Measure not on the Scale of Perfection

5th International Conference on Evidence Law and Forensic Science

Chief Justice Robert French AC
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The Chief Justice of South Australia, the Chief Justice of Tanzania, the Speaker of the Legislative Assembly of South Australia, Professor Zhang Baosheng, your Honours, members of the scientific and legal academies, ladies and gentlemen, thank you for asking me to address this 5th International Conference on Evidence Law and Forensic Science.

Three quotations frame this address about the interaction between scientific evidence and the judicial process and the limitations of each. The first quotation is from the German poet, philosopher, historian and playwright, Friedrich Schiller, who wrote:

> Let no man measure by a scale of perfection
> The meagre product of reality
> In this poor world of ours.[1]

What Schiller wrote might well encapsulate a modest approach to the results of applying scientific evidence to decision-making by courts. The premise of the saying is that reality, like the truth, is out there waiting to be discovered. Today, however, scientists question even the nature of reality. My second quotation is from one of the world's leading cosmologists, Leonard Susskind. In a *Scientific American* profile in 2014 he said:

> The way physics has been going reality is becoming difficult to defend.[2]

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1 Thomas Carlyle, *The Selected Works of Thomas Carlyle* (Bibliogtheca Cakravarti Foundation, 2014) 227.

2 Peter Byrne, 'Leonard Susskind: The Bad Boy of Physics' (2014) *Scientific American*, http://www.scientificamerican.com/article/bad-boy-of-physics-extreme-physics-special//.

Despite that pessimistic view courts have to accept reality as at least a working hypothesis, a necessary premise for the fact-finding process which is part of their function. But science is also sceptical about facts. Hence my third quotation from Stephen Jay Gould, who said:

> In science, "fact" can only mean 'confirmed to such a degree that it would be perverse to withhold provisional assent'.[3]

Plainly the fit between science and law is not to be measured by a scale of perfection. Nevertheless, it is the job of judges, lawyers and the legal and scientific academies to make the necessary engagement work as best they can.

Courts have to determine facts, in the face of uncertainty**,** in order to decide the cases they have before them. In a simple model the process of decision-making has three stages:

1. Identify the applicable legal rules.
2. Decide what the facts are on the basis of evidence before the court.
3. Apply the legal rules to the facts to determine the outcome of the case.

Science interacts with that decision-making process in different ways. A law may use scientific terminology. Sometimes it may use it wrongly or take it out of context. Some laws use factual terms which reflect out-dated concepts. In the criminal law, the concept of 'intention' is of critical importance. So too is the notion of a person's capacity to control their actions or to know the difference between right and wrong. Those are terms to which ordinary people give a non-scientific meaning and apply every day. But if psychiatrists or neurologists are called to give evidence, said to be relevant to intention or capacity to control actions, they may find a difficult interface between the contemporary science of the mind and the statutory language.

I mentioned that sometimes the law may use scientific terms erroneously. In 1975, a young American woman was charged under the *Customs Act 1901* (Cth) with importing into Australia a prohibited import, namely cannabis. The word 'cannabis' was defined in the Act as a cannabis plant or any part of a cannabis plant. A cannabis plant was defined as a plant of the genus cannabis sativa. That definition raised a difficulty because, according to the

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[3] Stephen Jay Gould, 'Evolution as Fact and Theory' (1981), republished in *Hen's Teeth and Horse's Toes* (Norton & Co, 1994) 254.

International Code of Botanical Nomenclature, it was not proper to describe a genus by the use of two words unless they were joined by a hyphen. Under the Code the second word 'sativa' denoted a species.

At that time there were many botanists, the monotypic tribe, who took the view that the genus cannabis had only one species, namely, cannabis sativa. There was another tribe of botanists, the polytypic tribe, who held that the genus contained other species, cannabis indica and cannabis ruderalis. Those species could be distinguished from cannabis sativa only by their leaf and branch distribution. The accused woman had brought her cannabis into Australia in the form of Buddha sticks. In that form the cannabis is dried and crushed and rolled up. It was not possible to determine whether it was cannabis sativa, cannabis ruderalis or cannabis indica. Her defence, therefore, was that the Crown could not prove that the imported plant was of the prohibited species. At trial, expert witnesses debated whether cannabis had only one species or more than one. Fierce debate had raged between the two tribes of botanists in a number of court cases in the United States. Nothing generates passion like taxonomy.

In the end the science was side-stepped. The trial judge decided that despite its wrong use of botanical classification, the definition of cannabis in the Act should be interpreted as applying to all species. That view was ultimately upheld in the High Court.[4] The Act was subsequently amended to make it clear that the cannabis plant referred to was a plant of the genus cannabis. That case focussed on the first step in the judicial process which I have described, namely the identification of the relevant rule of law. I represented the young woman concerned. I am able to tell the story because it was one of my defeats. It is rarely tasteful to speak of one's victories.

