

# Problems posed by DNA evidence Of blood, babies and bathwater

Ian Freckelton

*Forensic science in Australia and the United States grapples with the complexities of novel scientific evidence*

Forensic science has experienced a number of highly publicised embarrassments over the past 15 years — in Australia the *Splatt*, the *Chamberlain* and *Tran* cases, in New Zealand the *Thomas* case, in England the *Preece*, the *Birmingham Seven* and the *Guildford Four* cases, in the United States the *Castro* case, to name but a few. Australia's response has been to improve quality control procedures, consolidate in-house training and to formulate a Code of Ethics. Most latterly a National Institute of Forensic Science has been established in order to further standardise procedures and to reduce the possibility of errors which in many eyes have reduced the esteem in which forensic science can be held.

This article argues that the legal system has not functioned in such a way as to facilitate the accountability of forensic science as a reliable discipline, resulting in the unsatisfactory position that it is not possible to accept or deny the proposition put by modern-day forensic scientists that cases such as *Chamberlain* were an extraordinary phenomenon unlikely to be repeated because of the development of better mechanisms for excluding errors. It is also maintained that the legal system has reacted in an understandable and, in general terms an appropriate, way in excluding DNA profiling evidence where it could not be reassured that its tribunals of fact could adequately evaluate such scientific material. Suggestions are made for procedures to assist in the utilisation of complex expert evidence of the kind needed in DNA profiling cases.

## Legal ignorance of matters scientific

The disinclination and inability of lawyers to deal with matters scientific is a problem that besets the legal system in many jurisdictions. As Professor Kreiling recently wrote:

There appears to be unanimity among commentators that lawyers are deplorably ill-informed about science and scientific methods. And this appears to be the norm. The lack of proper training is the biggest problem with respect to non-utilization of scientific evidence. The lack of training affects another prerequisite to proper use of scientific evidence — the ability to oppose an offer of evidence. Even when the proponent recognizes that scientific evidence would be helpful, the evidence frequently goes unchallenged, contrary to the assumptions of the adversary system. As illustrated by the DNA cases, attorneys frequently fail to challenge the admissibility of unreliable evidence.<sup>1</sup>

The result of lawyers' lack of acquaintance with other disciplines is poor utilisation of their own experts, from selection to examination-in-chief, as well as cross-examination that rarely grapples effectively with the complexities of the experts' techniques, theories and methodologies.

To make matters worse the frequent absence of sufficient time and facilities for legal counsel to research and prepare for cases in the criminal domain has the practical result that the lawyers involved are thrown upon those few textbooks which they can hurriedly locate on the shelves of a Supreme Court or university library and the good offices of those experts with whom they happen to be familiar in a relevant area. The system is not structured in such a way that expert witnesses, particularly in the criminal field, will regularly be subjected to rigorous and well-informed cross-examination likely to test the quality of the scientific work that they have undertaken or the propriety of the protocols followed by them or their laboratory. The result of this is that it is simply not possible to say whether it is only the extraordinarily rare cases like *Chamberlain*<sup>2</sup> and *Splatt*<sup>3</sup>, where resources, supporters and remarkable dedication finally brought about Royal Commissions, that disclose poor quality work and unacceptable attitudes by forensic scientists or whether such problems beset the system much more regularly but simply are not brought to light.

## The debacles

In light of the different views of forensic scientists and those anxious about the quality assurance and standards of forensic science, it is valuable to focus on the kinds of problems exposed by two prominent cases in which forensic science was found wanting.

*Ian Freckelton is a Melbourne barrister.*

## Australian forensic science's low point

Commissioner Morling in his 1987 Report into the Convictions of the Chamberlains found the following disturbing flaws in the scientific work done in the Chamberlain case:

- use of tests without confirmatory work to verify the results (p.82);
- failure to use adequate controls, particularly on blood samples from the Chamberlain car (pp.84, 86, 103, 125, 129);
- testing on articles from which a clear result could not be expected, and failure to use a control in such circumstances (p.129);
- failure to test the anti-foetal haemoglobin anti-serum before using it (p.78);
- use of an anti-serum produced as a research product and when it had been made clear by its manufacturer that its diagnostic significance was limited and should be established by interested scientists working in clinical laboratories (p.76);
- failure to take adequate account of the effects of denaturing from the heat in the car and the effluxion of time when interpreting test results (p.66);
- excessively hasty testing (pp.19, 318)
- discrepancies between worknotes and laboratory result books, as well as inadequate note-keeping punctuated by crossings-out and changes and a failure to record some tests allegedly completed (pp.103-5);
- employment of tests by scientists relatively inexperienced in them without adequate guidance from a more experienced scientist (pp.138, 313);
- destruction of testing material without even the recording of the results photographically (pp.92, 312);
- absence of a system for cross-checking results and procedures (p.137);
- preparedness to 'speculate' rather than be confined by the available data (p.218).
- descent into partiality by some of the scientists (p.222);
- preparedness by some witnesses to go beyond their areas of expertise (pp.192, 200);
- unpreparedness of forensic scientists to consult one another (pp.277, 314-15);

