

"THE INTERACTION BETWEEN SCIENCE AND LAW –
LEGAL SCIENCE OR A SCIENCE OF LAW"

Introduction

What do cannabis sativa¹, viagra², carcinogens and epidemiology³, the BRCA1 polypeptide⁴, and a Norwegian roll-on/roll-off container ship⁵ have in common? The answer is Chief Justice Robert French, the judge and lover of science.

Chief Justice French graduated from the University of Western Australia with a Bachelor of Science in Physics and, in 1964, was one of two students from Western Australia to attend the International Science School, then known as the Nuclear Research Foundation Summer Science School, at the University of Sydney⁶. His love for, and understanding of, science has permeated his judicial writing and his legal method.

* Justice of the High Court of Australia. The author acknowledges the assistance of her Associate, Simon Frauenfelder, in the preparation of this paper. The errors are the author's alone.

¹ *Yager v The Queen* (1977) 139 CLR 28; [1977] HCA 10.

² *Pfizer Overseas Pharmaceuticals v Eli Lilly & Co* (2005) 225 ALR 416.

³ *Amaca Pty Ltd v Ellis* (2010) 240 CLR 111; [2010] HCA 5; *Amaca Pty Ltd v Booth* (2011) 246 CLR 36; [2011] HCA 53.

⁴ *D'Arcy v Myriad Genetics Inc* (2015) 89 ALJR 924; 325 ALR 100; [2015] HCA 35.

⁵ *Ruddock v Vadarlis* (2001) 110 FCR 491.

⁶ See French, "From Light and Life to Genes to Galaxies: 45 Years On", speech delivered at International Science School, Sydney, 13 July 2009 at 1.

The intersection, and at the point of intersection – the interaction – between science and law was and remains of considerable interest to Chief Justice French. His Honour has and retains a deep interest in science, the problems science raises for judicial decision making and the implications scientific method has for the law, legal reasoning and legal method.

In a speech his Honour gave in 2011, titled "Judging Science", his Honour noted that⁷:

"There are interesting questions about differences between legal method and scientific method and whether they can ever properly mesh or are fated to be like ships passing in the night."

There are clearly differences between legal and scientific method, if "legal method" is understood as how judges decide cases. Structural features of the judicial role mean that legal method must be different from scientific method in at least two ways. First, in ascertaining the relevant rule of law, a judge must take into account a wider range of considerations than the conclusions of scientific fact, even if those scientific conclusions appear to provide a clear answer to the question at hand. Legal method necessarily has additional evaluative components that are largely absent from scientific reasoning.

Second, a judge is constrained by the binary notion of a fact being proved to the sufficient legal standard or the fact not being proved. There is no room for the nuanced, qualified and incremental conclusions that typify scientific reasoning and research. This clearly affects how cases are to be decided.

⁷ French, "Judging Science", speech delivered at the 13th Greek/Australian International Legal and Medical Conference, 30 May 2011 at 2.

However, those differences mask a fundamental similarity between legal and scientific method, which emerged as scientific method transformed law into a rigorous, empirically-based discipline. The scientific advances of John Locke, Isaac Newton and others in the 17th and 18th century had a transformative effect on law by influencing crucial legal doctrines such as precedent and the criteria by which facts are proved.

And the influences of those advances stretch to the present day. Those advances changed how we *think about* law. They changed our mindset towards considering law *as a science* – as a "coherent, systematic body of knowledge, combining particular facts with general principles"⁸. Like the observations and results of chemistry or physics experiments, individual cases became data and evidence by which law could be ordered into a body of overarching principles. When the facts of new cases presented difficulties for those principles, the principles were to be reconsidered, either to reaffirm the principles as they stood or to recast them to take account of the new or different facts of a case. By this process of empirical testing, the principles were further and continually refined. This is the true interaction between law and science, and is science's great gift to law – science has supplied a way of approaching the task of judicial reasoning; a way of building on the knowledge of the past; and, put more simply, a way of thinking.

This paper will address the interaction between science and the law under the following four headings – the interaction (and differences) between scientific method and legal method; the scientific transformation of legal method; legal uncertainty and the lessons from scientific method; and, finally, law as a science – judging through scientific analysis. And it will do so by reference to the work of Robert French.

⁸ Berman and Reid, "The Transformation of English Legal Science: From Hale to Blackstone", (1996) 45 *Emory Law Journal* 437 at 440.

Why? Because Robert French's work at the bar, as a judge and his extra-curial writings show a unique appreciation for both the apparent differences, but also the deep similarities between scientific and legal method.

The interaction (and differences) between scientific method and legal method

The law has long observed the importance and relevance of scientific evidence to the legal method, and the resolution of disputes. In the 1554 case of *Buckley v Thomas*, Saunders J acknowledged that the law is not jealously guarding of all wisdom, and properly acknowledged the expertise of others⁹:

"And first I grant, that if matters arise in our law which concern other sciences or faculties, we commonly apply for the aid of that science or faculty which it concerns. Which is an honourable and commendable thing in our law. For thereby it appears that we do not despise all other sciences but our own, but we approve of them and encourage them as things worthy of commendation."

But in order to understand how, and to what extent, scientific method and legal method interact, we should first understand what is meant by "legal method". On more than one occasion¹⁰, Chief Justice French has posed a three-step model of judicial decision-making and legal method:

1. Identify the relevant rule of law;
2. Determine, after hearing the evidence, what the facts are; and then.
3. Apply the rule of law to the facts to determine the rights and liabilities, if any, of the parties to the case.

⁹ *Buckley v Thomas* (1554) 1 Plowden 118 at 124; [75 ER 182] at 192.

¹⁰ French, "Science and Judicial Proceedings – Seventy-six Years On", (2009) 17 *Journal of Law and Medicine* 206 at 211; French, "Judging Science", speech delivered at the 13th Greek/Australian International Legal and Medical Conference, 30 May 2011 at 3.

However, as the Chief Justice wisely noted, with any "apparently simple" model "complexity may arise in its application"¹¹. Scientific concepts and evidence are properly called in aid of this process, but for reasons related to a judge's structural position and the nature of the decisions they need to make, the scientific method and its results cannot always provide the complete answer to the issues the courts must decide. To make good that proposition, it is necessary to consider each step separately.

