sup>194</sup>

The Court of Appeal concluded that ‘the judge’s summary would have left the jury with the impression that the process undertaken had been completed to a point that established certainty when this was not supported by the evidence.’<sup>195</sup> This suggests that the way fingerprints evidence is routinely reported and presented in most Australian jurisdictions – as a categorical identification – is not admissible in Victoria. *Ghebrat* is anomalous and seems to have been ignored.<sup>196</sup>

The only substantial challenge to fingerprint evidence in Australia – *JP v Director of Public Prosecutions* – was launched by a junior barrister in a regional town in New South Wales.<sup>197</sup> JP was alleged to have broken into a house, and ruffled through draws, while the elderly residents were in bed. A minor, he was prosecuted in the Children’s Court for aggravated break and enter based on a single latent fingerprint match – ‘identified to’ his left thumb.<sup>198</sup> JP’s barrister had read the article ‘How to cross-examine forensic scientists: A guide for lawyers’ – an NRC report-inspired propaedeutic for lawyers.<sup>199</sup> The case was heard before a magistrate (without a jury); in consequence we have written ‘reasons’.<sup>200</sup>

The Crown relied on the testimony of a fingerprint examiner and an expert report that was not compliant with the jurisdictional expectations set out in the Code of Conduct for Expert Witnesses.<sup>201</sup> The report did not explain what was done, list assumptions (e.g. uniqueness of fingerprints), explain the basis for the opinion, identify the ‘specialised knowledge’ (required by s79 of the UEL), or refer to any limitations or uncertainties. There are, for example, no references to ACE-V and the process of review involved. There are no references to error, uncertainty, limitations, what the latent fingerprint examiner knew about the case when undertaking the comparison, and no images are included with the report. There are no

<sup>192</sup> An example of institutional amnesia, *Parker* is not cited.

<sup>193</sup> *Ghebrat*, 145.

<sup>194</sup> *Ghebrat*, 145. (emphasis in appellate decision) This extract also suggests how clumsy judicial responses might be. For, even if the individual has a heightened ability to analyse and compare prints, it does not follow that he or she can categorically identify or has insight into the level of error.

<sup>195</sup> *Ghebrat*, 146.

<sup>196</sup> According to Austlii, *Ghebrat* has not been cited by another criminal court.

<sup>197</sup> *JP v DPP* [2015] NSWSC 1669.

<sup>198</sup> *JP*, [10]. There was a generic description of a young male intruder.

<sup>199</sup> Evidence-based Forensics Initiative, ‘How to cross-examine forensic scientists: A guide for lawyers’ (2014) 39 *Australian Bar Review* 174.

<sup>200</sup> See also *R v Bomyk* 2013 BCSC 1927 and *R v Bomyk* 2017 BCSC 849.

<sup>201</sup> See G. Edmond, K. Martire and M. San Roque, ‘Expert reports in the forensic Sciences’ (2017) 40 *UNSW Law Journal* 590.

references to any of the scientific reviews. Rather, the report was merely a very short and opaque statement that purported to positively identify JP as the source of the latent print recovered from the scene. Given these deficiencies (which were ubiquitous among Australian fingerprint reports at the time – exemplified in *Bennett*), the defence challenged the admissibility of the expert report and the related opinion.

During the proceedings the fingerprint examiner was questioned in detail about ACE-V, validation, error, expressions, cognitive bias, uncertainties and limitations.<sup>202</sup> He was unfamiliar with scientific research in these areas and did not know about the NRC and NIST reports. He had not read NSW Police training materials on cognitive bias. He did not undertake his (ACE-V) analysis in sequence and appears to have commenced with the comparison. Nevertheless, he was ‘100 per cent’ confident in his opinion and rejected the possibility that he had made an error in this or any other case.<sup>203</sup> The high quality of the latent print and the existence of 35 points in common were raised, for the first time, during questioning.

In assessing the fingerprint evidence, the magistrate concluded:

In this matter I have oral and written evidence from [the fingerprint examiner]. His evidence was unshaken on his view as to the matching of the thumbprint of JP. In my view I disagree with the submissions in this matter, he has given sufficient evidence in these proceedings as to how he reached that determination. As an expert his expertise was not shaken, his opinion was not shaken.<sup>204</sup>

This, despite the examiner conceding ‘that he had not read a lot of the literature referred to ... in the cross-examination.’ The examiner contradicted the express conclusions of the NRC and NIST reports, testifying that provided the ‘protocol [i.e. ACE-V] was followed properly it should not involve bias or incorrect assessment.’<sup>205</sup> We encountered other examples in Section 2. When asked he preferred his own beliefs and NSW police procedures to the findings and recommendations of the NRC and NIST, even though he was not familiar with their reports and recommendations or relevant research. His response to questions not only disclosed a surprising level of ignorance (for a legally-recognised expert witness), but his answers were inconsistent with, and combative toward, shared findings and recommendations from scientific organisations of unquestioned authority.

The admissibility of the fingerprint evidence (and report) and the conviction were pursued on appeal. The appellate court indicated that while the report ‘set out the methodology that was applied in examining the fingerprints’ it did not state ‘what that examination revealed’.<sup>206</sup> Instead, there was ‘simply a statement of the ultimate opinion’. Deficiencies, such as the report not providing ‘scientific criteria for its accuracy to be tested’ and not explaining the reasoning process, were said to be repaired by the examiner’s oral evidence – specifically his answers during cross-examination.<sup>207</sup> Though how this was actually accomplished remains something of a mystery. In reviewing the admissibility case law, the appellate court drew on *Bennett, Tang and Dasreef*:

The judgments in *Bennett* and the observations of Spigelman CJ in *Tang* at [144] indicate that “little explicit articulation or amplification” of the outcome of the application of the methodology is required to satisfy the second condition of admissibility of an opinion about the correspondence between two

<sup>202</sup> See also ‘Forensic science evidence and the limits of cross-examination’ (2018) 42 *Melbourne University Law Review* (forthcoming).

<sup>203</sup> He accepted that other fingerprint examiners might on occasion err. Contrast *Ghebrat v The Queen* [2011] VSCA 299.

<sup>204</sup> Transcript quoted in Edmond et al, ‘Expert reports in the forensic Sciences’.

<sup>205</sup> Transcript quoted in Edmond et al, ‘Expert reports in the forensic Sciences’.

<sup>206</sup> *JP*, [54]. Although, in terms of explaining the ‘method’ there was not even a reference to ACE-V.

