Expert evidence presented in the Gordon Wood murder trial is examined in the light of his subsequent acquittal by the appeal court. A case is made that the scientific evidence presented at the trial was valid but it was misinterpreted by the appeal court. The fundamental reason appears to be that lawyers in general, and the judges in particular, had no formal qualifications in the relevant scientific field, which in this case was physics. Specific examples from the judgment are analysed to illustrate the nature of the problem. It is concluded that the validity of scientific evidence cannot reliably be determined by people who have no qualifications in the relevant or a related science. That might be stating the obvious, but it is particularly relevant when lawyers are charged with these tasks.

Keywords: expert evidence; Gordon Wood trial; physics; biomechanics; appeal court

1. Introduction

As described in many recent articles in this journal and elsewhere, expert opinion and the forensic sciences are being closely scrutinised by the legal profession, the primary concern being that flawed evidence or bad science can lead to a miscarriage of justice. The focus has been on the experts and the sciences themselves rather than the failure of the legal system to detect faulty evidence at the time it is presented in court. The legal system can indeed detect faulty evidence presented in court, but faulty evidence can also slip through the cracks and may not be detected until many years later, if at all. Part of the latter problem can be attributed to the fact that lawyers are generally not well versed in expert fields or in the forensic and other sciences.

Lawyers commonly admit to being amateurs when it comes to scientific matters, but are reluctant to admit that it can sometimes cause a significant problem. The nature of the problem can be illustrated by an example from the author’s own experience. Most expert witnesses are likely to have had the same or similar experiences. I gave expert evidence in a court case where a driver was charged with negligent driving, having run into and seriously injured a motorcyclist. I wrote a report on the physics of the accident, concluding that the motorcyclist was traveling at excessive speed. The barrister representing the driver was worried about my report since it included numerous equations as well as technical words and phrases such as conservation of momentum, centre of percussion and coefficient of restitution. He asked me to explain the physics in much simpler terms when I went into court. He emphasised that university physics was beyond everyone’s comprehension, and even high school physics would
be too complicated. What he wanted was “kindergarten physics”. I did the best I could, but the court still struggled to understand even the simplest aspects of the physics of the problem. That in itself is not surprising, given that physics students themselves struggle with elementary physics, and given that law students may be influenced to become law students when they discover that they have no aptitude for science and mathematics. Faigman (a Professor of Law), in his article “Judges as Amateur Scientists”, put it this way:

In my experience the typical lawyer is not merely ignorant of science, but rather has an affirmative aversion to it. Nothing will put a class of law students to sleep faster than putting numbers on the chalkboard. A bell curve makes their eyes glaze over. A minor equation or two, or calculating a standard deviation, renders law students unconscious; and a more complicated regression analysis induces a deep coma.

There was no one in the court who had the faintest clue as to whether my physics was correct or not. What seemed to matter most in court was that I was a professor of physics with many years experience and that I gave the court the impression that I knew what I was talking about. My evidence in the case was challenged by the barrister representing the prosecution. He asked only one question, and that was whether I had taken into account the fact that the exterior of the car was made from thin metal rather than plastic. The police had prepared their own report on the accident but the prosecution made no attempt to obtain an independent assessment of my own report. That, in a nutshell, is probably how expert evidence is often presented and evaluated. There was no serious attempt to test the validity of my evidence. No harm was done in this case (in my opinion), but it points to the fact that mistakes can easily occur in court without being detected. The problem is largely avoided in the scientific and academic world by submitting reports or papers to independent expert referees for evaluation prior to publication. As a result, many refereed journals publish less than half of all submitted manuscripts, and those manuscripts that are finally accepted usually require one or two revisions before the referees are happy with them. Furthermore, the identity of the author is usually not revealed to the referees, meaning that the work can be judged purely on its merit. The reputation, prior experience, formal qualifications and demeanour of the author are then totally irrelevant, unlike the heavy emphasis placed on these factors in the courtroom.

