

Bernard Robertson | G. A. Vignaux | Charles E. H. Berger

# Interpreting Evidence

Evaluating  
Forensic Science  
in the Courtroom

Second Edition

WILEY



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Evaluating Forensic Science in the Courtroom

Second Edition

by

BERNARD ROBERTSON

*Barrister, Wellington, New Zealand*

G.A. VIGNAUX

*Emeritus Professor*

*Victoria University, Wellington, New Zealand*

CHARLES E.H. BERGER

*Principal Scientist, Netherlands Forensic Institute*

*Professor of Criminalistics, Leiden University,*

*The Netherlands*

WILEY

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# Preface to the First Edition

This book started as part of a wider project, the examination of the applicability of logical and probabilistic reasoning to evidence generally. This has been the subject of vigorous discussion in the legal literature and is one of the main threads of the ‘New Evidence Scholarship’.

Forensic science suggested itself as a case study as there seemed to be some degree of consensus that forensic scientific evidence should be thought about in probabilistic terms, but when we surveyed the field it appeared to be a mess.

- Some expert witnesses, such as fingerprint officers, make categorical statements that two impressions are from the same finger.
- Some experts, such as glass experts, would only say that a sample could have come from a particular source and then gave some straightforward sounding statistics about the frequency of glass of that type.
- Some types of evidence, such as DNA, seemed to involve statistical arguments of impenetrable complexity.

The law seemed in equal confusion.

- There was a rule preventing giving an opinion on the ultimate issue, yet courts regularly heard witnesses talk about the probability of paternity.
- A court would reject evidence in one case because it usurped the role of the jury and in another because it was not definitive and conclusive.
- Courts sometimes pointed out problems with evidence that the forensic science profession did little about and sometimes ruled evidence out for reasons that had little to do with its probative value.

It also seemed to us that courts and textbook writers were keener to bandy words such as ‘reliability’ and ‘regard the evidence with caution’ than to explain what ideas lay behind these phrases.

The time had clearly come for some fundamental re-evaluation of forensic science. As we studied the matter, we realised that the application of a few basic logical principles solved the problems of description and prescription with which we were faced. That is not to say that solutions came easily; the application of these principles requires hard thinking and we cannot pretend to offer answers to all the questions. The results lead to advice about how to think about evidence of much more practical value than an admonition to ‘regard the evidence with caution’.

While preparing this book we found some forensic scientists who had been thinking along the same lines and had published papers in the scientific literature. The most prolific

current writer is Dr Ian Evett of the British Home Office Forensic Science Service. Gradually, and despite opposition from within the scientific and legal fraternities, these ideas have begun to appear in legal literature and to influence the giving of evidence.

The result is that while the insights in this book will seem to some readers as revelatory as they first did to us, this book is, in fact, part of a movement throughout the forensic scientific world to re-evaluate scientific evidence and, at the same time, to encourage a greater sense of unity and professionalism amongst forensic scientists. So far as we know, however, this book is the first to be written as a single book-length work on the subject.

### **Who Is This Book Aimed At?**

The task of convincing forensic scientists that they must rethink their interpretation of scientific evidence is one for scientists writing in scientific journals. At some point, however, the scientist has to communicate with a lawyer and perhaps with a jury. Likewise, the lawyer who understands the law and is an expert at communicating with juries has to be able to understand the scientist. It is evident that in the past there has been a sad failure of communication.

This book attempts to remedy that. It is designed to be read by both lawyers and forensic scientists so that each will better understand the other and they will be better equipped to work together to explain the evidence to the court.

We intend that the book will also be of value to academics and students. The basic logical principles we apply provide the intellectual tool-kit for re-evaluating the law relating to expert evidence and indeed to evidence generally. We believe that this is a classic example of deep theoretical thinking appropriate to university courses providing far more practical solutions to practitioners' problems than the ad hoc reasoning which has been applied to expert evidence in the past.

In completing this task we have been helped and encouraged enormously by academic colleagues and forensic scientists including, through the wonders of electronic mail, those from the United States and the United Kingdom. Particular mention must be made of Dr Evett, who has not only been of invaluable technical assistance but who chivvied us vigorously when we were slacking on the job. Valuable comments on drafts were provided in the later stages by Richard Friedman, David Kaye and Dennis Lindley and by David Wilson of John Wiley and Sons Ltd who supported us enthusiastically. We have also benefited from discussion at many conference and staff seminar presentations at our own and other universities, and from a presentational point of view we have even benefited from the outright hostility we have met on occasions. We have conducted thoroughly enjoyable (to us at any rate) Masters and Honours courses in which a number of enthusiastic students have contributed ideas and sharpened up our presentation. Some are mentioned by name at appropriate points in the book.