<sup>207</sup> *JP*, [61].



fingerprints (*Dasreef* at [37]).<sup>208</sup>

The appellate court read *Bennett* as requiring ‘some explanation or statement of what the examination revealed ... must be provided for the evidence to be admissible, *albeit not much*.’<sup>209</sup>

In terms of proof, the court concluded that ‘there was no material to indicate that, to the extent the criticisms were sustained’ – from the NRC, NIST and Fingerprint Inquiry reports – ‘they materially affected the weight to be attached to [the examiner’s] opinion that the fingerprints were identical.’<sup>210</sup> The court accepted that:

it was open to the his Honour to conclude that there was no material to indicate that, to the extent the criticisms were sustained, they materially affected the weight to be attached to [the examiner’s] opinion that the fingerprints were identical. Otherwise his Honour had the distinct advantage of being able to observe [the examiner] give evidence and respond to criticism.<sup>211</sup>

Notwithstanding detailed cross-examination on materials that directly questioned the ability to categorically identify, the Court found that at ‘no stage ... was it contended that [the examiner] was not suitably qualified to undertake a fingerprint analysis and express an opinion that two fingerprints were identical.’<sup>212</sup> In terms of the admissibility challenges, and the omission of the assumption that ‘no two persons have the same fingerprint’ the Court indicated that:

That omission is irrelevant to the admissibility of the report in that the relevant opinion was treated by the presiding magistrate as only being a statement to the effect that the two fingerprints were identical. His Honour reasoned for himself as to whether that fact suggested that it was JP’s fingerprint.<sup>213</sup>

The appellate court was satisfied that the ‘certificate set out the methodology that was applied’ but, disagreeing with the magistrate, concluded that ‘nowhere in the certificate was there any statement of what the examination revealed.’<sup>214</sup> Rather, the certificate reported the ‘ultimate opinion’ about the match and its implications. This opinion was ‘insufficiently supported by any reasons ... for it to be admitted into evidence.’<sup>215</sup> While the certificate was, on that basis, technically inadmissible, the admissibility of the opinion fell to ‘be assessed by considering the entirety of his oral evidence and not just the certificate’. The prosecution was not prevented from ‘remedying’ any ‘deficiency’.<sup>216</sup> The examiner’s description, during his testimony, of what he had done was presented as rendering his opinion not merely admissible but persuasive given that the identification of JP was based upon it. Ironically, the very cross-examination that exposed a complete lack of familiarity with fundamental scientific research, scientific criticisms and limitations with ACE-V, was presented as having remedied any deficiencies in the opinion and the failure to explain the reasoning and method.<sup>217</sup> The range of issues raised by the defence on appeal was dismissed as issues for weight or

<sup>208</sup> *JP*, [58]. *JP*, [32], quoting *Tang and Dasreef*, [32]. (italics added). *JP*, [32] citing *Dasreef Pty Ltd v Hawchar* (2011) 243 CLR 588, [37] and *JP*, [35]. The second condition is that the opinion is wholly or substantially based on specialised knowledge.

<sup>209</sup> *JP*, [42]. (italics added)

<sup>210</sup> *JP*, [90]. Self-evidently, the fingerprints were not literally identical.

<sup>211</sup> *JP*, [90].

<sup>212</sup> *JP*, [26].

<sup>213</sup> *JP*, [52].

<sup>214</sup> *JP*, [54].

<sup>215</sup> *JP*, [54].

<sup>216</sup> *JP*, [56].

<sup>217</sup> This might be considered undesirable on policy grounds, because it excuses the state’s failures and transforms the decision as to whether to contest forensic science evidence tactical.

‘metaphysical’ and therefore irrelevant.<sup>218</sup> The failure to provide criteria, tender ‘comparison charts’ and ‘specify or provide the necessary scientific criteria for its accuracy to be tested’ were described as issues for judicial discretion, rather than admissibility.<sup>219</sup>

However perfunctory the treatment at trial and appeal, *JP* was the first time that an Australian court was asked to consider underlying methodological issues and the implications of scientific research and advice for latent fingerprint evidence.<sup>220</sup> Notwithstanding detailed cross-examination on the NRC and NIST reports, these are not cited in the written decisions by the trial and appellate courts. The examiner’s inability to accept them as authoritative – because he was not familiar with them – meant that they were not available to impugn his credibility or inform the evaluation of his conclusion. They were effectively marginalized in the evaluation of the opinion and the determination of guilt. They were not, in effect, (in) evidence.<sup>221</sup>

The trial court accepted the latent fingerprint examiner’s evidence as complete proof and, quite bizarrely, questioned the status and findings of reports by prestigious scientific and technical organisations, and Justice Campbell in Scotland, though without actually naming them. Consider the following:

The difficulty of course with a lot of material that was cross-examined on is there is no method, no chance to actually test the validity of those arguments. I note that a lot of that material, there is a report there from 2008 or 2009 but I do not have the actual name in front of me, and a follow up report in 2012 provided to judicial bodies of the United States. There is no evidence of any action taken on those views by those researchers or otherwise. The report from Scotland does not take it any further than his opinions being on the balance of probabilities that would assist further inquiries. No great depth as to what the actual error was and how that could potentially relate to the matter in this matter.<sup>222</sup>

The only time ‘validity’ is raised is to question the considered and convergent conclusions of premier scientific organisations and independent judicial inquiries; all pejoratively characterised as ‘arguments’. And, perhaps even more problematic, in the context of an accusatorial trial, the magistrate cast limitations and error as issues for the defence.

### ***B. Legal continuity: Scientific insights lost to post-JP decision-making***

Lack of engagement with scientific knowledge and scientific recommendations has meant that insights from *JP* do not form part of the formal legal record. Like other challenges that are unreported or reported in ways that do not engage with scientific materials, insights are effectively lost to legal consciousness and experience. Consequently, other lawyers and judges are not apprised of problems, issues and materials raised in the truly exceptional case where a reliability challenge is launched. Lawyers and judges are not only seemingly oblivious to scientific research and scientific recommendations and their implications, but they seem to have an exaggerated view of the value of the latent fingerprint evidence. A good example of this ignorance and the persistence of epistemologically superficial challenges to latent fingerprint evidence can be observed in the aftermath of *JP*, in the South Australian case of *R v Parry*.<sup>223</sup>

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<sup>218</sup> *JP*, [60].

<sup>219</sup> *JP*, [60]-[61].