Step 1 – Identifying the relevant rule of law

The first step, the task of identifying the relevant rule of law, carries with it the difficulties of interpretation of cases, statutes and extrinsic materials. These sources, called in aid by the parties, provide competing solutions, each with different claims to be the correct way of resolving particular difficulties. This is particularly so where the relevant rule is to be identified from statute. As Chief Justice French has commented¹²:

"The problems of interpretation thrown up by statutory language are not solved as one can solve a simple linear equation which has only one solution. *They are not scientific problems.* Language is plastic and nuanced and has a history. For most words there is more than one core meaning." (emphasis added)

Often, science can provide one, among a number, of competing answers. The scientific answer may have the benefit of being clear, empirically tested to a high degree of certainty, and the subject of cogent expert evidence. These features provide a strong logical reason to accept it. But the considerations that attend the judge's task of interpretation extend beyond what may be directly established by empirical evidence, and include evaluative reasoning.

¹¹ French, "Science and Judicial Proceedings – Seventy-six Years On", (2009) 17 *Journal of Law and Medicine* 206 at 211.

¹² French, "Science and Judicial Proceedings – Seventy-six Years On", (2009) 17 *Journal of Law and Medicine* 206 at 211.

This point can be illustrated first by a well-known and simple example from the United States. In *Nix v Hedden*¹³, decided by the United States Supreme Court in 1893, the single question for determination was "whether tomatoes ... [were] to be classed as 'vegetables' or as 'fruit', within the meaning of the Tariff Act of 1883"¹⁴. Evidence was given of the meaning of "fruit" as the "seed of plants, or that part of plants which contains the seed, and especially the juicy, pulpy products of certain plants, covering and containing the seed". Clearly, the seed-bearing tomato met this definition.

However, for Gray J, who delivered the Court's reasons, the "botanical" meaning of fruits and vegetables was not to the point, and not determinative of the question:

"Botanically speaking, tomatoes are the fruit of a vine, just as are cucumbers, squashes, beans and peas. But in the common language of the people, whether sellers or consumers of provisions, all these are vegetables, which are grown in kitchen gardens, and which, whether eaten cooked or raw, are, like potatoes, carrots, parsnips, turnips, beets, cauliflower, cabbage, celery and lettuce, usually served at dinner in, with or after the soup, fish or meats which constitute the principal part of the repast, and not, like fruits generally, as dessert."

In short, the pragmatic, or real world, trumped the science.

The second example is closer to home - *Australian Competition and Consumer Commission v Coles Supermarkets Australia Pty Ltd*¹⁵, which concerned whether advertising the bread as "baked today, sold today" or "freshly baked" was misleading or deceptive in circumstances where the bread had been par-baked some time in advance, frozen, and then returned to the oven a short time before sale. In that case, the parties agreed that when placed in the oven shortly

¹³ 149 US 304 (1893).

¹⁴ *Nix v Hedden* 149 US 304 at 306 (1893).

¹⁵ (2014) 317 ALR 73.

before sale, the par-baked products underwent what is known as the "Maillard reaction" – a common chemical reaction caused by the breakdown of sugar and its interaction with amino acids, which has the effect of creating flavour and changing the colour of food. Here, when placed in the oven the products became hot, their exterior became darker and harder, their interior became softer and lighter and the products "developed a strong 'bread' aroma"¹⁶. For that reason, "there was no dispute that the process of heating at Coles of the par-baked bread [could] be legitimately described as baking"¹⁷.

But that was certainly not the end of the matter. The ACCC's case was that advertising of the bread as "freshly baked" meant that consumers were likely to form the erroneous impression that the bread products had recently been prepared from scratch¹⁸. In the end, the Court found that there had been a misleading representation that the goods had been baked on the day of sale, using fresh, not frozen product, noting that the "analysis is a factual one, evaluative in character, by reference to the available meaning and connotation of general marketing expressions"¹⁹.

These simple, and some may say obvious, examples point to a more important consideration: that there remains in the process of legal method and judicial decision-making the need for evaluative reasoning, rather than direct acceptance of observable outcomes that may appear to determine the question. What may, on first blush, appear to be an answer to the question may be determinative of the *scientific* but not the *legal* question; it may be the answer to a different question; it may only provide a partial answer to the relevant

¹⁶ (2014) 317 ALR 73 at 78 [26], 84 [59].

¹⁷ (2014) 317 ALR 73 at 78 [27].

¹⁸ (2014) 317 ALR 73 at 80 [34].

¹⁹ (2014) 317 ALR 73 at 100 [159]-[160].

question; or it may be an answer arrived at only by reference to a constrained set of factors.

Chief Justice French is familiar with this gap between scientific knowledge and legal outcomes. I will refer to three examples — one from his time at the bar, one from his time on the Federal Court and the other from his time as Chief Justice.

The first is the 1977 High Court decision of *Yager v The Queen*²⁰, which concerned an appeal by a young woman convicted of possessing a prohibited import, namely a quantity of cannabis. The Chief Justice recently recounted this decision in a speech to the Greek/Australian International Legal and Medical Conference. However, one detail omitted from that speech that does appear in the Commonwealth Law Reports is that one "R.S. French" appeared as junior counsel for the young woman, even taking responsibility for reply submissions.

The case concerned a young woman who arrived in Fremantle as a passenger on a ship called the "Kota Singapura". At her trial, she admitted that upon arrival she was in possession of plant material "of the genus Cannabis" but she disputed that the plant material was a "prohibited import" within the meaning of the *Customs Act 1901* (Cth). The basis of her argument was a scientific one, and was summed up by Barwick CJ²¹:

"If, upon its proper construction, the statute rendered *all* plant material of the genus cannabis a prohibited import, there was no other question to be considered, for as I have said the applicant admitted that the material in her possession and which she had imported was plant material of the genus cannabis. If, on the other hand, the statute on its true construction only rendered *one* particular species of the genus cannabis, namely, what

²⁰ (1977) 139 CLR 28.

²¹ *Yager* (1977) 139 CLR 28 at 33.

was said to be the species *cannabis sativa*, then there was, in my opinion, no evidence that the plant material in the possession of and imported by the applicant was plant material of that species." (emphasis added)

"Cannabis" was relevantly defined in the statute as a "cannabis plant", which was in turn defined as "a plant of the genus *Cannabis sativa*". As the Chief Justice noted in his speech, "[t]hat definition raised a difficulty" because "according to the 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*" (emphasis added)²². A botany professor gave evidence that "*cannabis sativa*" was merely one of three species of cannabis within the overall genus cannabis, such that one could not properly speak of the "genus *cannabis sativa*"²³. The species of the plant material in question could not be determined as it had been crushed and rolled.