We have been generously supported by research grants from the Victoria University of Wellington Internal Grants Committee, which have enabled us to employ several research assistants as the project ground through its various phases. Isobel Egerton, Andrew Fairfax, Victoria Heine, Michael Sleight and Victoria Wicks-Brown have all contributed during vacations and term time.

Certain passages are adapted versions of papers which we have published elsewhere. More than one passage is extracted from our paper 'Expert evidence: law, practice and probability' (1992) 12 *Oxford Journal of Legal Studies* 392; the passage on stylometry is adapted from 'Stylometric Evidence' [1994] Crim L R 645, of which Isobel Egerton was co-author; much of Chapter 7 is to be found, differently arranged, in 'DNA Evidence: Wrong Answers or Wrong Questions' (1995) 96 *Genetica* 145; the section on fingerprints is adapted from 'The Interpretation of Fingerprints' (1994) 3 *Expert Evidence* 3. The assistance we have had from the editors and publishers of those journals is also gratefully acknowledged.

This book is based on a logical argument and the state of the law in any particular jurisdiction is not important for its thesis. Nonetheless, we have endeavoured to state the law correctly where we give examples and citations and hope that the law is correct as of 1 January 1995.

Bernard Robertson  
Palmerston North

G. A. (Tony) Vignaux  
Wellington  
1995



# Preface to the Second Edition

It has been 20 years since the first edition of *Interpreting Evidence*. It was written in such a way that neither changes in the law nor advances in technology would invalidate the discussion. Since then, however, there have been substantial advances in the application of the principles discussed to new areas of forensic science. At the same time, there has been some confused reaction in the courts and little sign of great increase in understanding in the legal profession or academia.

The original authors had been asked by several scholars to prepare a new edition both to update the book so that it remained as comprehensive as possible and also because there was a need to get the book back into circulation. One of these, Charles Berger, a forensic scientist, not only urged the writing of a new edition but offered to participate and provide much-needed insight into recent advances. The authors were therefore delighted to recruit him to the team.

While the principles and Chapters 2 and 3 remain largely the same, a number of improvements have been made:

- We have removed reference to obsolete methods such as blood-grouping, now replaced by DNA testing and to methods such as stylometry, which has been effectively dismissed as being of any value;
- Chapters have been reordered, so that the whole logical method is set out before we discuss problems caused by the use of other methods;
- There has been a general rewriting to improve style and presentation and to take into account various detailed criticisms we have received; and
- Chapters 7 and 8 are largely new and, in particular, take account of advances in the application of Bayesian analysis to new areas of evidence.

We have benefited from feedback about the first edition from forensic scientists and lawyers around the world. We are especially grateful for comments and help while preparing this edition from Colin Aitken, Niko Brümmer, John Buckleton, Christophe Champod, Ian Evett, Tacha Hicks Champod, Daniel Ramos, and Marianne Vignaux, none of whom, of course, are responsible for the views expressed or any errors made.

Bernard Robertson  
Wellington

G. A. (Tony) Vignaux  
Wellington

Charles E. H. Berger  
The Hague

1 June 2016



# 1

## Introduction

Forensic scientific evidence can help us to establish:

- that a particular person was at a given place at a given time;
- that a particular person carried out an activity, such as signing a cheque or breaking a window;
- that something was done with a particular instrument, for example, a door was forced with a particular tool, a shot fired from a particular weapon, or a call made from a particular telephone;
- a relationship between two people, for example, in paternity disputes and incest or immigration cases.

There is a whole range of techniques used for forensic purposes, and new methods are continually being added to the arsenal of the forensic scientist. Our purpose is not to discuss the technical details of these methods, which rapidly become dated. We propose to concentrate on how such evidence should be interpreted and incorporated into the court process.<sup>1</sup>

### 1.1 Three ‘principles’

Traditionally, several ideas have been proposed as principles for forensic science:

- (i) Locard’s ‘Principle’: A perpetrator will either leave marks or traces on the crime scene, or carry traces from the crime scene. This is often misquoted as ‘every contact leaves a trace’ but Locard never actually claimed this.