<sup>220</sup> The earlier challenge in *Bennett*, concerned with the provision of images and the failure to describe specific points of similarity, rather than the validity or the procedure and its accuracy, was relied upon to support admission and accuracy. See also *Bennett v Police* [2005] SASC 167, [16], [54] on the superficial engagement with ‘his method of working’ and ‘reasoning process’.

<sup>221</sup> There is no sense that having a rebuttal expert, especially one commenting on methods, limitations and risks, would have changed judicial attitudes. Consider *R v Bornyk* 2017 BCSC 849 and *R v Madigan* [2005] NSWCCA 170.

<sup>222</sup> Transcript quoted in Edmond et al, ‘Expert reports in the forensic Sciences’.

<sup>223</sup> *R v Parry* [2017] SASFC 66.

The appeal in *Parry* concerns problems in the processing and disclosure of the latent fingerprint evidence. Parry's fingerprints were originally linked to an aggravated robbery through a set of reference prints, obtained in unrelated circumstances in 2007, and uploaded on NAFIS – the national fingerprint database.<sup>224</sup> That identification was performed by Godden, verified by Andrews and reviewed by Lewis.<sup>225</sup> Another comparison was subsequently undertaken, using what are characterised as 'inferior' quality reference prints. These were obtained on Parry's arrest for the robbery in 2013. This comparison produced less conclusive evidence. Using the 2013 reference prints, Neilson concluded that the 'impression does not contain sufficient clear ridge detail for a positive identification ... however it cannot be excluded as having been made by the right ring finger [of] Parry'.<sup>226</sup> That conclusion was verified by Noack and reviewed by Greenlees. Subsequently, when the disparity was realized, just days before trial, communications between the prosecutor and the police led to the resolution of the discrepancy between the two conclusions – specifically, the positive identification and the inability to exclude. Noack prepared a new statement using the superior 2007 prints as a reference. With these prints he identified three latent fingerprints to Parry (to two different fingers) and concluded that Parry 'cannot be excluded' in relation to two other latent fingerprints.<sup>227</sup>

On appeal, Parry challenged the failure to adjourn proceedings to allow him to call Neilson (who was away), the failure to exclude Noack's evidence because of the difference between the comparisons using the two different sets of reference prints (from 2007 and 2013, respectively), limitations placed on the cross-examination of Noack, the unfair prejudice alleged to have been created by reference to Parry's fingerprints being on the NAFIS database, as well as inadequate directions about forensic disadvantage and identification evidence. The appeal was unsuccessful, concerns about inadequate disclosure and the unwillingness to delay proceedings were found to be inconsistent with both the materials available to the defence and decisions made by the trial counsel; such as 'positively eschew[ing] adjournment'.<sup>228</sup>

What is interesting for our purposes is how the trial and appeal – by experienced counsel – proceeds entirely on grounds that are inattentive to scientific research and reliability issues.<sup>229</sup> Even the ground that tentatively explores the inability to explore communications between the examiner (Noack) and Neilson does not engage with the extensive literature on human factors, particularly the danger of cognitive bias.<sup>230</sup> Rather than focus on the documented risks of examiners undertaking comparisons, verification and review in circumstances where they are aware of the expected result, the ground of appeal appears to be focused on 'collaboration', really some kind of implied conspiracy, between Noack and Neilson because of Neilson's apparent unavailability.<sup>231</sup>

There are no references to the scientific reports and recommendations. The trial and appeal in *Parry* proceed as though nothing had happened since *Bennett* in 2006 and perhaps even *Blacker* in 1910.

## 8. Discussion

<sup>224</sup> National Automated Fingerprint Identification System.

<sup>225</sup> Here, verification appears to be a separate comparison and the review is for technical compliance purposes.

<sup>226</sup> *Parry*, [38].

<sup>227</sup> *Parry*, [50]. It is useful to observe that opinions based on multiple prints, especially prints identified to different fingers, are typically much more probative than an opinion based on a single latent fingerprint.

<sup>228</sup> *Parry*, [68], [79].

<sup>229</sup> The parties and/or judges refer to *JP*, but there are no references to the substantial concerns or scientific reports.

<sup>230</sup> The Court of Appeal seems satisfied by the fact that there was apparently no contact these examiners.

<sup>231</sup> *Parry*, [111]-[114]. The court does not explain the probative value of the multiple fingerprint matches and the attendant reduction in the risk of error.

It is important at the very outset to reiterate that this article does not contest the admissibility or continuing use of latent fingerprint evidence *to assist with* identification. Rather, the concern is with the lack of legal engagement with scientific knowledge and insights, in particular: the dearth of epistemologically-informed challenges; the historical misrepresentation and exaggeration of the value of latent fingerprint evidence; its likely overvaluation by lay decision-makers; the actual frailty of trial safeguards; along with apparent judicial indifference (or insensitivity) to emerging scientific research and its implications for understanding legal practice.

It would seem to be necessary, as a condition for admission, that the proponent of forensic science evidence *know* and disclose the *known* value of the evidence in order to place decision-makers in a position where they might be able to rationally evaluate it.<sup>232</sup> Where evidence has been used by the state for a century, and is in routine use, it cannot be the responsibility of the defence to identify omissions, fundamental methodological oversights and limitations of general application in order to persuade a jury of their significance in individual adversarial proceedings. To adopt such a lax, capricious and inefficient approach to opinion recognised as expert places unbearable strains on the defence, and relieves the state of responsibility for formally evaluating the ‘scientific’ procedures it routinely represents as not merely probative but reliable and sometimes even infallible.

#### ***A. The myth of admissibility standards and critical legal scrutiny***

There are no reported decisions on the admissibility or probative value of latent fingerprint comparison that are substantially engaged with scientific research, let alone validity and scientific reliability. Australian courts have never required it. Rather, early courts asserted that fingerprint comparison was part of the ‘science of identification’, ‘based on experiments’ and that ‘individuality ... is ... generally recognised’.<sup>233</sup>

At one level, given prevailing admissibility rules and jurisprudence at the beginning of the twentieth century, this might not be surprising.<sup>234</sup> However, we should recognise that this accommodation allowed evidence to be admitted without being formally evaluated or appropriately qualified in reports and testimony. Our admissibility rules did not require latent fingerprint examiners to formally evaluate their procedures, or to provide insight into limitations, or to express their opinions in scientifically-defensible terms. As the way fingerprints were collected, processed and analysed was transformed, slowly evolving adjectival rules (including the introduction of new uniform evidence law from 1995 and Codes of Conduct for expert witnesses just a few years later) were not mobilized and applied in ways that led to enhanced scrutiny or placed appropriate expectations on latent fingerprint examiners. There were few epistemologically-based challenges to latent fingerprint evidence, and over time complacent examiners (appearing before complacent courts) became less likely to provide reasons, identify specific points of similarity or provide images to the defence – e.g. *Bennett* and *JP*. Even after the release of the NRC, NIST, PCAST and AAAS reports, latent fingerprint examiners continue to report and testify in ways – i.e. offering categorical identification without reference to accuracy – that are not compliant with jurisdictional rules (requiring ‘knowledge’) and procedural expectations (requiring the disclosure of limitations).