Unfortunately for the young woman, and for the young R.S. French, the trial judge, the Court of Criminal Appeal and a majority of the High Court held that the reference to "*genus cannabis sativa*" although potentially scientifically incorrect, was intended to mean and did mean any plant within the genus cannabis. Mason J emphasised that where Parliament had intended to prescribe a genus, the statute could not be interpreted to prescribe a species²⁴:

"At best the applicant's case is that Parliament was mistaken in treating *cannabis sativa* as a genus, but this cannot alter the circumstance that Parliament prescribed a genus; it does not allow us to say that Parliament prescribed a species."

²² French, "Judging Science", speech delivered at the 13th Greek/Australian International Legal and Medical Conference, 30 May 2011 at 4.

²³ *Yager* (1977) 139 CLR 28 at 41-42.

²⁴ *Yager* (1977) 139 CLR 28 at 45.

Only Murphy J found in favour of the young woman, holding that there "is a strong presumption that Parliament, when it uses scientific terms on a technical subject uses them correctly"²⁵.

A similar lesson was learned in *Pfizer Overseas Pharmaceuticals v Eli Lilly & Co*²⁶, a hard fought patent appeal that Chief Justice French decided in his time on the Federal Court. In that case, certain claims in the Viagra patent were held to be invalid because, although Pfizer had established by way of complex scientific evidence that the claims involved an inventive step, the claims did not meet the separate requirement that the claims be fairly based on the matter described in the patent specification²⁷. Science provided part, but not all, of the answer to the legal question.

The third example is the plurality decision in *D'Arcy v Myriad Genetics Inc* in the High Court²⁸. That case involved a number of claims within a patent held by Myriad over an isolated nucleic acid BRCA1-polypeptide, which could be used to ascertain genetic predispositions to breast cancer and ovarian cancer. Both the primary judge²⁹ and the Full Federal Court³⁰ had confirmed the validity of the claims, finding that the isolated nucleic acid met the requirements for the subject matter of a patent, being a "manner of manufacture" under s 18(1)(a) of the *Patents Act* 1990 (Cth). In doing so, the Full Court had relied upon a particular reading of the High Court decision in *National Research Development Corporation v Commissioner of Patents*³¹, finding

²⁵ *Yager* (1977) 139 CLR 28 at 50.

²⁶ (2005) 225 ALR 416.

²⁷ (2005) 225 ALR 416 at [404] 498.

²⁸ (2015) 89 ALJR 924; 325 ALR 100.

²⁹ *Cancer Voices Australia v Myriad Genetics Inc* (2013) 99 IPR 567.

³⁰ *D'Arcy v Myriad Genetics Inc* (2014) 224 FCR 479.

³¹ (1959) 102 CLR 252; [1959] HCA 67.

that an "artificially created state of affairs" had been created because the scientific evidence established that there were "structural" and "functional" differences between the isolated nucleic acid and the nucleic acid in its naturally occurring form within the body³².

The scientific differences observed by the Full Court were undoubtedly there. The scientific evidence established it. The plurality – French CJ, Kiefel, Bell and Keane JJ – characterised the Full Court's reasoning as follows³³:

"The approach taken by the Full Court and urged by Myriad involves an apparently straightforward characterisation based on the formal terms of the patent identifying the isolated nucleic acids as products which, notwithstanding their derivation from naturally occurring DNA, have been brought into existence by human artifice and, in that sense, 'made'. So characterised, *and without further inquiry into the breadth of the claims or their substance*, they could be seen to fall comfortably within principles attracting characterisation as a manner of manufacture. *None of the purposive or policy factors mentioned earlier in these reasons need be considered on that approach.*" (emphasis added)

However, those scientific differences were not the whole story. The legal method and the judicial decision-making required more. It required that the Court consider the context of the method of manufacture, the coherency of patent law, and the effect that recognition of the claims would have on medical research. For the plurality, where any "new class of claim involves a significant new application or extension of the concept of 'manner of manufacture'", there had to be deep engagement with "factors connected directly or indirectly to the purpose" of the *Patents Act*³⁴. The plurality expanded the two factors previously considered in *NRDC* to a six-factor test – whether patentability would be consistent with the purposes of the Act, whether patentability would enhance

³² *D'Arcy v Myriad Genetics Inc* (2014) 224 FCR 479 at 517 [212]-[213].

³³ *D'Arcy* (2015) 89 ALJR 924 at 947 [87]; 325 ALR 100 at 130.

³⁴ *D'Arcy* (2015) 89 ALJR 924 at 936 [28]; 325 ALR 100 at 114.

or detract from the coherence of the law, the impact of international obligations and the patent laws of other countries, as well as whether patentability would involve law-making of a kind which should be done by the legislature³⁵.

So what do these examples teach us? They point to the fact that in identifying a rule or legal principle, the process of legal method and judicial decision-making requires evaluative reasoning rather than simply direct acceptance of observable outcomes that may appear to determine the question from a scientific perspective.

Steps 2 and 3 – Determining the facts and applying them to the law

There is also a necessary difference between legal and scientific method in the conclusions that a court must draw in circumstances where the existence or proof of facts is less than certain. In the scientific sense, to speak of a "fact" being "certain" outside the world of proofs of logic and pure mathematics is, to borrow a term, to commit a heresy. In a celebrated and popular quote, the palaeontologist and biologist Stephen Jay Gould once said³⁶:

""[F]act' does not mean 'absolute certainty'. The final proofs of logic and mathematics flow deductively from stated premises and achieve certainty only because they are *not* about the empirical world ... In science, 'fact' can only mean 'confirmed to such a degree that it would be perverse to withhold provisional assent.' I suppose that apples might start to rise tomorrow but the possibility does not merit equal time in physics classrooms." (emphasis in original)

Science has accepted uncertainty and developed methods and tools for dealing with it. One example is the confidence interval which, in basic terms, is used to express a range of values and a level of likelihood that a given result within the underlying population will be within that range. It acknowledges

³⁵ *D'Arcy* (2015) 89 ALJR 924 at 936 [28]; 325 ALR 100 at 114-115.

³⁶ Gould, *Hen's Teeth and Horse's Toes*, 1st ed (1983) at 254-255.

that extrapolations from observed data have limitations, but seeks to understand and quantify those limitations. Science even goes so far as to *embrace* uncertainty, because that is where advances in understanding and application can be made. As a recent UK report on the role of uncertainty in science stated³⁷:

"For the most part, settled science is not what scientists spend time thinking about, questioning or researching. Researchers aspire to add something new to what we know. *Uncertainty is what they are interested in.*" (emphasis added)

To put it lightly, courts are less interested in uncertainty, especially with respect to the proof of factual matters. I will come later to consider the implications of how we came to understand facts as always less than certain. But for present purposes, it is important to note that a court must, in finding facts, find that a fact is proven or that it is not. There is no shade of grey. The factual inquiry must have a binary, dichotomous, black-and-white outcome.