Sometimes a law requires a court to accept, without further inquiry, the outcome of a technical test or to presume as true a matter of fact which a scientist would not accept as true. Presumptions about the relationship between the amount of alcohol in a person's breath and the amount of alcohol in their blood, or about the rates at which alcohol is absorbed into the blood stream or eliminated from it, may fall into that category.

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4 *Yager v The Queen* (1977) 139 CLR 28.

In Western Australia there were regulations, in the 1970s, governing the use and evidentiary effect of breathalysers. The breathalyser readings were given presumptive force, as evidence of the concentration of alcohol in the blood. They depended upon an assumption about the relationship between the concentration of alcohol vapour in the breath sample and the concentration in the blood. This was called the 'partition coefficient' and was assumed to be 1500 to 1. The other assumption was used to calculate back from the time the test was administered to the time at which the accused had been last driving a motor vehicle. The assumption was that alcohol was absorbed into the blood stream at .016 per cent per hour for the first two hours after the last drink and eliminated at the same rate thereafter — a handy linear relationship fairly untypical of biological systems. That may have been because it was proposed to Government by the Chief Government Chemist. The Chief Government Pathologist, who had not been consulted about the assumptions, turned out to be a willing witness for the defence in such cases pointing out the variability in partition coefficients and of absorption and elimination rates in real people. He was a feisty Scotsman. On one occasion, in which he was giving evidence for the defence, he was asked by a frustrated police prosecutor whether there were not some people within his profession who disagreed with him. He said: 'There are peculiar people in every profession Sergeant, even yours.'

In the second stage of decision-making, finding the facts, cause and effect may be central to scientific testimony in courts. The problem is an acute one where scientific evidence demonstrates correlations between an event and an outcome expressed in probabilistic terms. Epidemiological evidence falls into that category. In such cases the scientific evidence does not necessarily present the court with a proposition that event X caused outcome Y, but rather that there is a statistical correlation between them which may or may not be sufficient to support a finding of a causal connexion by some inferred process.

A recent case involving epidemiological evidence concerned a smoker,[5] who died of lung cancer. He had been exposed to asbestos fibres in the course of employment with two different employers. Both the tobacco smoke and asbestos inhalation were capable of causing the cancer from which he suffered. No medical examination could show the cause of his cancer. Epidemiological evidence was not able to assign a probability greater than 23 per cent to the chance that his cancer was caused by exposure to asbestos with or without his also

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5 *Amaca Pty Ltd v Ellis* (2010) 240 CLR 111.

being exposed to tobacco smoking. Each witness who expressed a view on the matter assigned a probability of at least 67 per cent to the chance that the cancer was caused by smoking alone. The High Court held that causation was not established. The evidence proved nothing more than that exposure to asbestos might have been a cause of his cancer

A passage in the Court's judgment referred to the difference between the judge's function and that of the scientist:

> The courts' response to uncertainty arising from the absence of knowledge must be different from that of the medical practitioner or scientist. The courts cannot respond to a claim that is made by saying that, because science and medicine are not now able to say what caused [the**]** cancer, the claim is neither allowed nor rejected. The courts must decide the claim and either dismiss it or hold the defendant responsible in damages.[6]

So it can be said that in fact finding the courts are unable to measure on the scale of perfection.

Statistical and probabilistic evidence are the stuff of much scientific testimony today. There is sometimes a challenge in translating such evidence into material upon which a court may make a decision, especially when a lay jury is involved. A good example is in the use of DNA analysis to determine whether an accused person was the same person whose DNA was found at a crime scene. The way in which that evidence is explained to a jury may be challenged. In a murder prosecution an expert witness testified about a sample of mitochondrial DNA found in a hair under the fingernail of the deceased person. He compared that DNA sample with the DNA of the man accused of the murder. The expert said that one in 1600 people in the general population would share the DNA profile found in the hair. That evidence concerned what is called the 'frequency ratio' of the DNA sample. The expert also said that 99.9 per cent of people would not be expected to have a DNA profile matching that of the DNA taken from the hair. That evidence is called an 'exclusion percentage'. Both statements say quantitatively the same thing.

The accused on appeal in the High Court[7] argued that the exclusion percentage should not have been allowed to be put before the jury because it was unfair and prejudicial. He argued that subliminal effects could lead jurors to give greater weight to the 99.9 per cent

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6 Ibid 121–22 [6].

7 *Aytugrul v The Queen* (2012) 247 CLR 170.

figure than it deserved. There was no evidence of psychological studies which established that proposition. Nor was the Court prepared to take judicial notice of the proposition in such a way as to generally treat as inadmissible evidence of an exclusion percentage. The Court said:

> The exclusion percentage given was high — 99.9 per cent — but relevant content was given to that figure by the frequency ratios that were stated in evidence.[8]

In so saying however, the Court did observe that there might be cases in which evidence given of the exclusion percentage might be unfair.[9]

Not all scientific evidence is of equal merit. Courts have a gate-keeping function to ensure that expert opinions are based upon a proper body of science. The gate-keeping function has been around for a long time. It is interesting to look back to the first tentative consideration by courts of x-ray evidence and finger print evidence. The District Court of Colorado in *Smith v Grant,*[10] one of the first cases to deal with X-ray evidence, said in 1896 in rather rhetorical language:

> We have been presented with a photograph taken by means of a new scientific discovery the same being acknowledged in the arts and in the science. It knocks for admission at the temple of learning and what shall we do or say? Close fast the doors or open wide the portals?[11]

In the end the portals were opened.