Since early recognition, in the first years of the twentieth century, latent fingerprint evidence has been continuously admitted in Australian criminal courts. And, it continues to

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<sup>232</sup> G. Edmond and A. Roberts, ‘Procedural Fairness, the Criminal Trial and Forensic Science and Medicine’ (2011) 33 *Sydney Law Review* 359.

<sup>233</sup> In *Parker* the High Court strongly suggested individuality even though the full court had explicitly rejected it.

<sup>234</sup> Consider the undemanding common law tests in *Folkes v Chadd* (1782) 3 Dougl 157; 99 ER 589 and *R v Silverlock* [1894] 2 Q.B. 766. Also, English courts had admitted fingerprint evidence, see Appendix, as had US courts, see e.g. *People v Jennings*, 252 Ill. 534, 96 N.E. 1077 (1911).

be admitted in the same form, even though traditional expressions are ‘overstated and are now widely recognized as indefensible.’<sup>235</sup>

### ***B. The convenient myth of trial safeguards***

Safeguards that are epistemologically insensitive – that do not attend to scientific research – are safeguards in name only. This study directly challenges prevalent legal beliefs about the effectiveness of trial safeguards and adversarial proceedings. In order to better understand both their limitations and their ability to instill in judges a false sense of confidence, consider the Court of Appeal’s assessment of the positive identification in *Blacker*. A century before empirically-based insights into the performance and abilities of latent fingerprint examiners were available, before training was formalized and standards developed, on appeal the fingerprint evidence was said to have been ‘carefully given and thoroughly tested.’ In addition, we are told that:

The jury also were very carefully directed by the learned Judge as to the risk of error to which evidence of this class is open, and as far as the conduct of the trial is concerned every precaution was taken to guard against any wrongful impression being conveyed to the jury.

There is no evidence of meaningful testing or caution. This was not a ‘new science of identification’ and it was not ‘based on experiments’ that were oriented toward improving accuracy or comprehension. The assessment by the Court of Appeal, like many similar judicial assertions over more than a century, is a hollow assertion based largely on legal impressions (and collective legal ignorance). Such assertions may help to reassure remote audiences about the administration of justice, but careful directions on the risks were not possible because most of the risks were unknown (or not recognised at law). Our courts did not possess or require evidence of validity or scientific reliability. There is no sense in which these and subsequent judges were being disingenuous, but they were recounting and relying upon untutored impressions and beliefs. How could a judge who was not conversant with the accuracy of a procedure ‘carefully direct ... as to the risk of error’? How could they ‘guard against any wrongful impression’?

In *Parker*, and almost every subsequent case where the admissibility of latent fingerprint evidence was raised – almost always in relation to some kind of non-epistemic issue – examination-in-chief and cross-examination (and careful judicial ‘instructions’) were presented as appropriate mechanisms to test and explain the evidence. In terms of evidence and proof, provided the jury ‘were satisfied with the witness under examination and cross-examination to arrive at the conclusion ... that was sufficient to justify a conviction.’<sup>236</sup> In practice, challenges were not attentive to epistemology and so did not provide trial and appellate courts with insights and materials to facilitate rational decision-making. Even when procedural impediments (such as the failure to produce a report identifying points of similarity on photographs – as in *Bennett*) or epistemological problems were raised explicitly (as in *JP*), trial and appellate judges were not particularly engaged with the issues. Challenges and questions rarely made a difference.

What is surprising in an accusatorial system of justice is that where the issue loomed Australian judges expected (and continue to expect) impecunious defendants to address, indeed overcome, the state’s dereliction – that is, its non-disclosure, omissions, oversights and exaggeration.<sup>237</sup> In *JP*, bizarrely, scientific research and advice on the very procedure used by the fingerprint examiner were characterised as abstraction (even metaphysical) and

<sup>235</sup> AAAS report, 9.

<sup>236</sup> *Parker*, 168.

<sup>237</sup> In *JP*, this appears to extend to expecting the defendant to identify an actual error. See also *Aytugrul v The Queen* (2012) 247 CLR 170.

not considered relevant to practice or identification in the specific case – see also 8.D, 8.E, 8.F and 8.G.<sup>238</sup> Rather than consider error from the perspective of scientific reports and recommendations, the magistrate expected the defendant to somehow identify an actual error – presumably relying on the non-compliant expert certificate (or report), that provided little meaningful information.<sup>239</sup> In *JP*, the fingerprint examiner’s opinion on identity and the procedure used to produce it is used to trump pertinent scientific research and criticism.<sup>240</sup>

Among this sample of the leading Australian fingerprint decisions, trial safeguards were repeatedly presented as the appropriate ‘solution’ to problems with forensic science evidence. This approach ought to be considered imprudent because over the course of a century trial safeguards resulted in only one court, a Children’s Court in Dubbo, hearing about the kinds of issues regarded by scientists as fundamental. Even that exposure was indirect, through questions posed during cross-examination.<sup>241</sup> The availability of trial safeguards did not facilitate appropriate exploration of the sorts of questions and issues required to understand and evaluate latent fingerprint evidence. Reliance on trial safeguards did not lead to latent fingerprint evidence being presented or understood in the ways that attentive scientists insist are appropriate. The requisite information has never been required or provided. Even now that latent fingerprint evidence is known to be foundationally valid, with an error rate that appears to be (impressively) low, disclosure of limitations and recognition of the reality of error – required by Codes of Conduct and Practice Notes – remains exceptional.