This causes particular problems in the court's determination of causation. The difference here between legal and scientific method was important in two cases decided by the High Court in 2010 and 2011, both concerned with exposure to asbestos. It is instructive to consider the latter case first – the 2011 decision of *Amaca Pty Ltd v Booth*³⁸.

Mr Booth developed mesothelioma at around age 50. He had been exposed to asbestos briefly as a child and while loading a truck³⁹, but the bulk of his exposure came during his 30 years as a motor mechanic, where he would

³⁷ Sense About Science, "Making Sense of Uncertainty: Why Uncertainty is Part of Science", (2012) at 6.

³⁸ (2011) 246 CLR 36.

³⁹ *Booth* (2011) 246 CLR 36 at 42-43 [9].

regularly drill and grind brake linings and thereby release asbestos dust⁴⁰. 70% of the asbestos fibres he had been exposed to came from brake linings manufactured by Amaca and Amaba (formerly James Hardie companies), and those brake linings contained one specific type of asbestos fibre – namely, "chrysotile"⁴¹.

The issue for the High Court was whether there was sufficient evidence to support the primary judge's finding that exposure to asbestos in the brake linings manufactured by Amaca and Amaba had caused Mr Booth's mesothelioma⁴².

By a four to one majority, the Court found there was sufficient evidence. The Chief Justice delivered separate reasons, in which his Honour gave important consideration to when a statistical correlation between one event (exposure) and another event (developing mesothelioma) would suffice to prove causation. Importantly, it is the existence of a causal relationship of some kind that must be demonstrated. But once some causal connection is proved – even if only a "mere possibility" or "real chance" – then a causal connection may be established. His Honour said⁴³:

"However, if the association between two events is shown to have a causal explanation, then the conclusion may be open, if the second event should occur, that the first event has been at least a contributing cause of that occurrence. An after-the-event inference of causal connection may be reached on the civil standard of proof, namely, balance of probabilities, notwithstanding that the statistical correlation between the first event and the second event indicated, prospectively, no more than a 'mere possibility' or 'real chance' that the second event would occur given the first event."

⁴⁰ *Booth* (2011) 246 CLR 36 at 43 [10]-[11].

⁴¹ *Booth* (2011) 246 CLR 36 at 43-44 [12]-[13].

⁴² *Booth* (2011) 246 CLR 36 at 50 [32].

⁴³ *Booth* (2011) 246 CLR 36 at 54 [43].

It was enough that expert evidence established some causal connection, even though the expert – a professor of pathology – admitted that his "opinion [was] not given at a high order of confidence because of the controversy over this issue in the scientific literature at present"⁴⁴. Further, the finding of causation was despite epidemiological evidence that suggested that the likelihood of mechanics developing mesothelioma was not necessarily greater than other sections of the population⁴⁵.

The contrast is the Court's 2010 decision in *Amaca Pty Ltd v Ellis*⁴⁶. That case involved the death of a man from lung cancer at the age of 45. He had smoked for 26 years before his diagnosis. He was exposed to asbestos in 1975 and 1978, and again from 1990 to 2002⁴⁷. His estate succeeded at first instance and on appeal against the manufacturer and his employer, but lost in the High Court. The crucial difference from *Booth* was that, in *Ellis*, there was no direct evidence as to why he developed lung cancer – there was only epidemiological evidence that assigned a maximum probability of 23% that asbestos exposure caused his cancer, with or without smoking. Causation could only therefore be inferred⁴⁸.

The Court's unanimous decision made the following important comments about the difference between the conclusions that a medical practitioner or scientist may reach, and those that a court is *required* to reach⁴⁹:

⁴⁴ *Booth* (2011) 246 CLR 36 at 56 [46].

⁴⁵ *Booth* (2011) 246 CLR 36 at 47 [22]-[23].

⁴⁶ (2010) 240 CLR 111.

⁴⁷ *Ellis* (2010) 240 CLR 111 at 121 [3]-[4].

⁴⁸ *Ellis* (2010) 240 CLR 111 at 131 [47].

⁴⁹ *Ellis* (2010) 240 CLR 111 at 121-122 [5]-[6].

"When, as here, medical and scientific examination cannot say whether exposure to respirable asbestos fibres was a cause of Mr Cotton's cancer, the medical practitioner and scientist have little choice but, as one witness said at trial, to 'take it into consideration in looking at what *might* have caused his lung cancer'. In their inquiries, the uncertainty about cause means that they cannot 'exclude it from the end result'.

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 Mr Cotton's 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." (emphasis in original)

These judgments record the significant difference between judicial certainty and the heresy that concept would attract from a scientific perspective.

The scientific transformation of legal method

Having identified marked differences between legal and scientific method, one could think that while science has its utility in providing important evidence to assist in making judicial decisions, the disciplines have structural differences that push them apart, and limit their interaction.

That is not the case. Legal method and, in particular, the process of judging have important features in common with scientific method and inductive reasoning. What has been described as "the scientific transformation of legal method". In his celebrated collection *Essays in Jurisprudence and Ethics*, 19th century jurist Sir Frederick Pollock drew important and incisive parallels between the common law structures of precedent and the inductive processes of scientific reasoning. In Pollock's words, he sought "to show that these operations have a truly scientific character, and that English case-law may fairly

claim kindred with the inductive sciences"⁵⁰. It is worth understanding his thesis and observations.

Pollock observed that scientific method and the system of "English case-law" shared two fundamental elements. The first element was a commonality of purpose. For Pollock, the "ultimate object" of science was the prediction of events – to take observations and to generate hypotheses in order "to say with approximate accuracy what will happen under given conditions"⁵¹. The same, he said, was true of law but that the "particular kind of events it seeks to predict are the decisions of courts of justice"⁵². Given a set of facts and conditions, one might use the generally derived principles of law to predict how a court would decide the given issue.

This observation is, to us today, logical and unsurprising. The aim of "prediction" is the foundation of legal advice given to all clients and the process followed in shaping submissions made to a court. In the process of judging, courts decide cases consistently with authority by – at least implicitly – considering how the case at hand would be decided based on existing authority. As with science, the accuracy of the prediction depends, in part, on the degree of similarity between the facts in issue and those originally leading to the outcome previously tested and observed.