A more sceptical approach was taken to fingerprint evidence by Chief Justice Madden in the Supreme Court of Victoria in 1912 when he said:

> We are asked to accept the theory that correspondence between two sets of fingerprints is conclusive evidence of the fact of the identity of the person who made those fingerprints as an established scientific fact standing on the same basis as the propositions of *Euclid* or other matters vouched for by science and universally accepted as proved.[12]

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8 Ibid at 184 [24].
9 Ibid at 186 [32].
10 29 *Chicago Legal News* 145 (26 December 1896).
11 Ibid.
12 *R v Parker* [1912] VLR 152, 154.

Evidence is not treated as admissible scientific or expert evidence just because it is given by a scientist. Last year the High Court heard a case about the admissibility of evidence of anatomical similarities between an accused person and the perpetrator of an armed robbery shown on closed circuit television footage committing the robbery. He was disguised wearing dark clothing covering his trunk and limbs and a covering of white material shrouding his head and face leaving only a narrow slit exposing his eyes. In holding that the evidence of anatomical similarities by a highly qualified professor of anatomy should not have been admitted, the Court said that the expert witness' opinion was not based upon his knowledge of anatomy. His knowledge that the human population includes individuals who have oval shaped heads and individuals who have round shaped heads when viewed from above, did not form the basis of his conclusion that the offender and the accused each had oval shaped heads. That was based on a subjective impression of what was seen upon examination of the images. The Court held that observation to apply to evidence of each of the characteristics of which the witness gave evidence. The evidence could have carried a weight it was not entitled to because it was given by an expert even though not based upon his expertise.

There is a continuing need to identify and articulate the proper limits of forensic scientific evidence, both on the part of scientists themselves by explaining those limits to the courts, and by the courts in dealing with their evidence.

Forensic science today provides techniques and tools for criminal investigation and prosecution that could scarcely be imagined even as recently as 25 years ago. It has the capacity to support determinations of guilt and innocence. But bad forensic science also has the capacity to seduce and mislead. A tragic Australian example was the Chamberlain case.[13] The judicial process did not discover the mistakes that led to the wrongful convictions in that case. It took a Royal Commission to do so. Improvements to the processing and handling of physical evidence, including preservation of original samples, have resulted from the errors uncovered in that case and other incidents.

Science and technology can be difficult and in some cases beyond the grasp of decision-makers who lack the essentials of a scientific education. Scientific literacy is central to modern decision making. It does not mean that all judges must have a science degree

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13 *Chamberlain v The Queen (No 2)* (1984) 153 CLR 521.

along with their law degree. But it does require that the courts have the capacity to assess scientific evidence and that there is ongoing education for judges in relation to areas of science and technology relevant to their decisions. It is also desirable that judges have some understanding of the processes by which discovery and invention proceed. The fit will never be perfect but hopefully better than 'meagre'.

My interest in science and the interaction of science and law dates back a long time. Nearly 40 years ago, as a newly minted lawyer who happened to have a science degree with a physics major, I was keen to take on cases which involved scientific questions. One such case concerned a young man riding a motor bike who was clocked at twice the speed limit by a radar gun. He insisted that he had only been travelling at the speed limit. The radar gun works by transmitting a radar beam at a certain frequency. When that beam hits a moving object it is reflected back and its frequency shifts upwards. This is called the Doppler Effect. The radar gun combines the reflected signal with the outgoing signal to produce a resultant frequency called the 'beat frequency' which is a function of velocity. According to that beat frequency, the gun produces a readout of speed.

I remembered from my basic physics that the speed of a wheel at the top is twice the speed at the axle. So if the motor bike were travelling at a speed 'V', the spokes at the top of the wheel would be travelling at the speed 2V relative to an external observer. Could this be the explanation for the disputed reading? Had some of the reflected beam come off spokes travelling at twice the speed limit even though the bike itself was travelling within the law? Could my client have been telling the truth? I engaged the services of a PhD student. We brought to court a bicycle wheel, a radio frequency generator and a couple of oscilloscopes. The magistrate was transfixed by the evidence. However, he didn't know very much about physics. In the end he said he would rely upon the policeman's personal estimate of the speed and convicted my client. He was probably right to do so. His approach had the virtue that he did not have to judge the difficult science put before him. For the most part, however, scientific questions cannot be so easily side-stepped by the courts. Every day, judges are asked to judge science and scientists are asked to explain it.

This Conference brings together the cultures of the law and science. Meetings such as this are indispensible to the challenge of making their interaction effective for the great

purposes of doing justice according to law. It has been a privilege to be asked to address you on that topic.