The only conspicuous effect of trial safeguards on the presentation of latent fingerprint evidence, across more than a century of routine use in Australia, was the expectation from *Parker* and *Ghebrat*, that fingerprint examiners should not contend that all fingerprints are different (or unique). That is it. No other significant constraints have been placed on admission and reliance. There are no constraints on positive identification, even though that is inescapably predicated upon fingerprints being unique (and uniqueness somehow enabling examiners to positively identify persons). Fingerprint reports that are non-compliant with jurisdictional rules, such as Codes of Conduct, are routinely admitted (or excused). Failures and omissions are said to be repaired at trial; sometimes through the actions of defendants, as in the cross-examination in *JP*.<sup>242</sup> Apparently nothing defendants (or appellants) can do or say would lead to the exclusion or qualification of latent fingerprint evidence. Australian judges are far too ready to excuse fingerprint examiners and prosecutors.<sup>243</sup>

To be clear, trial safeguard *might* work if latent fingerprint examiners complied with codes in good faith. They *might* work if prosecutors insisted on compliance and disclosure and explained the forensic science evidence they rely upon in terms that capture its known value – embodying their obligations around truth and fairness as ‘ministers of justice’.<sup>244</sup> Better resourced and better informed defence counsel *might* effectively raise questions about methods and other epistemological issues. They *might* even be able to recruit and use rebuttal experts effectively.<sup>245</sup> And, trial judges who were more conversant with scientific and technical forms of evidence, or applied meaningful admissibility standards, *might* be better

<sup>238</sup> *JP*, [60].

<sup>239</sup> Consider ‘Science Friction: Streamlined Forensic Reporting’ (2018) *Oxford Journal of Legal Studies* (forthcoming).

<sup>240</sup> In the NSW Judicial Commission Criminal Trial Courts Bench Book, at 355, in introducing ‘Expert Evidence’, the following is written: ‘The method by which fingerprint evidence is admitted is discussed in *JP v DPP (NSW)* [2015] NSWSC 1669 at [39]ff.’ That is all.

<sup>241</sup> See G. Edmond, D. Hamer and E. Cunliffe, ‘A little ignorance is a dangerous thing: Engaging with exogenous knowledge not adduced by the parties’ (2016) 25 *Griffith Law Review* 383.

<sup>242</sup> Regardless of whether full disclosure occurred just before trial (as in *Parry*) or only falteringly during cross-examination (as in *JP*).

<sup>243</sup> Both groups have a range of formal obligations.

<sup>244</sup> See e.g. *Boucher v The Queen* (1954) 110 CCC 263, 270 and *Whitehorn v The Queen* (1983) 152 CLR 657, 663-4.

<sup>245</sup> Though consider S. Cole, ‘A Cautionary Tale about Cautionary Tales about Intervention.’ (2009) 16 *Organization* 121.

positioned to tailor (more) appropriate instructions and informed reviews. The emphasis is on ‘might’. Primary protections should not be reliant on procedures that repeatedly fail.

In principle, it seems better to regulate the admission of expert evidence rather than try to repair exaggerated claims during adversarial proceedings before non-technical audiences. The frailty of trial safeguards places a premium on admissibility decision-making. Unfortunately, admissibility standards in all Australian jurisdictions are inattentive to (validity and scientific) reliability and judges have neither imposed nor enforced meaningful conditions on the admissibility of latent fingerprint evidence. Admissibility standards were weak historically and remain weak. Modern reliance on earlier admissibility decisions (or practice, in the absence of reported decisions) and even longstanding legal practice may not reveal much about the value of forensic science evidence.<sup>246</sup>

### *C. Subverting the rational evaluation of expert evidence*

Trial procedures and safeguards are intended to provide means of exploring and testing evidence and placing the decision-maker in a position conducive to making sense of – i.e. rationally evaluating – it, especially where the evidence is contested. Rules of evidence and procedure, such as s79(1) of the UEL and Codes of Conduct for Expert Witnesses, are designed to provide parties with timely information to enable them to consider their options.<sup>247</sup> Rules requiring impartiality, disclosure, the provision of reasons, and identification of ‘knowledge’, are intended to encourage moderation in expert performances and to bring limitations, uncertainties and disagreement to light.

This study suggests that the reports (and certificates) prepared by latent fingerprint examiners have not placed decision-makers – whether defence counsel, prosecutors, judges or jurors – in a position to rationally evaluate their evidence. Consider the reports provided in *Bennett* and *JP*, for example. Consider also the testimony in *JP*. This evidence was not presented in a way that reflected its actual value. There was a lack of research support, no reference to standards, no reference to uncertainties, no reference to an indicative error rate, and criticisms and concerns from mainstream scientists were not disclosed. This was not always just a case of omission. In *JP*, the examiner’s assumptions and beliefs were *mis*-represented as fact or true.<sup>248</sup> The examiner expressly rejected the possibility of error and repeatedly represented ACE-V as infallible. The examiner expressly dismissed authoritative scientific reports and reviews that he had not read. This testimony deprived decision-makers of the ability to gauge the value of the fingerprint evidence and appreciate some of the range of limitations. *JP* is atypical only in the sense that defence counsel was aware of, and sought to elucidate, these and other epistemological issues.

Our courts seem to have approached latent fingerprint evidence accepting the self-serving claims of examiners and their abilities at face value. They assumed opinions were correct. It was left to the defence to try to locate and explain the very information that fingerprint examiners and prosecutors were formally obliged to disclose and address – where identification by fingerprint was in issue. In the absence of judicial concern with validity and scientific reliability, how were decision makers to address the requirement that the opinion be based on ‘specialised knowledge’? How were they supposed to gauge the probative value or weight of the evidence – even ‘at its highest’?<sup>249</sup> In the absence of knowledge, decision-

<sup>246</sup> S. Cole, ‘Grandfathering Evidence: Fingerprint Admissibility Rulings from *Jennings* to *Llera Plaza* and Back Again’ (2004) 41 *American Criminal Law Review* 1189.

<sup>247</sup> See Code of Conduct for Expert Witnesses, Uniform Civil Procedure Rules (UCPR) Schedule 7 and cases such as *HG v R* [1999] HCA 2; *Ocean Marine Mutual Insurance Association (Europe) OV v Jetopay Pty Ltd* (2000) 120 FCR 146, [22]- [23].

<sup>248</sup> This may have been inadvertent, but that is not particularly helpful in the context of adversarial proceedings.

<sup>249</sup> See ‘Icarus and the Evidence Act: Section 137, probative value and taking forensic science evidence “at its highest”’ (2016) 41 *Melbourne University Law Review* 106.



makers were compelled to rely upon other information and their impressions when determining the value of the evidence.<sup>250</sup> Rather than formal studies of the abilities of examiners applying ACE or ACE-V, in the handful of cases where epistemic issues were raised, decision-makers were obliged to rely on the demeanour and confidence of the examiner, the performance of trial counsel examining and cross-examining, popular impressions about latent fingerprint evidence, the fact of admission and long legal reliance, along with guidance from epistemologically-starved trial judges, along with review by epistemologically-starved appellate courts.<sup>251</sup>

Decision-makers continue to be confronted with the task of evaluating the evidence in conditions where they are deprived of the very information required to do so rationally. Existing procedures, rules and assumptions compel decision-makers to speculate.