Lawyers tend to attack (or praise) the scientist rather than the science itself in an attempt to quantify the validity of the science. That approach is rarely adopted in the scientific world when judging scientific work, since it has no scientific validity. Similarly, an expert who is well spoken, self-confident and has an ability to explain complex matters in simple terms may well be judged to be more reliable in a court of law than one who fails to impress in the same manner. In fact, good science has nothing to do with eloquence or demeanour. Good science involves getting the science right. Even good scientists sometimes make mistakes in their measurements or calculations or assumptions or the science itself, so previous success is no guarantee of future success. That is why reputable journals send all papers off to referees, even if the author has previously published hundreds of papers or won a Nobel prize.

One might expect greater attention to detail to occur in a murder trial. Expert evidence in a murder trial may be subject to more intense scrutiny, although barristers are generally not well equipped to ask all the right questions or to understand all of the technical aspects of the evidence. As a result, some of the expert evidence presented at the trial that perhaps should be challenged may not be challenged at the time, although
it may well be challenged several years later on appeal. Therein lies another problem. The appeal court is required to weigh up the evidence even if the judges themselves have no formal qualifications in matters presented to the court by expert witnesses.

The nature of the latter problem can be illustrated by the high-profile murder trial and subsequent acquittal of Gordon Wood in Sydney several years ago. Wood was found guilty in November 2008 of throwing his girlfriend, Caroline Byrne, off a cliff at The Gap in Sydney in 1995. The author is qualified to comment on the case as one of the expert witnesses who gave evidence at the trial. As it turned out, the appeal court was highly critical of both my evidence and the prosecutor in this case, as outlined in their publicly available judgment and in a recent paper by Etter published in this journal. Etter lists 17 factors that can contribute to a miscarriage of justice. She did not include the fact that lawyers generally have no formal qualifications in any of the sciences and are therefore not well equipped to understand or interpret or challenge expert evidence presented in court, even when the evidence is dumbed down to kindergarten level. It therefore comes as no surprise to find that Etter (a lawyer) began her criticism of my evidence by quoting the publisher’s blurb from the cover of my book on the subject, and made no attempt at all to evaluate the scientific evidence itself. As is the usual case in scientific journals, authors who are criticised in a journal are normally given a right of reply. I therefore comment below on the validity of that criticism, given that it may be of general interest to other experts and forensic scientists involved in legal matters. Etter’s comments were based on the CCA judgment, so my reply is concerned primarily with the judgment itself.

The present paper outlines a case that the science in the Wood trial, and the evidence on which it was based, was valid and rigorously tested, but the appeal court misinterpreted both the science and the rationale behind the scientific investigations involved. Normally, in a case like this, there is an opportunity for the DPP to challenge the decision of an appeal court by reference to the High Court. No such challenge was made by the Director of Public Prosecutions, and no reason was given or required for the decision not to challenge. As a consequence, there has not previously been any informed analysis of the scientific evidence presented at the trial or of the response of the appeal court to that evidence.

One of the problems faced by the appeal court was the sheer volume of evidence that needed to be digested and interpreted. Included in that evidence were the results of 13 years of police investigations, statements and evidence from more than 100 witnesses, and four detailed scientific reports that I had provided to the police on the physics of the fall, as well as a refereed scientific paper on the subject published in the Journal of Forensic Sciences and another refereed paper published in the American Journal of Physics. As far as I can determine, all of my reports and papers remained unread by the CCA since no significant mention of any of that material was made in the CCA judgment.

After the trial, I also wrote a book on the subject for the general public, the primary purpose being to explain how it is sometimes possible to distinguish between an accident, a suicide or a homicide when someone falls to their death from a height. Very little research has been undertaken into falling accidents and fatalities, despite the fact that the cost to the community is similar to that involved in traffic accidents and fatalities. That is, it runs into many billions of dollars per year, even in Australia. Falling fatalities have a lower profile but feature prominently in coroners’ inquests. Falling accidents are by far the largest single cause of the 420,000 injuries in Australia each year requiring hospitalisation (38%), followed by transport accidents (13%).
A second objective in writing the book was to show that physics can be applied in an interesting way to research or investigate even relatively mundane events. There is a common misconception that modern physics is concerned only with exotic phenomena, since these aspects of the subject tend to be more highly publicised. I did not write the book to promote my own contribution in “solving” the case, a mistaken view that was seemingly held by the CCA. My book became the primary reference source for the appeal court since it was written for the lay person and was much easier to read than my reports. Regrettably, the CCA misinterpreted both the physics and the primary messages that I attempted to convey. The CCA also came up with one reference text of their own, this being *Starkie on Evidence*, third edition, published in 1842.