Edmond Locard (1877–1966) was a French forensic scientist. He proposed that we should always consider whether traces of the victim or crime scene can be found on

<sup>1</sup> We use evidence here in the sense of observations (that are certain) that influence our degree of belief in the truth of things we cannot be certain about, such as those listed here. We do not limit evidence to information that has been designated as such by a court.

the accused and whether traces of the accused can be found on the crime scene or victim. After an assault, for example, we might find skin and blood under a deceased's fingernails and infer that they come from the attacker. We might arrest a suspect on the basis of other evidence and find, on him or his clothing, fibres which might come from the deceased's clothes, blood which might come from the deceased or soil and plant material which might come from the scene.

- (ii) 'Principle' of individuality: Two objects may be indistinguishable but no two objects are identical.<sup>2</sup>

The combination of these two ideas together might seem to have enormous potential value to the forensic scientist. If every contact provides ample opportunity for the transfer of traces, and every trace is different that seems to be cause for optimism. However, if no two objects are identical, then, for example, no two fingerprint impressions will be identical even if they are taken from the same finger; no two samples of handwriting by the same author will be identical. The question is whether two marks have the same source, and how much our observations help us in answering that question.

We describe these two statements as proposed principles rather than laws because neither meets the standard definition of a law of science. The philosopher Karl R. Popper (1902–1994) said that for a law to be regarded as scientific it must be potentially falsifiable, that is, it must be possible, at least in theory, to design an experiment which would disprove it.<sup>3</sup> It seems to be impossible to design an experiment to refute the first of these principles. If an experiment fails to find an impression after two objects have been in contact, it may be that all that is revealed is the limitations of the detection process. The proposed principle that no two objects are identical does not require proof, since two objects that would be identical in every way would – by definition – be one object. Unfortunately, it does not follow from the uniqueness of every object that we can correctly point out its unique source.

- (iii) Individualisation 'Principle': If enough similarities are seen between two objects to exclude the possibility of coincidence, then those objects must have come from the same source.

This 'principle' has a long history in forensic science, as can be seen from the following quotes that span the 20th century:

*The principles which underlie all proof by comparison of handwritings are very simple, and, when distinctly enunciated, appear to be self-evident. To prove that two documents were written by the same hand, coincidences must be shown to exist in them which cannot be accidental.*<sup>4</sup>

*When any two items have characteristics in common of such number and significance as to preclude their simultaneous occurrence by chance, and there are no inexplicable differences, then it may be concluded that they are the same, or from the same source.*<sup>5</sup>

<sup>2</sup> Wittgenstein: 'Roughly speaking, to say of two things that they are identical is nonsense, and to say of one thing that it is identical with itself is to say nothing at all' (*Tractatus*, 5.5303).

<sup>3</sup> Popper KR, *Conjectures and Refutations: The Growth of Scientific Knowledge*, 5th ed (Routledge and Kegan Paul, London, 1989).

<sup>4</sup> Osborn AS, *Questioned Documents*, (Rochester, New York, 1910), p. 211.

<sup>5</sup> Huber RA, Expert witnesses, (1959), 2, *Criminal Law Quarterly*, 276–296.

*... we look for unique characteristics in the items under examination. If we find a sufficient number of characteristics to preclude the possibility or probability of their having occurred by coincidence in two different objects, we are able to form a conclusion of individualization. It's as simple as that.*<sup>6</sup>

This popular so-called principle, while simple, is fraught with problems. The possibility of a coincidence can never be completely excluded, which precludes categorical statements of individualisation. There is no general criterion possible for the number of coincidences needed to decide an individualisation; whatever level is chosen is purely arbitrary. How certain we would want to be for a decision would depend on the gravity of the crime involved (e.g. capital murder versus shoplifting). How certain we could be would also depend on other evidence and information in the case. Clearly, such issues and decisions are not up to the forensic scientist but rather the trier of fact. The role of the forensic scientist is not to decide the issue, but to describe what the evidence is worth. This 'principle' should therefore not be used.

## 1.2 Dreyfus, Bertillon, and Poincaré

In 1894, Alfred Dreyfus (1859–1935), an officer in the French army, was charged with treason in what was to become one of the most famous criminal trials in history. The charges were espionage and passing information to Germany. The espionage had definitely taken place and one of the central items of evidence was the comparison of the handwriting in an incriminating note with Dreyfus's own handwriting. A prominent witness for the prosecution was Alphonse Bertillon (1853–1914).