#### ***D. Problems with expert-jury boundary work***

One of the consequences of the failure to place juries in a position where they could make sense of the latent fingerprint evidence is that it is unclear how they were supposed to – as judges in *Parker* (notably *Hodges*), *Lawless*, *O’Callaghan* and *Bennett* seemed to require – evaluate the expert evidence without undertaking their own analysis of the prints. Courts have done little to assist the jury to fulfill this ambiguous and somewhat heroic legal expectation. How are juries to decide? What were they supposed to do when presented with the prints? Reported decisions caution juries against comparing the prints or simply deferring to expert witnesses.<sup>252</sup> However, decision-makers are not given the information required to evaluate opinions and related claims.

#### ***E. Identifying an error and other expectations imposed on the defence***

There seems to have been an unstated and practically insurmountable expectation that fingerprint evidence is correct and the defence must demonstrate a reason why it should not be relied upon. This approach is inconsistent with the terms of s79(1), the Code of Conduct for Expert Witnesses, the obligations on prosecutors, as well as the burden of proof in accusatorial trials, following *Woolmington*.

It is not the responsibility of the defence to identify an error; and they will rarely be in a position to do so. Rather, it is the responsibility of the state, through the prosecutor, to eliminate all reasonable doubt consistent with non-guilt. There are two important points to make here. First, the risk of error associated with a forensic science procedure should be negated by the state where that possibility is raised.<sup>253</sup> The state, through the prosecutor can rely on latent fingerprint evidence but that reliance should be constrained by its known value – as demonstrated through appropriately designed scientific studies. Claims of positive identification and error-free performance are inconsistent with the available evidence. They are, according to the AAAS, ‘indefensible.’<sup>254</sup> Defendants should be entitled to rely on the known limitations of latent fingerprint evidence.<sup>255</sup>

Secondly, the defence will hardly ever be in a position to demonstrate an error even when one has occurred. Opinions about fingerprints are based on an examiner’s perception and

<sup>250</sup> Martire and Edmond, ‘Rethinking expert opinion evidence’.

<sup>251</sup> See e.g. *Lawless*, 423 (reproduced in Section 5). In some cases latent fingerprint evidence will have been combined with other evidence. Whether the fingerprint evidence is genuinely independent of the other evidence is an interesting question.

<sup>252</sup> Empirical studies confirm that laypersons are quite error prone, particularly where prints are similar but non-matching. See studies by Tangen et al, ‘Identifying Fingerprint Expertise’.

<sup>253</sup> Where reports are raised by the defence, the state would seem to have an obligation to respond.

<sup>254</sup> AAAS report, 71.

<sup>255</sup> In many cases, especially those with more elaborate evidentiary arrays, this will make little difference to the outcomes in terms of pleas or trials and appeals.

cognition.<sup>256</sup> Yet, the defendant is somehow expected to challenge this subjective assessment (and its exaggerated presentation as complete evidence of identification) displaced spatially and temporally from the circumstances of its production. Defendants may not be provided with information about the collection and continuity of the sample, the search(es) on the database (and the pool of candidates), whether other examiners (dis)agreed about sufficiency or identity, which features were considered similar, the reasons differences are considered apparent (and not real), any notes, what the examiner knew about the investigation and the suspect (the cognitive bias issue), the conditions of verification, as well as information about the individual examiner and their personal proficiency and professional history.<sup>257</sup> Though, even the provision of such information does not enable defendants to ‘look inside’ the examiner’s head in order to identify error or unconscious bias.

The possibility of cross-examination does not somehow repair non-disclosure or allow the defence to determine how or where an error might have been made. At best it might expose derogation and non-compliance, but these are routinely excused by judges.<sup>258</sup>

#### ***F. Epistemology versus the beliefs of a latent fingerprint examiner (or bureau)***

One persistent though misguided response to the occasional challenge to latent fingerprint evidence is the heavy reliance placed on the testimony (really impressions) of experienced latent fingerprint examiners. This reliance preceded the existence of scientific research (before 2009) and persists insensitive to it (after 2009). By not requiring evidence of validity and scientific reliability, trial and appellate courts seem to be suggesting that specific identification decisions made by individual fingerprint examiners somehow trump or circumvent general research evaluating the procedures used to produce these very opinions.<sup>259</sup> This risks becoming irrational. A result (really opinion) obtained using ACE-V should not be expressed in terms stronger than ACE-V has been shown capable of producing. Trial and appellate courts must direct their attention to formal (i.e. general) evaluation because this provides scientific insight into actual abilities. These studies assist with presentation and the rational attribution of a value to the evidence.

Rather than rely on the impressions of latent fingerprint examiners, scientific research provides the appropriate framework for understanding the evidence.<sup>260</sup> The examiner’s opinion cannot rise above the scientific research, even if the examiner is oblivious to that scientific research, is confident, appears to have fared well (i.e. was ‘unshaken’) in cross-examination, and so on.<sup>261</sup> The fact that the examiner in *JP* – a legally recognised expert – was not familiar with the only formal studies of his ‘method’ might be considered alarming.<sup>262</sup> It reveals something about legal regulation of expertise and the ability to place decision-makers in a position to evaluate the opinion.<sup>263</sup>

This point is not restricted to latent fingerprint evidence but applies to all scientific, technical and medical evidence, especially procedures in routine use. These should be

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<sup>256</sup> Use of an independent latent fingerprint examiner may not lead to the identification of an error. Several examiners endorsed mistaken identifications in the Mayfield and McKie cases. Indeed, in McKie an examiner engaged by the defence confirmed the identification subsequently criticised by Justice Campbell. In Mayfield, an independent examiner endorsed the mistaken identification by several FBI examiners.

<sup>257</sup> See *R v Smith* [2011] EWCA Crim 1296, for an example of non-disclosure.

<sup>258</sup> They are thereby transformed into issues of weight for the jury.

<sup>259</sup> D. Faigman, J. Monahan and C. Slobogin, ‘Group to Individual (G2i) Inference in Scientific Expert Testimony’ (2014) 81 *University of Chicago Law Review* 417.

<sup>260</sup> This is why PCAST advocated reporting the known error rates from the ‘black box’ studies.