My own book and its title were heavily edited and restructured by the publisher. As a result, the CCA ended up criticising material that was written by the editor, assuming that I had written it. The editor tended to over-emphasise the role that I played in the case and omitted much of the physics content, in order to dramatise and streamline the narrative. As part of the contract with the publisher, I was given only two days to make minor revisions, after the editor had made major revisions. I had not anticipated that the editorial changes would be so extensive.

2. Background history

The 13-year time delay between Ms Byrne’s death and Wood’s trial reflected both the circumstantial nature of the prosecution case and the superficial nature of the initial police investigation. The Gap is a notorious suicide spot and Caroline Byrne had just visited a doctor complaining that she was feeling depressed, without knowing why. The police initially concluded that it was an obvious case of suicide. At an inquest in 1997, the coroner concluded that there were suspicious circumstances and that the police should investigate further. Of particular concern was the fact that Caroline died at night time and that Wood spotted her body a few hours later at the bottom of the cliff at a time when it was pitch black. He claimed that he last saw her at about lunch time and that he was guided to The Gap by spiritual communication.

Just before the inquest I was contacted by a detective who wanted to know if I could figure out whether Caroline jumped or was pushed, given that she had landed 9 m out and 30 m down and that there was safety fence at the edge of the cliff. I called him back within the hour and said that it was more likely that she had jumped. I never heard from him again. Six years later I was again contacted by the police, requesting a formal report on my earlier calculations. In order to do that, I visited The Gap, conducted a few simple experiments, and reported back seven weeks later that it was likely that Caroline had run at high speed across the cliff top, outside the safety fence. She had landed much too far out to have been pushed.

I was contacted by the police the second time after an initiative of my own. After the inquest, the press became obsessed with the story and with the cast of characters involved, eventually claiming that Wood had killed his girlfriend. Given my earlier calculation for the police and the total lack of interest shown by the press and the police in the unusually large landing distance, I contacted the coroner and eventually the police to suggest that they should conduct some tests to help resolve the issue as to whether Caroline had jumped or had been pushed.

The appeal court interpreted those events in a very different light. They said, at paragraph 717:
A/Prof Cross makes plain that he approached his task with the preconception that, based on his behaviour, as reported after Ms Byrne had died, the applicant had killed her. He clearly saw his task as being to marshal the evidence which may assist the prosecution to eliminate the possibility of suicide and leave only the possibility of murder.

At 734, the CCA commented further that:

As far back as 1999 A/Prof Cross had involved himself in the matter to an extraordinary degree. He records his frustration with the police and coronial processes and the steps he took of his own initiative to press his opinions.

At 758, the CCA continued their attack by claiming that:

Rather than remaining impartial to the outcome and offering his independent expertise to assist the Court he formed the view from speaking with some police and Mr Byrne and from his own assessment of the circumstances that the applicant was guilty and it was his task to assist in proving his guilt.

The CCA clearly misunderstood and misinterpreted the documented evidence on that issue. I originally advised the police in 1997 that Ms Byrne most likely jumped to her death. It remained a mystery to me for the next six years why the police appeared not to accept that advice and why they undertook no tests of their own. When I eventually undertook some tests in 2003, I again reported that Ms Byrne had most likely jumped. That evidence alone directly contradicts the conclusions reached by the CCA. Furthermore, I first met Mr Byrne at the committal hearing in 2007. We did not discuss the case at all, either then or prior to 2007. The claim by the CCA concerning Mr Byrne was either fictional or resulted from a misunderstanding of the facts. Indeed, all of the above claims by the CCA were incorrect, were not (and could not be) supported by any factual evidence, and were made without reference to the scientific methods used to investigate the physics of the fall. The defence experts themselves made no adverse comments on those methods. In fact, there was considerable agreement between the experts on both sides, although some of our results differed, as described below.

I came to the conclusion that Ms Byrne did not commit suicide only after I had finished all my experiments. The experiments that I undertook were designed to test whether Ms Byrne’s death was the result of an accident or suicide or homicide, and indeed whether it was physically possible to make such a distinction. It was only after I had completed all the experiments and analysed the experimental results that I realised that such a distinction was possible in this particular case. Those experiments are described in the *Journal of Forensic Sciences* and were conducted with the same rigour and even greater attention to detail than one would normally expect in an experimental physics investigation.