Thus, the deficiencies highlighted by Commissioner Morling ranged from inappropriate methodologies, inadequate quality assurance systems to unacceptable practices adopted by forensic scientists. It was a damning critique of practices across a number of forensic science disciplines.

## DNA profiling's low point

The case of *People v Castro*<sup>4</sup> remains the leading United States authority on the admissibility of DNA profiling evidence. A mother and her two year old daughter had been stabbed to death in their Bronx apartment and, acting on information received, detectives interrogated a neighbourhood handyman, Jose Castro. They noticed on his watch a small bloodstain, which was sent for analysis to Lifecodes scientists who extracted about 0.5 mg of DNA. This was compared with DNA from the two victims. Lifecodes issued a formal report to the District Attorney stating that the DNA patterns on the watch and the mother matched, and reporting the frequency of the pattern to be about 1 in 100 000 000 in the Hispanic population. The report indicated no difficulties or ambiguities.

The case of *People v Castro* was the first time that DNA profiling techniques were seriously put under the forensic microscope. Sheindlin J of the New York Supreme Court held that there was 'unanimity amongst all the scientists and lawyers as well that DNA identification is capable of producing reliable results' (at 8). However, he found the testing laboratory to have failed in its responsibility to perform the accepted scientific techniques and experiments in several major respects and so ruled that in that case the DNA tests could not be used to show that the blood on the accused's watch was that of the victim. He found the testing laboratory's tests to be sufficiently reliable for the purposes of exclusion of a match, but not for positive proof of a match between the blood samples.

The decision in the *Castro* case has highlighted a number of disturbing problems, not so much with DNA technology as with its application in particular cases and with laboratory standards, procedures and safeguards. They may be reduced to the following broad areas, many of which are strikingly reminiscent of the deficiencies pinpointed by Commissioner Morling in his *Chamberlain Report*:

1. *Discrepancies between forensic report and laboratory findings.* The

only autoradiogram (the supermarket-like bar code enabling comparison of different DNA samples) involving a crucial probe showed five bands in one of the lanes examined and only three in the other. This was contrary to the formal Lifecodes' report. The explanation given for the inconsistency was that the two non-matching bands could be discounted as being contaminants 'of a non-human origin that we have not been able to identify'.<sup>5</sup> Sheindlin J disagreed, holding that the existence of the extra two bands was of critical importance 'in determining whether the forensic DNA testing performed in this case demonstrates these bands to be human DNA or non-human DNA ... Further testing was required'. The result of this finding was the ruling that 'the credible testimony having clearly established that the testing laboratory failed to conduct the necessary and scientifically accepted tests, the evidence demonstrating an inclusion is inadmissible as a matter of law'.

2. *Deficient laboratory records.* Initially, evidence was given that the control DNA came from a female-derived cell line but later the same witness changed his mind and maintained that the control came from a male scientist with a short Y chromosome. After evidence was given by the defence about the unlikelihood of this being the case, a senior scientist informed the court that no precise record had been kept of which DNA preparation had been used but it was apparent that the control DNA came from a female technician. (Compare Morling Report, at pp.103, 105).

3. *The use of controls.* The confusion over the identity of the donor of the control DNA highlighted the absence of suitable controls. The judge's response was to declare that in the absence of both male and female controls, 'it is difficult to determine whether the probe hybridized correctly. The failure to include both controls renders the experiment uninterpretable'.

4. *Identification and matching of bands.* The Lifecodes report in *Castro* appears to have committed the same sin as was so vigorously condemned by the South Australian *Shannon Report* — the approach adopted by the investigating scientists was one of looking for similarities in samples rather than focusing on dissimilarities. Lander is particularly critical of Lifecodes' preparedness to make direct comparisons between lanes containing different DNA samples, rather than considering each lane in its own right:

Personally, I do not understand how the presence of matches at D17S79 and DXYS14 has any bearing on the determination of a match at D2S44: each test must be evaluated independently, especially as the individual probabilities of a match for each locus are multiplied together at the end.<sup>6</sup>

He also points out that the stated Lifecodes' matching rule, that two fragments are classified as matching when their positions differ by less than three standard deviations, was breached in the Castro results. That should have led to an adjudication of 'no match'. His view is that the subjective process of visual matching may have taken over to the detriment of the integrity of the matching process.