Bertillon was a Paris police officer who rose to found a police laboratory for the identification of criminals. He was well known for proposing a system of anthropometry, which became known as Bertillonage. Anthropometry simply means the measurement of humans. Bertillonage required taking a photograph and recording a series of measurements of bone features which were known not to change after adolescence. Later, fingerprints were added to the features recorded. The basis of the system was that it would be unlikely that any two people would have the same measurements over the whole range of features.

Bertillonage suffered from a number of problems. The method was slow and expensive and was far from error free. The officers taking the measurements had to be specially trained; this involved more expense, and even then, at the levels of accuracy called for, no two would take the same measurements from the same series of features. Nor could the system be applied to juveniles.

The purpose of the system was to determine whether or not a person had the same measurements as a person who had earlier been arrested. This can be very useful, for example, when someone is arrested on suspicion of failing to attend court or when a person being sentenced denies that previous convictions relate to him. However, Bertillonage could not help investigators by providing evidence that a particular person had been, for example, at the scene of a crime.

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<sup>6</sup> Tuthill H, *Individualization: Principles and Procedures in Criminalistics* (Lightning Powder Company, Salem, Oregon, 1994) p. 27.

Although fingerprints were later taken as one of the Bertillonage measurements and Bertillon himself solved a crime using fingerprints in 1902, there was no formal classification system for them. Once such systems were developed (by Galton and Henry in England and India, and Vucetich in Argentina) it was possible to quickly exclude the majority of the fingerprint collection (i.e. the other classes) on each search. Fingerprints became a far quicker and simpler method of identification than anthropometry. In the first full year of operation by the London Metropolitan Police, fingerprints identified 3 times as many persons as anthropometry and, 2 years later, 10 times as many. Not only were fingerprints far simpler and cheaper to obtain and record but they could also help investigators identify the perpetrators of crimes. Bertillonage was dropped.

Bertillon gave evidence in the Dreyfus case as a handwriting expert and claimed that Dreyfus had written the incriminating document. His evidence referred to certain similarities and multiplied together the probabilities of each of the similarities occurring by chance to arrive at a very low probability of them occurring together by chance. His evidence was subjected to devastating critique by a number of people including Poincaré, an eminent mathematician.<sup>7</sup> Poincaré made three important points about Bertillon's evidence. The first was that Bertillon had simply erred in that the figure he produced was the probability of getting the four similarities amongst four examined characteristics. There were far more characteristics examined, and so the chances of finding four similarities were actually much greater than Bertillon's figure. The second point Poincaré made was that events that have actually occurred might be seen beforehand as highly improbable. The example he gave was the drawing of a particular number or set of numbers in a lottery. The probability that any particular set of numbers will be drawn is extremely low. Once it has been drawn, however, that low probability does not mean that the draw has been dishonest.

Most importantly of all, Poincaré discussed what is called the inverse probability problem, the difference between calculating in advance the probability of an effect and calculating after the event the most probable cause of an effect:

*As an example of probability of effects, we usually choose an urn containing 90 white balls and 10 black balls; if we randomly draw a ball from this urn, what is the probability for this ball to be black; it is evidently 1/10.*

*The problems of probability of causes are far more complicated, but far more interesting.*

*Let us suppose for example two urns of identical exterior; we know that the first contains 90 white balls and 10 black balls, and the second contains 90 black balls and 10 white balls. We draw arbitrarily a ball from one of the urns, without knowing from which, and we observe that it is white. What is the probability that it came from the first urn?*

*In this new problem, the effect is known, we observed that the ball drawn was white; but the cause is unknown, we do not know from which urn we made the draw.*

*The problem that we are concerned with here is of the same nature: the effect is known, the indicated coincidences on the document, and it is the cause (forgery or natural writing) that is to be determined.<sup>8</sup>*

<sup>7</sup> Taroni F, Champod C, and Margot P, Forerunners of Bayesianism in early forensic science, (1998), 38, *Jurimetrics*, 183–200.

<sup>8</sup> Poincaré H, Darboux G, Appell P (1908) Rapport de MM. les experts Darboux, Appell et Poincaré, In *Affaire Dreyfus; La révision du procès de Rennes; Enquête de la chambre criminelle de la Cour De Cassation* vol. 3, p. 502. Paris: Ligue française pour la défense des droits de l'homme et du citoyen.