The judges appear to have based their extraordinary attack on my integrity (rather than the science and my evidence itself) on a preconceived belief, expressed in paragraph 715 that:

Once an expert has been engaged to assist in a case, there is a significant risk that he or she becomes part of “the team” which has the single objective of solving the problem or problems facing the party who engaged them to ‘win’ the adversarial contest. It is an almost inevitable result of the adversarial system.

If anything, that claim is an attack on the adversarial system itself, but it is also an attack on forensic scientists in general and myself in particular. The judges are making the
outrageous claim that any expert employed by the police will almost inevitably fake or bias their results in order to come up with the result that the police are looking for. Nevertheless, their comment about the adversarial system is partly correct, for a different reason. If an expert comes up with evidence that does not support the case, either for the prosecution or the defence, then the expert is very unlikely to be called to give evidence.

Shortly after I submitted my first report to the police, in 2003, I contacted the police again to ask them two questions. Having re-read my own report, two questions stood out. One was how Ms Byrne managed to be wedged head first in a cavity without any significant injury other than a head injury, and the other was how the police knew where she had landed, given that no photographs had been taken at the time the body was recovered. The police admitted that they did not know the answer to either of those questions. They suggested that I should visit the site again, given that I had never seen or been shown the landing spot. The CCA misinterpreted the circumstances. They claimed at 317:

By the time he was able to revisit the site, A/Prof Cross had become involved and was questioning whether the correct location had been identified. A/Prof Cross’ reasoning for doing so appears to have no foundation other than perhaps out of concern to eliminate the possibility of suicide, thus leaving open a prosecution for murder.

Evidence presented at the trial, including notes from my log book, shows clearly that I was concerned to understand in more detail what had happened, to check the facts and to resolve doubts. That is what an expert witness is supposed to do, according to the code of conduct. More significantly, it is how any reputable scientist approaches any scientific task. One of my concerns related to Ms Byrne’s physical injuries. According to the police, most suicides at The Gap result in the scattering of body parts on the rocks below. In Ms Byrne’s case, there were minimal body injuries, indicating that she followed a very specific head-first trajectory, and one that might help to identify the specific launch point if I could obtain detailed information on the rock formation surrounding the landing point.

The CCA misinterpreted evidence concerning my visit to the site, ignored standard scientific practice, and came up with their own explanation based on nothing other than an invalid conjecture. The fact that the police took no photographs of the body at the time was enough to raise concerns that they may have given me unreliable information. The CCA effectively judged that to be a matter of no concern, without foundation. From a scientific point of view, the landing spot was of critical importance since it was the primary evidence on which I had based all my measurements and calculations. The police subsequently admitted that the failure to capture photographic evidence was a serious mistake on their part, as was their failure to establish a crime scene either at The Gap or at the apartment shared by Mr Wood and Ms Byrne. In fact, I treated everything that the police told me with a degree of scepticism, and verified all facts for myself when I could. For example, I found five or six different mistakes in various cliff drawings compiled by the forensic imaging group, and had them carefully rechecked and corrected before I could rely on them. On another occasion, the police borrowed a 65 kg dummy from the fire brigade for some preliminary throwing experiments. Having conducted the tests and having quizzed the police, I then weighed the dummy myself. It was 35 kg not 65 kg.

As it turned out, the police had given me the wrong landing spot. The correct landing spot was even further out, 11.8 m from the edge of the cliff. The correct spot was
first identified early in 2004 when Sergeant Powderly, the police officer who recovered the body, was asked to point it out. Up to that time (i.e. nine years after Ms Byrne’s death) the landing spot was not an issue that the police had considered to be of any significance whatsoever. Powderly pointed to the spot without hesitation, and gave several reasons why it was that spot and not the other spot. However, his identification was contaminated by the fact that he had previously identified the “wrong” landing spot in a police video recording made in 1996. The mistake involved the fact that he narrated the video from the top of the cliff while another police officer at the bottom of the cliff was pointing to the wrong spot.