5. *The impact of degradation of DNA samples.* The small quantity of DNA present on the watch which was examined by the Lifecodes' scientists was to a degree degraded, a problem which was compounded by the fact that the suspect was a member of the Hispanic population. The danger was that the sample on the watch was a heterozygote with a relatively high band undetected because of degradation.

6. *The impact of probe contamination.* Various artefacts were discovered in the results. Lifecodes sought to explain these by the unsatisfactory occurrence of contamination of probes. It appears that Lifecodes 'continued to use probes even after learning that they were contaminated, while apparently keeping no precise records of when such probes had been used'. This would make calculation of the likelihood of false matchings impossible because samples may also be contaminated. Sheindlin J held that 'the use of a contaminated probe is unscientific and unacceptable. Immediately upon discovering a contaminated probe its use should have been discontinued'.

7. *Calculation of matching probabilities.* One critic colourfully maintained that the Lifecodes process of calculation of matching probabilities is 'like catching a match with a 10-foot-wide butterfly net'<sup>7</sup> as it failed to take account of the actual threshold used for declaring matches. He also criticised the account taken by Lifecodes of heterogeneity of particular populations, maintaining that this led the company seriously to miscalculate its statistics. Sheindlin J held that:

The rule for declaring a measured match must be the same rule which is used for declaring a match between the measure-



ments and the data pool. This was not done in this case. Because of this error, the population frequencies reported by Lifecodes in this case are not generally accepted by the scientific community.

### Australian DNA profiling decisions

In light of the disturbing similarities between the problems of scientific methodology highlighted by Commissioner Morling and Sheindlin J, it is not surprising that the two Australian cases to have carefully examined objections to prosecution-led DNA profiling evidence have been wary of allowing conflicting expert evidence to go before jurors if they would be in no adequate position to evaluate the competing contentions.

### The Tran case

In the 1990 case of *R v Tran* (1990) 50 A Crim R 233 the Crown sought to introduce evidence of DNA profiling to establish a connection between the accused and a rape/murder victim. Three vaginal swabs and a bloodstain from the deceased, two from her boyfriend and four from the accused were sent to Cellmark Diagnostics for analysis. The accused was a Vietnamese man said to be aged between 25 and 35.

Four tests were performed and in each test eight clearly visible bands could be seen in the single trace profile of the deceased's vaginal swabs. However, no bands could be obtained in the victim's profile due, it was said, 'to the low yield of DNA obtained' (at 234). It was clear that the bands did not

match those of the deceased's boyfriend. However, in addition to the eight clear bands, two very faint bands appeared and on another there was one very faint band. It was said that these bands 'appeared to match the suspect' but due to the faintness the scientists agreed that they could 'not put a statistical weight on them' (at 235). Nonetheless, the Cellmark expert witness measured the faint bands with the use of a ruler and found the bands in the sample to correspond with those of the accused person. The probability that the bands matched by chance was calculated at 1 in 152 by the use of a database of 300 Afro-Caribbeans, this being the most conservative of the databanks of which the Cellmark Laboratory was possessed.

A number of scientists of varying backgrounds gave evidence for the defence, querying the reliability of the evidence led for the prosecution. Their concerns may be summarised as follows:

- No other form of blood testing had been undertaken against which the DNA testing could be compared.
- One defence expert using a measuring device, which he said was capable of introducing objectivity into the measurement and comparison of bands, measured the lower of the bands as five units removed from the bands in the accused's track, meaning that there was not a match. The device did not register the upper band described by the prosecution.

- The same expert concluded that the DNA from the boyfriend had leaked across the other tracks, possibly at the time of the electrophoresis stage. He said there was a 'possibility of a sample breaking between the wells underneath' (238). All in all, he said there was not sufficient evidence to conclude a match and insufficient evidence to conclude that the upper band was a track.

Another expert said that the lower band was 'uncomfortably close to a ridge' and he would not be confident enough to classify it as a band. He disagreed with the main prosecution witness and expressed the view that the upper band did not extend across the entire lane, meaning in his view that the result was unacceptable and he could not have confidence in it. He was critical of the practice of proclaiming faint marks to be bands.