<sup>261</sup> Ironically, ignorance (and ignorance of ignorance – or ‘unknown unknowns’) may produce less conservative opinion evidence.

<sup>262</sup> This begs questions about whether examiners – who have perceptual and comparative abilities – should be entitled to speak about their procedures if they are unfamiliar with pertinent scientific research? Can they be considered expert (beyond making decisions) if they are unfamiliar with relevant ‘specialised knowledge’?

<sup>263</sup> Recall *Makita* and *Davie*.

formally evaluated so that we have a reasonable idea about their value, rather than admit opinions and rely on the pronouncements of those using proffering, marketing, and advocating them in conjunction with the vagaries of individual adversarial proceedings.

### ***G. The primacy of epistemology (over other ‘legal’ issues)***

There is a supplementary issue here. Once again it extends beyond latent fingerprint evidence to other forms of forensic science and forensic medicine evidence. Most of the historical challenges to latent fingerprint evidence were focused on legal-procedural issues, around the collection and use of prints, the use of photographs, the marking and enlargement of photographs, the use of reference prints collected from minors, non-compliant reports, the task left to the jury, judicial directions and so forth. However, it makes no sense to waste time and resources litigating such issues before the value of latent fingerprint procedures are formally evaluated and understood – i.e. known. Logically, we should want to know the value of a procedure and the conditions that govern its application and use (particularly the terms of expression), so that we can consider whether we should even care if reference prints were legally obtained or judicial directions appropriate. Before we waste time and money litigating the peripheries of expert opinions courts should require proponents to demonstrate that the procedure is valid and scientifically reliable – that is, the opinion is based on ‘specialised knowledge’ derived ‘from ‘study or investigation’.<sup>264</sup> We should be confident that those allowed to express their opinions are demonstrably expert and their opinions are based on knowledge (rather than experience and legal tradition).<sup>265</sup>

### ***H. The common law ‘method’***

One of the issues emerging from the foregoing discussion is the capricious nature of legal engagement with latent fingerprint evidence. Case-based responses to scientific evidence may be unprincipled, inconsistent and even incoherent.<sup>266</sup> Our common law legal systems treat each case discretely because of its peculiar characteristics. While every case may be different, this does not provide a particularly persuasive explanation for inconsistent approaches or the failure to engage with validation where the underlying procedures (such as ACE-V) are substantially similar. While the size, quality, and number of prints may vary between cases, the actual processing and reporting should be consistent, indeed standardised.

In focusing on individual cases, our common law courts have not dedicated sufficient attention to system issues – questions around the fingerprint ‘method’, its limitations and the ability to categorically identify persons. They have preferred the testimony of individual examiners and their willingness to make categorical identifications in circumstances where there was no meaningful disclosure and no legal awareness of the substantial criticisms and concerns expressed by peak scientific organisations.

Common law courts have been less interested in general scientific studies than specific (or case-based) opinions, even if the specific opinions seem to be inconsistent with the results of the general research and difficult to characterise as knowledge – whether scientific or specialised. The focus on individual cases has tended to blind courts to methodological problems and constrained systematic engagement with scientific research and its implications for legal practice. This essay seems to suggest, based on a century of legal ignorance, that our past practices have not served us well.

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<sup>264</sup> *Honeysett v The Queen* (2014) 253 CLR 122.

<sup>265</sup> Martire and Edmond, ‘Rethinking expert opinion evidence’.

<sup>266</sup> They have produced unprincipled and incoherent results. Why, for example, do courts allow latent fingerprint examiners (and those comparing bullets and voices) to testify in categorical terms (i.e. to positively identify persons), whereas DNA profiling is limited to probabilistic forms of expression, and face and body comparison is (or was) limited to describing similarities?

### ***I. Feedback and the failure to learn (or encourage learning in others)***

One of the most disturbing features of this account is that legal knowledge of latent fingerprints has not advanced in more than a hundred years. Indeed, the high point of jurisprudence in terms of epistemology seems to be the dissent in *Parker*. Contemporary judges do not require latent fingerprint examiners to support their claims with evidence. Contemporary judges do not require any evidence of validity and scientific reliability.<sup>267</sup> They allow latent fingerprint examiners to identify persons in categorical terms and leave appropriate qualifications and caveats for the defence and trial safeguards, even though they only seem to have been raised on a few occasions in the course of a long century. Furthermore, no defence counsel – perhaps with the exception of counsel in *Ghebrat* – seems to have persuaded a trial or appellate court that they matter. Rather inappropriately, longstanding legal practice and socio-legal experience stand in the place of scientific research and scientific knowledge. This is unfortunate because many other forensic ‘sciences’ have based themselves on latent fingerprint comparison and adopted the ACE-V ‘method’ – e.g. ballistics and toolmarks, shoe, foot, tyre and voice comparison, along with identification from images. In consequence, poorly formed and pre-scientific ideas about forensic science and medicine continue to inform the production of forensic science evidence, admissibility decisions (unconcerned with reliability), presentation and forensic testing, the exercise of mandatory and discretionary exclusions (unconcerned with reliability), the understanding of proof and standards of appellate review.

The trial and appeal in *JP*, like the decisions in *Bennett*, *Parry* and even *Ghebrat*, yield no epistemic insights. They offer no evidence of institutional learning or sophistication. There is no evidence that the judicial officers in *JP* have any more insight or sophistication than those who encountered fingerprint evidence a century earlier. The judges and almost all of the lawyers seem to be oblivious to relevant scientific research and its significance. In the absence of scientific and technical sophistication the judges in *Lawless*, *O’Callaghan*, *Bennett*, *JP*, *Parry* and *Hillstead* seem to be in substantially the same position as the judges in *Blacker* and *Parker*. Here we can observe, for those who choose to look, just how inadequate conventional rules, procedures, jurisprudence, Codes of Conduct and responsibilities (devolved onto prosecutors, defence lawyers and trial judges) are in practice. In order to defend the legal performance and the status quo, it would seem to be necessary to accept that the way fingerprint evidence is routinely reported, used in investigations, and presented in courts (along with ordinary challenges), are appropriate.<sup>268</sup> This article, and its heavily reliance on scientific research and recommendations, reveals that such a position is untenable. At the very least it is inconsistent with the expectations of a system of justice that purports to be rational and interested in taking systematic advantage of scientific, technical and medical knowledge.