The mistake was sufficiently serious that I later climbed to the bottom of the cliff to investigate the differences between the two spots. It became clear that the “wrong” spot was too narrow to wedge Ms Byrne up to her waist. For that and other reasons presented at the trial, I concluded that the “correct” spot was indeed 11.8 m out, as indicated in Figure 1. For example, Powderly consistently described the landing spot as a “crevice between two large boulders” in all his initial statements and even in his 1996 video, rather than a “hole” or a “cavity”. The crevice is shown in Figure 2.

The CCA took a dim view of this turn of events. At 34 they said:

As it happens the change in the landing position had significant implications for the prosecution case. The applicant submitted to this Court that this was an example of A/Prof Cross “actively participating in the making of evidence directed to traversing of the existing forensic evidence” which as a consequence caused the trial to miscarry.

Figure 1. Plan view of the cliff top and the rocks below. Point A marks the “correct” landing spot, 11.8 m out from the tip of the north ledge. The north ledge was the only location on the cliff top with a clear run-up approach, unimpeded by rocks or bushes. Point B marks the “wrong” landing spot initially identified by the police.
It would appear from this comment that double checking the facts constitutes a grave breach of accepted forensic procedures, according to the CCA. Nevertheless, the change in the landing position did indeed create a serious problem in finding a possible explanation as to how Ms Byrne managed to land so far out. It took an additional three years, around 20 different experiments and four separate reports to determine that (a) it was too far for a running jump or dive and (b) a strong male acting alone could indeed throw a woman of Ms Byrne’s light weight (57 kg) the required distance. It took twenty different experiments to arrive at that conclusion since there was nothing in the scientific or any other literature to indicate how far a woman of average athletic ability could jump, dive or be thrown, given the relatively short approach distance from the safety fence to the edge of the cliff.

3. My qualifications

It was determined by the CCA, and stressed by Etter², that I expressed opinions outside my field of specialised knowledge, that I have no qualifications or experience in biomechanics and that my primary area of expertise is plasma physics. The facts are (a) I obtained a PhD in plasma physics in 1968; (b) I have since written about 60 refereed papers and three books on the physics of sport, some in collaboration with biomechanists; (c) biomechanics is the application of physics to human movement; (d) there are hundreds of papers in the literature written by physicists on the subject of human movement; and (e) I frequently referee papers for editors of biomechanics journals, as well as physics journals.

Furthermore, I did not express any “opinions” at all, of any consequence, at the trial. Rather, I presented the results of a three-year study on a range of topics, including measured running, jumping, diving and throwing speeds and trajectories. The CCA

Figure 2. View of rocks below the cliff top, showing a mannequin in the “correct” crevice, and the “wrong” landing spot about 5 m to the right. Both locations are marked by a circle.
failed to appreciate that a paper qualification obtained in the distant past is not nearly as significant as subsequent experience over many years in a different or closely related field, or that an experimental physics investigation extending over a three year period might qualify me to comment on the results of that investigation. The main results of that investigation were peer reviewed by experts in the field and were published in the Journal of Forensic Sciences prior to the trial.

Primary qualifications are only the starting point for most scientists who develop more specialist knowledge during their subsequent career. Most develop that knowledge as a result of their own research, rather than formally re-enrolling at a University to obtain additional qualifications. For example, my tennis partner at the University of Sydney resigned his position as professor of physics to accept a position as professor of zoology at Princeton University. He subsequently became Chief Scientist of Great Britain, was knighted, and is now a member of the House of Lords.

4. The “killer” point

From my understanding of the case, Gordon Wood said he was asleep at home on the night his girlfriend died. When he awoke and found she was not home he went looking for her. It didn’t take him long to find her car parked near The Gap, so he drove 11 km back to the city, collected Ms Byrne’s father Tony and brother Peter, headed back to The Gap and together they started a search. At around 2 am, on a pitch black night, Wood pointed to the exact location where Ms Byrne was eventually found and told Peter he could see shoes and legs. Peter replied that he couldn’t even see the rocks at the base of the cliff since it was so dark. Police arrived soon after with torches and also could not see a body or the rocks. Powderly arrived later with a powerful search light and located the body. Wood explained to Tony Byrne and in a 1996 interview with the police that he was guided to the spot by spiritual communication.

That method of communication with the dead has never been verified scientifically. It is not accepted by physicists, but the appeal court judges didn’t seem to have a problem with it. They dismissed the prosecution’s claim that Wood had “esoteric knowledge” of Byrne’s location and orientation as being “illogical”.