- The same expert was critical of the assumption, which he claimed had been made by the experts called for the prosecution, that sperm were present. He noted that the extraction of DNA from sperm is notoriously difficult because of its peculiar protein qualities.
- A Victorian expert argued too that incomplete digestion could itself lead to faint bands and that after long exposure, the conditions could lead to faint bands. He argued further that the DNA of bacteria could also show up in results and that in the absence of a simple probing test to exclude a bacterial role, which had not been undertaken by the testers, the apparent presence of a faint band had the potential to be most deceptive.
- The Victorian expert also took issue with the calculation of the probabilities based on the non-Vietnamese population in what was a very small sample.
- The same expert urged the need for independent verification of measurements by separate scientists, a procedure that had not been followed in the Cellmark tests.
- Both the ACT expert and a statistician from the CSIRO were extremely critical of the use made of the Afro-Caribbean database.

Not surprisingly, in light of the foregoing, McInerney J found there to be a considerable scientific dispute potentially confronting jurors, including whether certain faint bands existed and then as to how they could be interpreted. He

found there to be a danger that jurors would look at the bands as they appeared and 'could subjectively conclude that that was a match' (at 241). But he was conscious that 'the jury would not be entitled themselves to perform that function, as it is a matter of considerable expertise to determine whether in fact there are bands there or not' (at 241). He pointed out that although it is the jury's function to make difficult findings of fact, such as those facing the jurors in this instance, practically speaking 'they could only do so if it was open to them to accept one witness against another' (at 241).

McInerney J referred also to the problems concerning the database and concluded that there were further difficulties which made the tests 'unreliable'. He determined that to put the material before the jury 'would have a tendency to produce a misleading and confusing impression' (at 242) and that, as they would not be in a position to determine the issues, if they attempted to they would be speculating. He continued:

In any event, if I were of the opinion that it would be open to the jury to conclude that these were matching bands and they matched the bands of the accused, thereby linking him against a one in 152 coincidental chance, if one accepts that figure, or alternatively one in 87 the state of the evidence is in an unsatisfactory state because of the fact that there is no database for Vietnamese. [242]<sup>9</sup>

His Honour excluded the evidence on the basis that the jury would not have been in a position to determine the threshold question of the existence of the bands and noted that if he had not rejected the evidence on this basis, he would have excluded it as being more prejudicial than probative.

### R v Lucas

In the first substantial decision on DNA profiling in Victoria Hampel J also excluded DNA profiling evidence, this time exclusively on the basis that the prejudicial effect of the evidence exceeded its probative value (*R v Lucas* unreported, Supreme Court of Victoria, 16 August 1991).

The Crown case against the accused had been based on circumstantial evidence. A smear of human blood was found on a wall in the accused's father's garage where the Crown maintained the accused had killed and/or dismembered the deceased. The Crown wished to adduce evidence of the results of the DNA testing of blood samples from the

parents of the deceased which it argued established the bloodstain on the wall to be the blood of the deceased or a close relative to a high degree of probability.

His Honour held that for evidence of a specialist scientific character to be admitted, it 'must have a basis in a body of recognised scientific theory' (at 13). However, its value and effect need not be subject to complete unanimity by all experts in the field — 'It is appropriate that it be tested by cross-examination and the jury may decide the weight proper to give to that evidence'. He held that particular caution must be exercised as 'the scientific appearance of expert evidence may be overwhelming'. 'This is particularly the case when the evidence sought to be adduced is of such an esoteric character that there is no real basis on which a non-expert jury can evaluate it independently of the experts'. (at 14)

After evidence questioning the integrity of certain of the statistical assertions as to the likelihood of the blood being that of the deceased as a result of the DNA testing of his parents' blood, the Crown conceded that it would not seek to have the evidence of one of the prosecution scientists admitted as to probabilities. However, it did seek to have evidence admitted to the effect that the stain on the garage wall was tested using the DNA profiling procedure and the results were 'consistent' with the stain having come from a child of the parents of the deceased.

This was vigorously opposed by counsel for the accused who argued that if mere consistency, or non-exclusion were left to the jury, it would have no basis on which to assess its value and to judge how frequently such a consistent position would occur. Hampel J upheld the objection:

DNA testing is widely regarded as extremely reliable and discriminating. Its limitations and particularly limits as to the conclusions which can be made from the tests are not generally appreciated. The jury has no basis on which it can evaluate the evidence. There is no way the jury can properly weigh the value of such evidence if there is no evidence before it as to the frequency of a match in the general population. . . . I think that there is in this case the danger that consistency could assume the colour of identity, or at least of probability. [at 17-18]

### The conservative approach of the law

The important issue that DNA profiling has posed afresh for the law is what its

approach should be in face of significant technical disagreement about a technique whose admission as evidence in particular cases has the potential to be damning against an accused person. The fact of the matter is that courts are not an appropriate forum for resolution of complex esoteric disputation among scientists — the places for that are the halls of academia or the developmental wings of forensic laboratories.