Not only have our courts failed to obtain scientific knowledge in their attempt to inform the admission and use of forensic science evidence, but perhaps an even greater loss has been the failure to use emerging scientific knowledge to improve our understanding of criminal justice processes. A tremendous and perhaps unprecedented opportunity has been squandered. The scientific reports discussed in Section 3 provide authoritative and unprecedented insight into forensic science evidence that, if accepted, strongly suggests that legal practice has been ineffective or misguided and perhaps both. By not providing conditions in which prosecutors and defence counsel could productively introduce such knowledge into admissibility determinations, trials and appeals, Australian courts have

<sup>267</sup> The emphasis is on ‘judges’ because existing rules could be interpreted and applied quite differently.

<sup>268</sup> It would also be premised on the idea that all who do not challenge the evidence do so because they know they are guilty, when this essay raises alternative possibilities – such as the improbability of success following any challenge even if a fingerprint identification was mistaken.

deprived themselves of knowledge in their attempts to produce correct verdicts fairly – doing justice in the pursuit of truth.<sup>269</sup>

One of the most important means of improving performance is through the provision of timely feedback.<sup>270</sup> Current practices deprive our courts of meaningful feedback. In something of a reactionary manner our courts have sought to defend their (historical) practice and portray what they have been doing for more than a century, without empirical evidence of performance, insight, or independent feedback, as justice.<sup>271</sup> For those who contend that trial safeguards are performing well, we can only wonder about the evidence supporting such contentions. Where are the epistemologically-informed challenges and where is the judicial recognition of the centrality of validity and scientific reliability? Where is the evidence of cross-examination and judicial guidance drawing attention to, and clearly explaining, the significance of these issues? Where is the evidence of latent fingerprint evidence being presented in scientifically-defensible terms? At this point it is far easier to identify authoritative but unprincipled rejections of reliability – in *Tang*, *Tuite* and *R v Chen* – than any (systematic) engagement with readily available scientific knowledge.

## 9. Conclusion

More than a century ago, the Chief Justice of Victoria, lamented that ‘the matter has not been investigated by scientists generally so that we can say that the propositions relied on by the Crown are accepted scientific facts’. Madden’s concerns about identification by latent fingerprint seems to have been vindicated by subsequent events. Almost a hundred years after his dissent, the reviews he believed were necessary were finally undertaken. While his concerns are not simply aligned with modern scientific methods and norms, recent research and the knowledge produced has finally placed latent fingerprints on a scientific foundation. Opinions about latent fingerprints turn out to be a probative, but not infallible, form of evidence. The results of scientific research, along with the considered advice of multi-disciplinary collectives of independent scientists, suggest that latent fingerprint examiners should not positively identify persons, and that their results should be expressed with an indication of performance (and error) – ideally in probabilistic terms. Fingerprint reports should include this information and refer to scientific research and mainstream scientific criticisms.

The Chief Justice’s concerns are important for the way they illuminate ongoing jurisprudential problems. The language adopted by Madden is eerily similar to the way the US Supreme Court defined knowledge in *Daubert*. We can these observe similarities in the High Court’s *Honeysett* decision:

the person’s training, study or experience must result in the acquisition of *knowledge*. The *Macquarie Dictionary* defines “knowledge” as “acquaintance with *facts, truths, or principles*, as from study or investigation” (emphasis added) and it is in this sense that it is used in s 79(1). The concept is captured in Blackmun J’s formulation in *Daubert v Merrell Dow Pharmaceuticals Inc*: “the word ‘knowledge’ connotes more than subjective belief or unsupported speculation. ... [It] applies to any body of known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds”.

Our rules and jurisprudence require it. Yet when it comes to latent fingerprint evidence no judge has reproduced the principled position pursued by Madden.<sup>272</sup> When it comes to

<sup>269</sup> H.L. Ho, *A Philosophy of Evidence Law: Justice in the Search for Truth* (Oxford University Press, 2008).

<sup>270</sup> See e.g. L. Lo Pucki, ‘Legal culture, legal strategy, and the law in lawyers’ heads’ (1996) 90 *Northwestern University Law Review* 1498.

<sup>271</sup> Yet, there has been no serious epistemic engagement and all challenges concerned with the accuracy of identification have failed.

<sup>272</sup> *Tuite* might be an exception, though it was undermined by a side-wind in *IMM v The Queen* [2016] HCA 14.

forensic science evidence, our courts have rarely required specialised knowledge and infrequently received meaningful feedback.

## APPENDIX

The judgment from the first reported English fingerprint case, *R v Castleton* [1909] 3 Cr App R 74, is reproduced below in full.

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COURT OF CRIMINAL APPEAL.

1909  
12 November.  
Thomas  
Herbert  
Castleton.

THOMAS HERBERT CASTLETON.

*The Court may accept the evidence of finger-prints though it be the sole ground of identification.*

This was an appeal from a refusal of Bucknill J. to grant leave to appeal against a conviction for burglary. Appellant was sentenced at the West Riding Quarter Sessions, on October 21st, to three years' penal servitude.

*Milton Barber* (under sect. 10 of the Criminal Appeal Act) for appellant, who was not present. The conviction is bad, as the only evidence against appellant was that of finger-prints upon a candle left behind. He was not defended at the trial. There was no other evidence against appellant. Even supposing the prints on the candle are those of appellant, the evidence is not sufficiently weighty. He was an associate of thieves, and it may have been that the finger-prints were put there by someone else.

[DARLING J: Can the prisoner find anybody whose finger-prints are exactly like his?]

Counsel said he was not instructed as to that, but the candle might have been used by somebody else, although it belonged to appellant. He referred the Court to a photograph of the impressions of the prints.

THE LORD CHIEF JUSTICE: We are clearly of opinion that this application must be dismissed. The suggestion has been made that these finger-prints may have been put there by someone else, but that suggestion was disposed of by the jury, who decided upon the evidence before them. Our attention has been drawn to the photographs of the impressions of the finger-prints. Looking at the middle finger particularly, as well as to the index finger of the right hand, we agree with the evidence of the expert at the trial.

*Application dismissed.*

*Castleton* was subsequently presented as authoritative on the issues of admissibility and proof. It was influential in Australia, the United States, and Canada. Though, the actual decision exemplifies profoundly limited engagement with the procedures used by examiners and their abilities. On the issue of sufficiency, the court both defers to the jury and trusts its own comparison of the fingerprints. Revealingly, Darling J's question seems to imply, in a way that persists (its spectre re-appears in *JP*, for example), that there is an expectation that

the appellant might somehow produce another person with 'identical' fingerprints (or point to an error in the identification).

**END**