The second element is that both rely on a fundamental and necessary assumption as to the uniformity of phenomena. In the sciences, the traditional assumption is that nature is uniform, and that we may safely believe that "whenever the same conditions are repeated they will give the same result"⁵³.

⁵⁰ Pollock, *Essays in Jurisprudence and Ethics* (1882) at 238.

⁵¹ Pollock, *Essays in Jurisprudence and Ethics* (1882) at 238.

⁵² Pollock, *Essays in Jurisprudence and Ethics* (1882) at 238.

⁵³ Pollock, *Essays in Jurisprudence and Ethics* (1882) at 239.

No less in the law. It may be taken for granted that fairness under the law – indeed the rule of law itself – requires that like cases be treated alike. It is also necessary that for any prediction to be possible, we must assume that given the same (or not dissimilar) facts and circumstances, the same judicial outcome will result.

As Pollock observes, this assumption is given life and made possible by the doctrine of precedent – "an understanding that the court should follow the authority of decisions formerly given on similar facts"⁵⁴. It is reinforced by the existence of a court hierarchy, whereby courts of appeal are empowered to give binding pronouncements of the law to correct errors and inconsistencies resulting from the courts below.

Pollock acknowledges weaknesses in this fundamental assumption in law. It stands to reason that any system that involves human action will create inconsistencies and anomalous decisions. And in a system in which the parties choose whether to appeal a judgment, inconsistencies and anomalies will stand unchallenged and uncorrected. These considerations do not undermine the assumption as a whole, or make it any less a necessary feature of the system of judging.

But Pollock does more than simply address this weakness. He posits that it is in fact greater proof of legal method as a form of science. Pollock argues that, because lawyers are so acutely aware of the potential for uncertainty and the influence of multiple factors on any issue and determination, their approach and advice that *accounts for* that uncertainty is proof positive of the scientific nature of their reasoning. In Pollock's own

⁵⁴ Pollock, *Essays in Jurisprudence and Ethics* (1882) at 240.

words, such reasoning is "not the less but the more scientific in proportion as they recognise the approximate character of all scientific assertion"⁵⁵.

However, the fact of similarity between judicial method and scientific method is not the whole story. The commonality of elements is not coincidental. Science holds a greater significance for law than simply an analogous process of reasoning. From an historical perspective it is evident that the very analytical frameworks we use today in our legal reasoning rely intrinsically on the influence of science. In particular, we must appreciate the influence that the scientific advances of the 17th and 18th century had, and continue to have, on how we think about and practice law. They were and remain of critical importance to legal method.

The changes to law in the 17th and 18th century can be generally described as a move from a "*philosophy* of law" to a "*science* of law". The 19th century United States politician, jurist and judge, Peleg Sprague, summed up the change from philosophy to science in a classic lecture titled "The New Science of Law"⁵⁶:

"Philosophy, in its original sense, is the love of knowledge, and implies the mental state of the seeker of truth. Science is strictly knowledge itself, or the result of the seeking of truth. But philosophy is objectively related to the discovery of causes, and to the antecedents of phenomena; while science is subjectively related to the deductions from the results of the investigation of phenomena."

In a more specific sense, I prefer the central thesis of a comprehensive and fascinating article published in 1996 by two scholars, Harold Berman and Charles Reid, titled "*The Transformation of English Legal Science: From Hale to*

⁵⁵ Pollock, *Essays in Jurisprudence and Ethics* (1882) at 256.

⁵⁶ Sprague, *The New Science of Law: An Introduction to the Principles of Legology*, (1875) at 3-4.

*Blackstone*⁵⁷. Their work observed two fundamental changes in the conception of scientific knowledge and method in the late 17th and early-to-mid 18th century, best expressed in the work of Isaac Newton and John Locke.

Those changes were:

1. the rise of inductive processes of reasoning, whereby general principles were derived and refined based on methodical empirical observation; and
2. a rejection of absolute truth or certainty as the object or goal of scientific inquiry, and the consequential acceptance that scientific knowledge and principles are inherently uncertain.

Those changes in methods, Berman and Reid argued, in turn influenced the development of two of the most fundamental aspects of legal method – the doctrine of precedent and the criteria for the proof of facts. In doing so, advances in science transformed English law, bringing into effect a conception of law *as a science* – namely, "a coherent, systematic body of knowledge, combining particular facts with general principles"⁵⁸.

In order to understand the importance of these changes, it is first instructive to consider the position before these changes. Even in a paper of this length, such consideration must work at a level of some generalisation, but such an understanding is both instructive and necessary.

Prior to the 17th century, the proper aim of scientific reasoning was to obtain certain, immutable knowledge of things and phenomena. A key influence on this thinking was the Aristotle's notion, stated in his *Posterior*

⁵⁷ Berman and Reid, "The Transformation of English Legal Science: From Hale to Blackstone", (1996) 45 *Emory Law Journal* 437.

⁵⁸ Berman and Reid "The Transformation of English Legal Science: From Hale to Blackstone", (1996) 45 *Emory Law Journal* 437 at 440.

Analytcs, of seeking knowledge by processes of deductive logic, whereby one understands a phenomenon by reasoning from an existing and accepted premise. Aristotle stated in his *Posterior Analytics* as follows⁵⁹:

"We suppose ourselves to possess unqualified scientific knowledge of a thing ... when we think that we know the cause on which the fact depends, as the cause of that fact and no other, *and further, that the fact could not be other than it is.*" (emphasis added).

The influence of this conception continued even into the work of Rene Descartes in the early to mid-17th century. Although not accepting Aristotle's view completely, the Cartesian method involved reasoning from existing unchallengeable premises – the most famous being the "cogito" – using rigorous logic and proofs to deduce further absolute truths.

One change of focus came with the work of Francis Bacon. He made known his distaste for the methods of the ancient Greeks and, impliedly, Descartes. He, quite cuttingly, stated⁶⁰:

"Yet they themselves, by only employing the power of the understanding, have not adopted a fixed rule, but have laid their whole stress upon intense meditation, and a continual exercise and perpetual agitation of the mind."

Bacon was more concerned with an empirical method that focused on observation, and that applied inductive logic to create generalised principles *based on those observations*. He described the aim for his method as being to "open and establish a new and certain course for the mind from the first actual

⁵⁹ Aristotle, "Posterior Analytics" in McKeon (ed), *The Basic Works of Aristotle*, (1941) at 111-112.