The issue, boiled down, is how much can we realistically ask randomly selected, lay representatives of the community to do in their capacity as jurors? They are regularly required to perform extremely difficult and challenging tasks involving the sifting of large amounts of evidence, sometimes presented to them over periods of months. They are asked to judge credibility and asked to rule in effect on alternative hypotheses for events that may be way outside their realm of experience. All of those tasks, it is assumed, they are capable of. But Justices McInerney and Hampel in New South Wales and Victoria have ruled, in effect, that a parameter of juror competence is reached when scientists disagree about an area in the forefront of scientific endeavour, such as DNA profiling, in a way that ceases to allow lay people to evaluate the competing expert contentions.

As the results of DNA profiling are potentially so inculcating for accused persons and the task of assimilating the different viewpoints on band measurement, potential for contamination, DNA degradation, track seepage, bacterial interference and appropriate statistical interpretation so alienating for the lay person and so difficult, this is an occasion for the law to be properly conservative. The *Castro* case is a warning to the law that the *Chamberlain* experience was not a one-off; carefully honed methodologies, protocols and quality assurance may exist but they are not always adhered to. If the scientists cannot reach anything approaching consensus about how their theories and techniques should be implemented, and how the results of their techniques should be interpreted, when people's liberty is at stake, ought not the scientists and the prosecutors wait a little longer?

The cautious approach of the New South Wales and Victorian decisions, then, has much to recommend it for as long as genuine disputation remains about the employment of DNA technology and the interpretation of its results.

But a mechanism must be found to solve the problem of evidence being withdrawn from jurors on the basis that they are not in a position adequately to comprehend and evaluate it. For a start, courtroom procedures must begin to change. Jurors must be given notepads and copies of transcript when they ask for it instead of relying on their 'best recollections'. They must be encouraged to ask questions, through their forepersons, and judges must be aware of their role as a catalyst for making expert testimony accessible for the lay tribunal of fact. Experts, too, have a role to play in communicating more effectively by better utilising demonstrative aids — diagrams, slides, computer simulations, etc.

But something additional is required to ensure that protocols and appropriate procedures are followed by forensic scientists, most of whom inevitably will be called by the prosecution. Sheindlin J's solution to the complex problems presented by the *Castro* case was to suggest the holding of a routine pre-trial conference in relation to DNA evidence and a practice whereby the proponent of the evidence would be obliged to give discovery of a variety of matters:

- copies of the autoradiographs, with the opportunity to examine the originals;
- copies of laboratory books;
- copies of reports by the testing laboratory;
- a written report by the testing laboratory setting forth the method used to declare a match or non-match, with all relevant criteria;
- a statement by the laboratory setting out the method used to calculate the allele frequency in the relevant population;
- a copy of the data pool for each locus examined;
- a certification by the testing laboratory that the same rule used to declare a match was used to determine the allele frequency in the population;
- a statement setting forth observed contaminants, the reasons for them, and tests performed to determine their origin and the results of the tests;
- if the sample is degraded, a statement of tests performed and the reasons for them;
- a statement setting forth any other observed defects or laboratory errors, the reasons for them and their results;

a chain of custody of the documents.

This has much to recommend it for the Australian context and it could well result in the DNA baby not being thrown out with the increasingly oily dishwater of scientific disputation.

## References

1. KR Kreiling, 'Scientific Evidence: Toward Providing the Lay Tri r with the Comprehensible and Reliable Evidence Necessary to Meet the Goals of the Rules of Evidence' (1990) 32 *Arizona Law Review* 915 at 936-7.
2. Royal Commission of Inquiry into Chamberlain Convictions, *Report*, (Justice TR Morling), NT Govt Printer, 1987.
3. Royal Commission Concerning the Conviction of Edward Charles Splatt, *Report* (CR Shannon QC), SA Govt Printer, 1984.
4. 144 Misc 2d 956 (NY 1989). See also *US v Two Bulls*, 918 F 2d 56 (8th Cir 1990).
5. See Lander, E.S., 'DNA Fingerprinting on Trial' (1989) 339 *Nature* 501 at 502.
6. At 503.
7. Lander, at 503.
8. Lander at 504-5.
9. Undoubtedly the statistical interpretation of the significance of results in the DNA profiling and other areas will be one of the greatest areas of forensic scrutiny in the immediate future.