DNA profiling (fingerprinting) has been widely heralded as a scientific breakthrough that will revolutionise forensic identification. But is it really as absolute and foolproof as previously thought?

By identifying distinctive patterns in genetic material, the DNA profiling test can determine with unprecedented specificity whether a given individual could have been the source of a biological specimen such as blood or semen stains, a small piece of tissue or even a single hair. DNA profiling promises to be particularly useful in criminal identifications because the test can 'type' samples too small or too old to be analysed by more traditional means. DNA profiling can also be used to establish family lines or parentage in disputed paternity cases.

It has been suggested that the margin of error is of the order of one in thousands of millions. Accordingly DNA profiling would appear to be a foolproof forensic identification test. However, a series of lawsuits in the United States of America, Australia and the United Kingdom as well as South Africa have shown otherwise and have indicated that DNA profiling is not as absolute or foolproof as previously thought.

A story, whose origins have been lost in the mists of time, has it that Julius Caesar, intending to grant amnesty to one of his mutineering army officers, issued the order: 'Execute not, liberate'. His message, however, was passed along with one small error; the comma was misplaced, so that the message which the officer's guard received read 'Execute, not liberate', and the unfortunate man lost his life.

All aspects of life depend on the accurate transmission of information. In life itself, as genetic messages are passed along through generations of individual cells even small mistakes can become life-threatening. In human beings the aberrant substitution of a single 'letter' in the genetic code is responsible for such lethal hereditary diseases as Huntington's chorea and thalassaemia. Several common cancers are also associated with a single letter change or point mutation as it is known.

For organisms as complex as human beings, attaining sufficient accuracy is a monumental task; the set of genetic instructions for human beings is roughly three thousand million (3 x 10^9) letters long and contains between 50 000 and 100 000 genes.

Background

Headlines in the media have focused on the use of DNA fingerprinting. The technique was initially developed by medical scientists and geneticists to investigate human hereditary diseases, but more recently the technique has been heralded as the solution to the positive identification of suspects in cases extending from murder to disputed paternity. Background information has been provided by the commercial DNA profiling companies not only in cases of homicide and disputed paternity, but also in cases involving rape, missing persons, assault, unidentified bodies, unsolved crimes and even hit-and-run cases.

In the United Kingdom, British immigration officials relied on the DNA test in the positive identification of a Ghanaian boy who wished to be reunited with his mother and fellow siblings in England and other law enforcement applications have followed. The technique can also be used in an exclusionary way as it was in one widely publicised murder case (Florida v Andrews CR 87/1400 Orlando 1987) which caused the media to call the test 'foolproof'. The DNA fingerprint, not unlike a 'supermarket bar code', led jurors to comment that they believed the test to be 'foolproof'. They found the defendant guilty when no rebuttal was offered to the DNA evidence.

However, courts on both sides of the Atlantic, and more recently in Australia, have remained cautious about the use of DNA fingerprinting as evidence, and reports in the media have begun to attract the notice of concerned United States courts.

In South Africa, in the Cape Province alone approximately 800 requests for DNA fingerprinting in disputed paternity cases were received by the Western Province Tissue Immunology Department at the University of Cape Town Medical School in 1991. Of their findings, none was placed before the then Cape Provincial Division for consideration. The cases were settled out of court on the basis of the blood tests alone.

Recognition by the courts of science and technology

DNA printing has been used in criminal cases since its 'debut' in 1985. In the United States, courts use either the Frye standard or relevancy standard of evidentiary review to determine the admissibility of novel scientific evidence.

It is suggested that neither of these standards provides sufficient protection against the premature admission of forensic DNA printing when applied with insufficient rigour. Courts applying both standards have admitted novel scientific evidence later proven to be unreliable. Moreover, the Frye and relevancy standards seem ill-equipped...
to address the complex issues associated with the use of DNA fingerprinting. This technology presents unusual problems in which quality assurance standards, fairness to criminal defendants and concerns about individual privacy must be considered. Because admissibility hearings are not designed to address these issues, courts have held DNA printing to be admissible despite a lack of impartial scientific validation, without requiring uniform standards of practice for crime laboratories or procedural safeguards for defendants, and with no explicit consideration for privacy rights. Thus there is growing criticism and pressure to recommend that legislature oversees the adoption of standards for DNA printing in legal cases.

**Forensic tests as evidence**

Ideally, a trial is a search for truth. To assist the court in this quest, the law allows qualified experts to testify and express opinions on matters in which they have been professionally trained. Yet the esoteric nature of the expert's opinions, together with the jargon and the expert's scholarly credentials, may cast an aura of infallibility over his testimony. Hence, to prevent the court from being unduly influenced by the questionable evidence of expert testimony, United States courts usually review the material in a pretrial hearing or alternatively in the absence of the jury.

To be admitted as evidence, a forensic test should, as a matter of common sense, satisfy three criteria:

- The underlying scientific principle must be considered valid by the scientific community.
- The validity of the technique applying that principle must be known to be reliable.
- The technique must be shown to have been correctly and properly applied to the case in question.

This last factor requires an examination of the condition of any instrumentation which is employed in the technique, adherence to proper procedure(s), the qualifications of the person(s) conducting the procedure(s), and the qualification(s) of the person(s) interpreting the results. The expression of common sense in a court of law, however, is at times elusive. The majority of United States courts decide on the admissibility of scientific evidence based on guidelines established in 1923 by *Frye v US* 293 P.1013 (DC Cir 1923).

In the past decade courts have faced the difficult task of ruling on the admissibility of evidence derived from a wide range of newly ascertained or applied scientific principles, for example neutron activation analysis, sound spectrometry (voice prints), psycholinguistics, atomic absorption, remote sensing and bite mark comparisons.

These are merely a few kinds of scientific evidence being used in the courts.

In addition, prior rulings on the admissibility of scientific evidence have been challenged. In some cases, previously rejected techniques, such as the polygraph and hypnotic evidence, have gained admissibility. In other cases, some well accepted scientific techniques such as radar and certain drug-testing procedures, have been challenged successfully.

Finally, the use of scientific knowledge to solve legal problems has long been recognised and it is not surprising that a society so dependent on science and technology should turn to such knowledge as a method of proof. However, the important point is not the cause of this development, but rather that the use of scientific evidence will continue and is likely to increase.

In *Frye v United States* the Court of Appeals for the District of Columbia affirmed a lower court's decision to exclude evidence derived from a precursor of the polygraph:

"Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this "twilight zone" the evidential force of the principle must be recognised, and while the courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, this thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs."

Judges, scientists, lawyers and legal scholars have all criticised the *Frye* standard. For many applications of forensic science, the underlying theory is well established, and the legal debate rages mainly over the question of whether one must prove only that a technique is generally accepted for scientific research or, more strictly, that the technique is reliable when applied to forensic science. Scientists commonly accept that when any technology is tried in a different application, such as forensic science, it must be tested thoroughly to ensure a thorough understanding of the technique's usefulness as well as its limitations. Indeed, many a technique that has proved reliable for research - polygraphy, for example - has turned out to be of questionable reliability when applied to forensic case work.

The often conflicting interests among individuals concerned create ethical and legal dilemmas which need to be addressed and resolved if the full potential of the proposed tests and DNA profiling are to be used to the full and if the interests of all parties are to be served equitably. One needs to be sure that fairness and beneficence is seen to be done and that a party is not prejudiced by unreliable or untested scientific evidence.

Chris Martin BSc (Hons) Biochem (Univ of Essex) (UK), BSc (Hons) Medicine (UCT) LLB (UDW), LLM (Natal Durban) is a candidate attorney in Durban.