⁶⁰ Bacon, "Novum Organum" in Maontagu (ed), *The Works of Francis Bacon*, (1848) vol 3 at 343.

perceptions of the senses themselves"⁶¹. However, in substance, Bacon's method still sought certain and immutable knowledge – certain conclusions about the state of the world⁶²:

"The sciences, on the contrary, require a form of induction capable of explaining and separating experiments, and *coming to a certain conclusion by a proper series of rejections and exclusions.*" (emphasis added).

It is at this point that the ideas of Newton and Locke appear. Berman and Reid suggest that their influence was so great because of their departure from these existing ideas – they "denied altogether the capacity of the human mind to achieve absolute truth and, instead, emphasised various empirical methods of achieving various degrees of probability in various fields of knowledge"⁶³. By acknowledging these realities and the inevitable fact that knowledge will never be complete and principles will never be perfect, this shift in thinking turned science – and eventually, the law – towards rigorous examination and re-examination in order to do the best it could.

First, the influence of empirical method. Newton proposed a theory or method of knowledge based on three major steps:

1. the derivation of general laws or principles from empirical evidence;
2. the extension of these principles from mathematical procedures; and

⁶¹ Bacon, "Novum Organum" in Maontagu (ed), *The Works of Francis Bacon*, (1848) vol 3 at 343.

⁶² Bacon, "Great Instauration" in Maontagu (ed), *The Works of Francis Bacon*, (1848) vol 3 at 339. See also Osler, "John Locke and the Changing Ideal of Scientific Knowledge", (1970) 31 *Journal of the History of Ideas* 3 at 4-5.

⁶³ Berman and Reid, "The Transformation of English Legal Science: From Hale to Blackstone", (1996) 45 *Emory Law Journal* 437 at 497.

3. the deduction of as yet unaccounted for facts from the general statement of the theory⁶⁴.

The parallels with the doctrine of precedent and the incremental development of the common law are clear. First, cases (as empirical evidence of what has gone before) are analysed to determine the existence of more generalised rules and principles. Second, those rules and principles are applied and, where appropriate, extended by logic and analogy if they hold valid. Third, it is accepted that the rules and principles are not immutable, because if circumstances arise that question or challenge the rule, the rule may need to be reconsidered.

But such a comparison does not account for the fact that in the 17th century, no strong doctrine of precedent existed. Indeed, it is in the time *after* these new scientific advances spread that the doctrine of precedent first starts to take form. The form of the doctrine of precedent that developed in this period was not the strict form of *stare decisis*, which required that the holding of a particular case was binding on courts below. Rather it was a "traditional" doctrine, a more flexible understanding within which the important factor was the *number of* previous cases that had decided analogous cases in a similar fashion⁶⁵.

But just as importantly, this doctrine left room for the reconsideration or rejection of principles that were either inappropriate or inapplicable. Certainty was not guaranteed, and it was reflected in the way that principles and the

⁶⁴ See Osler, "John Locke and the Changing Ideal of Scientific Knowledge", (1970) 31 *Journal of the History of Ideas* 3 at 9.

⁶⁵ Berman and Reid, "The Transformation of English Legal Science: From Hale to Blackstone", (1996) 45 *Emory Law Journal* 437 at 497.

weight of authority were not immune to reconsideration and rejection. This can also be seen as an important influence from early scientific method.

One consequence of Newton's empirical theory was that derived "general laws or principles" remained open to question based on new previously unobserved or unaccounted for circumstances. A principle may be consistent with new circumstances and its validity confirmed, such that we can grow more confident in it being correct. Or new circumstances may challenge the principle and bring its validity into question. The inevitable result of the empirical method was that Newton was "forced to lay aside the ideal of certainty and examine ways of making inductions as strong as possible"⁶⁶.

The rejection of certain truth as the proper goal for scientific inquiry meant that it was necessary to *judge* a principle or phenomenon based on how probable it is that it is true, based on the observed experience of our own and of others. For Locke, probability as a means of judging had two grounds: first, the "conformity of anything with our own knowledge, observation and experience" and second, the "testimony of others, vouching their observation and experience"⁶⁷.

This parallel was influential in the emerging criteria of "proof" in civil and criminal trials. Judicial instructions to juries in the late seventeenth and early-to-mid eighteenth century required they have a "satisfied conscience" persuaded by the evidence presented to them, which around 1770 developed into the familiar formulation of guilt "beyond reasonable doubt"⁶⁸. The

⁶⁶ See Osler, "John Locke and the Changing Ideal of Scientific Knowledge", (1970) 31 *Journal of the History of Ideas* 3 at 9.

⁶⁷ See Osler, "John Locke and the Changing Ideal of Scientific Knowledge", (1970) 31 *Journal of the History of Ideas* 3 at 15.

⁶⁸ Berman and Reid, "The Transformation of English Legal Science: From Hale to Blackstone", (1996) 45 *Emory Law Journal* 437 at 500.

scientific ideas of different levels of rational certainty, based on evidence and observed phenomenon – all falling short of certain truth – provided a basis for the very process of judging.

In short, science taught us to accept the fact that evidence presented will fall short of certain truth, but that the resulting uncertainty is not paralysing. It showed us that we can develop meaningful bases by which we can judge and act on the basis of necessarily imperfect proof, while still striving to make the best possible decision in the face of that uncertainty.

Legal uncertainty and the lessons from scientific method

The matter of *Ruddock v Vadarlis*⁶⁹ – the "Tampa case" – demonstrates how in law we can face uncertainty while still ensuring we make the best decision possible. The reasons of the Full Federal Court, and in particular those of the then Justice French, show how the inductive processes of reasoning are crucial in cases involving novel questions of law. Those processes help to clarify what is known, what is not known and what must be decided, and in doing so, they bring focus and precision to areas of uncertainty and controversy.

The Tampa case was the judicial part of a national controversy regarding the status and treatment of 433 people who were rescued on 26 August 2001 from a wooden fishing boat in the Indian Ocean by a Norwegian roll on/roll of container ship, the *MV Tampa*. As the Full Federal Court stated, it was a "most unusual case" in which "[t]here was substantial public, and indeed, international controversy about the Commonwealth's actions"⁷⁰. The Captain sought to land the rescuees at Christmas Island, but the Federal Cabinet

⁶⁹ *Ruddock v Vadarlis* (2001) 110 FCR 491.

⁷⁰ *Ruddock v Vadarlis (No 2)* (2001) 115 FCR 229 at 242 [29].

requested that the vessel not land, closed the Christmas Island harbour to the vessel and eventually arranged for 45 Special Air Services troops to board the vessel to provide assistance to those on board.

Interim arrangements were made for the rescuees to be conveyed to New Zealand and to Nauru, where their immigration claims were to be processed. But these arrangements were without prejudice to rights to be determined in proceedings commenced by the Victorian Council for Civil Liberties (now Liberty Victoria) and a Victorian solicitor, Eric Vadarlis, in which those plaintiffs claimed that the rescuees were being unlawfully detained by the Commonwealth. The plaintiffs sought writs of habeas corpus and the release of the rescuees onto the Australian mainland⁷¹.

The hearing process was dynamic and drastically abridged. The rescue occurred on 26 August 2001, interlocutory orders were made on 31 August and the first instance decision was handed down on 11 September 2001⁷², a date now infamous for another reason. The Full Court appeal then commenced on 13 September. Judgment was handed down four days later, on 17 September, holding that the Commonwealth's actions were authorised by non-statutory Executive power of the Commonwealth. The Commonwealth Parliament passed retrospective validating legislation on 26 September⁷³, which played a part in the subsequent refusal of special leave to appeal from the orders of the Full Federal Court⁷⁴.

⁷¹ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 522 [129]-[130].

⁷² *Victorian Council for Civil Liberties Inc v Minister for Immigration and Multicultural Affairs* (2001) 110 FCR 452.

⁷³ See *Border Protection (Validation and Enforcement Powers) Act 2001* (Cth).

⁷⁴ *Vadarlis v Minister for Immigration and Multicultural Affairs* [2001] HCATrans 625.

The central issue was whether the Commonwealth had a lawful basis to restrain the liberty of the rescuees. The Commonwealth did not assert any statutory basis for such a power, in the *Migration Act* 1958 (Cth) or otherwise – the Commonwealth relied solely on non-statutory executive power. Accordingly, the novel issue facing the Full Court on appeal was "[w]hether the Executive power of the Commonwealth authorised and supported the expulsion of the rescuees and their detention for that purpose"⁷⁵.

The circumstances demonstrated the difficulties attending the judicial role – especially the need to decide finally and authoritatively in the face of uncertainty. However, Justice French's reasons demonstrate how one can and should chart a course through uncertainty. As the scientific advances of the 17th and 18th century established, we must embrace uncertainty by understanding and acknowledging the limitations of our knowledge. We must appreciate that uncertainty is not an occasion for imprecision; much the opposite. It is the occasion for rigorously examining our present understanding and seeing how it must be extended or refined to deal with the novel situation before us.

The result is that in deciding novel legal questions, uncertainty means that we must carefully consider what the authorities *can* tell us, and precisely define what it is that the authorities *cannot* tell us. In other words, we must take a scientific approach.

That precision and care is evident in his Honour's reasoning *Tampa*. His Honour referred to historical thought such as Blackstone's conception of executive power as "the discretionary power of acting in the public good where

⁷⁵ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 533 [136].

the positive laws are silent"⁷⁶, a conception that was itself based on Locke's work. His Honour referred to international law concepts of the "gatekeeping" function of the state⁷⁷, as well as colonial authority about the powers of the New South Wales Governor to exclude foreigners from the colony⁷⁸. But as his Honour stated, "[t]he Australian case law does not resolve the question before this Court"⁷⁹.

While none of these sources could *provide* entire answers to questions about the executive power of the Commonwealth, they assisted and shaped his Honour's reasoning that "Australia's status as a sovereign nation is reflected in its power to determine who may come into its territory and who may not and who shall be admitted into the Australian community and who shall not"⁸⁰. In the result, his Honour held that the executive power of the Commonwealth, in the absence of statute, extended to the power necessary to authorise the actions taken⁸¹.

What is most important is that in the face of uncertainty, his Honour considered, analysed, understood, and reconciled. In short, he was – as we must be – active and inquisitive in the face of uncertainty.

Law as a science

To underline the significance of considering law as a science, we need to finally consider how judicial decisions reassess, refine and renew the law.

⁷⁶ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 539 [181] citing Blackstone, *Commentaries on the Laws of England*, 8th ed (1778) and Locke, *True End of Civil Government* (1764).

⁷⁷ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 541 [186]-[187].

⁷⁸ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 541-542 [188]-[190].

⁷⁹ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 543 [194].

⁸⁰ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 542 [192].

⁸¹ *Ruddock v Vadarlis* (2001) 110 FCR 491 at 543 [193].

In that process, we will see further important parallels between legal method and scientific method.

Like law, science "changes". Neither is static. Each develops. Each may change because we come to understand more about a particular topic, because our perspective changes, or simply because of re-examination of existing hypotheses and rules. Lewis Wolpert, an English Professor of Biology and author of a number of popular science works, has made two important observations about how science changes and develops. First, rather than old ideas being "discarded", they are most often integrated into newer, more developed understandings. Second, there exists an important, settled, "core" of scientific principles that can be regarded as "very secure"⁸²:

"In almost all cases in which science changes, the old ideas are not so much discarded as incorporated into the new. Thus Newton's mechanics is a special case of Einstein's theory. Changes usually occur at the advancing fronts of science and the core can be regarded as very secure. Archimedes' laws of floating bodies and levers, or the idea that DNA is the genetic material, is not really open to doubt any more."

Of course, there are exceptions to the gradual progression of knowledge both in science and in law. In science, some discoveries break with, and overturn, existing understanding and theories: for example, the Nobel Prize-winning work of Dr Barry Marshall and Dr Robin Warren in discovering the *Helicobacter pylori* (*H pylori*) bacterium. Their peerless work began with a four page article in published in 1984⁸³, and their subsequent work revolutionised the treatment of gastritis and led to others' treatment of peptic ulcers. In law, breaks with the past have a well-known history, from

⁸² Wolpert, "What Lawyers Need to Know About Science" in Reece (ed), *Law and Science* (1998) at 297.

⁸³ Marshall and Warren, "Unidentified Curved Bacilli in the Stomach of Patients with Gastritis and Peptic Ulceration" (1984) 323 *The Lancet* 1311.

Lord Atkin's neighbour principle⁸⁴ to the recognition of native title as part of the common law of Australia⁸⁵.

As Wolpert acknowledges, within the "core" of settled principle in science, there is little reason or scope for doubt. Predicting the outcome of events in those circumstances, as Pollock recognised, becomes more mechanistic and less open to doubt. It is similar with aspects of the judicial function. Justice Benjamin Cardozo, the celebrated jurist and eventual Supreme Court Justice, put it eloquently in his 1927 lectures delivered at his alma mater and law school, Columbia University⁸⁶:

"Diligence and memory and normal powers of reasoning may suffice to guide us truly in those fields where the judicial function is *imitative or static*, where known rules are to be applied to combinations of facts identical with present patterns, or, at worst, but slightly different." (emphasis added)

But as Wolpert also acknowledges, it is on the "advancing fronts" where science's boundaries of developed understanding expand.

The same is true of law. It is in the absence of authority, in novel areas of law and principle, that the law develops and the difficult questions must be answered. Cardozo continued⁸⁷:

"The travail comes when the judicial function is *dynamic or creative*. The rule must be announced for a novel situation where competitive analogies supply a hint or clew [sic], but where precedents are lacking with authoritative commands." (emphasis added)

⁸⁴ *Donoghue v Stevenson* [1932] AC 562.

⁸⁵ *Mabo v Queensland [No 2]* (1992) 175 CLR 1; [1992] HCA 23.

⁸⁶ Cardozo, *The Paradoxes of Legal Science* (1927) at 2.

⁸⁷ Cardozo, *The Paradoxes of Legal Science* (1927) at 2.

In these circumstances, the judge's role becomes one of rational, detailed synthesis rather than observation of facts and application of settled doctrine.

The High Court of Australia, in its position as a final general court of appeal, is called on more often than any other Australian court to engage in the "dynamic and creative" aspect of the judicial function. More often than any other Australian judicial officers, members of the High Court must take a step back, assess carefully the state of the law, assess whether and how the present law might be insufficient or incorrect, and formulate as best they can an answer to case at hand.

The process is akin to an experiment. It involves the proposing of initial hypotheses – the law need not change; the law must change in this way; there has been the following error below. The existing literature (precedent) is consulted for the assistance that it can give, and it is ascertained what assistance it cannot give. The hypotheses are then tested by rigorous examination and consideration. Again, Cardozo eloquently describes the process and its requirements, but also the uncertainty and difficulties that attend it⁸⁸:

"No rule of thumb will tell us in advance when events in their movement have traversed such a distance that to avoid undue disparity we must reformulate the rule of law. Many factors of convenience must be counted. Many observations from different angles must be made before the survey will be accurate. Then, when distances have been measured, the canon may be borne in mind. Precedent or formal logic may seem to be pointing to stability. The principle of relativity in the adaptation of the law to conduct may point the way to change."

An emphatic example of this process was French CJ's reasons in *Alqudsi v The Queen*⁸⁹. In that case, Nettle J and I came to a different conclusion than the Chief Justice, as did the other justices. However, his Honour's reasons

⁸⁸ Cardozo, *The Paradoxes of Legal Science* (1927) at 15.

⁸⁹ (2016) 90 ALJR 711; 332 ALR 20; [2016] HCA 24.

demonstrate clearly what is involved in the process of deciding these kinds of issues in the law.

Alqudsi involved an accused charged with an offence under a Commonwealth statute, the *Crimes (Foreign Incursions and Recruitment) Act 1978* (Cth). The charges alleged that he performed services with the intention of supplying or promoting the entry by another person into a foreign state with intent to engage in armed hostilities in that foreign state⁹⁰. That Act provided that trial of such an offence "shall be on indictment"⁹¹. As the offence was alleged to have occurred in New South Wales, s 68(1)(c) of the *Judiciary Act 1903* (Cth) and s 80 of the Constitution together required that he be tried in New South Wales and that New South Wales trial procedure be applied "so far as ... applicable to person who are charged with offences against the laws of the Commonwealth".

Before his trial took place, the accused applied under s 132 of the *Criminal Procedure Act 1986* (NSW) for a trial by judge alone, rather than trial by judge and jury. However, the issue facing the accused was that s 80 of the Constitution relevantly provides:

"The trial on indictment of any offence against any law of the Commonwealth *shall be by jury...*" (emphasis added)

The issue for decision was clear – whether s 80 required that the accused's trial "be by jury". The Chief Justice held that, in this case, s 80 did not require that the accused's trial be by jury⁹².

⁹⁰ *Alqudsi* (2016) 90 ALJR 711 at 746 [151]; 332 ALR 20 at 64.

⁹¹ s 9A(1) of the *Crimes (Foreign Incursions and Recruitment) Act 1978* (Cth).

⁹² *Alqudsi* (2016) 90 ALJR 711 at 716 [8]; 332 ALR 20 at 23.

For present purposes, the outcome is less important than how the Chief Justice's reasons came to that outcome. Those reasons demonstrate exactly what Cardozo meant when he stated that the analysis of principle requires "[m]any observations from different angles". They also demonstrate how existing authority is not discarded in dealing with new scenarios, but rather used to develop and consider new principles.

French CJ's reasons variously considered the drafting history of s 80, its application in early authority, the space that it leaves for Parliament to determine what trials would be "on indictment", and the analogous position of trial by jury under the Sixth Amendment in the United States. These considerations were not the mere recitation of knowledge for its own sake. Rather, it was his Honour using those sources as the raw material for understanding and analysis. It was the process of scientific induction – the distillation of observation and testing of hypotheses. This is clearest in the following passage⁹³:

"The strongest and most uncontroversial point to be taken from the examples proffered ... is that in interpreting a constitutional provision a formal rigidity which runs wider than the evident purpose of the provision is not a sensible or preferable constructional choice."

This understanding was part of his Honour's reasoning that existing authority, including the High Court decision of *Brown v The Queen*⁹⁴, had been decided based on reasoning broader than was necessary, and that s 80 did not prevent the use of trial by judge alone for a Commonwealth offence on indictment in the way provided for in the New South Wales legislation.

What is most important about this understanding is that his Honour does not take from the sources a direct answer to the question in issue. Instead,

⁹³ *Alqudsi* (2016) 90 ALJR 711 at 723 [34]; 332 ALR 20 at 33.

⁹⁴ (1986) 160 CLR 171; [1986] HCA 11.

his Honour assessed the issues based on the observed experience that was previous authority. His Honour's reasoning demonstrated again how scientific method has influenced the legal method at a fundamental level – it has shaped how we think about and approach our understanding of law and legal reasoning.

Conclusion

In direct and clear ways, science has been an important part of Chief Justice French's life and career. A foundational education in science has been succeeded by a lifelong fascination with the topic.

But Robert French's involvement with science has never been entirely separate from his career as a lawyer and judge. While there are necessary differences between scientific and legal methods, Robert French's work shows us how the principles and ideas of science have become part of our shared understanding of the world, and of the law.

The understanding that we all owe such a debt to science is something we must acknowledge, and something we should not forget.