It was that scenario that convinced the police that Wood must have been present when Ms Byrne fell to her death. It became the prosecutor’s “killer point” at the trial. Nevertheless, the appeal court dismissed that evidence on the basis that Wood could not have seen the body since it was too dark to see her. Even the trial judge had problems with the prosecution’s killer point, given the darkness of the night. The position adopted by the appeal court was summarised briefly at 207:

The evidence at the trial satisfies me beyond any doubt that no one would have been able to identify Ms Byrne’s body from the top of the cliff.

The court expanded on that position by noting at 285-6 that:

The evidence of the others present at the time, particularly Peter Byrne, was that the night was so dark and the presence of spray and wash on the rock shelf was such that, in combination, it was not possible to see anything at the bottom of the cliff. This must mean that the applicant could not have known, even if he was responsible for Ms Byrne falling to her death, that she had lodged in the rock shelf with her feet in the air. There was nothing to suggest that visibility would have been better at the time at which she died compared with the time at which the others who sought to identify her were present.
The ultimate difficulty for the Crown submission is that if nothing could be seen that night then, even if the applicant were responsible for her death, he would not have been able to identify where she was and the position of her body.

The appeal court did not address the issue of spiritual communication directly or how Wood managed to locate the body and direct the police to where she was. That question was not resolved by the judges, nor did they attempt to resolve it.

When I first spoke to the police about this issue I suggested that it would be worth checking the time that the moon set that night, given that a scream was heard at about 11 pm. They were not keen on that idea, suggesting that it might contaminate the evidence that it was a pitch black night. The police were keen to prove that Wood could not have known where she was unless he had been there when she fell. They indicated further that even if someone did attempt to check visibility at The Gap, the conditions would probably be different from the night in question.

Nevertheless, I did check the records and found that the moon set at 1 am. I also found that the sky was cloudless all day, and included that information in my first report to the police, together with a diagram showing the position of the moon at one hour intervals as it set in the west. The edge of the cliff was therefore likely to be visible at 11 pm when Ms Byrne went off the cliff at high speed, regardless of how she fell. It would help to explain how Wood managed to find her at 2 am and how he knew that her feet were in the air. He may have seen her jump or he may have found her a few minutes later or he may have thrown her or he may have seen someone else throw her.

Evidence concerning the moon was not presented at the trial, hence the total confusion at the trial and the appeal about the illogicality of the prosecution case and the absence of a plausible, scientific explanation of the events. From a scientific point of view, the neglect of significant forensic information at a murder trial is unfathomable. I also highlighted the problem in my book, which was admitted as evidence at the appeal, but the appeal court ignored that particular detail.

5. Running, jumping and diving speeds

In late 2003 I conducted a few experiments where detectives threw a 61 kg female police woman into a swimming pool. The woman was about the same height and weight as Caroline Byrne. The throw speeds were all too low to account for Ms Byrne’s fall. As a result, I concluded in my first report that she had probably run over the edge of the cliff. When the landing spot was revised by the police to a point nearly 3 m further from the cliff, even a jump or dive appeared to be ruled out. Further experiments were requested by the police in an attempt to explain the fall.

I calculated that Ms Byrne left the cliff top at a horizontal speed of at least 4.5 m/s, regardless of how she fell. In order to land head first, she must have been thrown head first or she must have dived off the cliff. If a person is sprinting in an upright position then there is no rotation from one step to the next. A person running straight off the edge of a cliff will therefore land feet first, unless there is a trip or stumble, in which case the launch speed will be reduced. Similarly, a person jumping feet first will land feet first. I showed video film at the trial, taken from YouTube, of young people jumping feet first off cliffs and landing feet first in the water below. Gymnasts can jump and rotate through the air before landing but only when their horizontal speed is relatively low. In the long jump, athletes jump at high speed and land feet first. There are good
physics reasons for these observations, related to the magnitude and direction of the forces acting on the feet.

I measured the running and jumping speeds of 13 female police cadets and found that their run speed varied from 3.7 to 4.9 m/s, depending on their athletic ability, regardless of whether the run speed was recorded after a run distance of 4.0 m or 4.5 m from the start. The average run speed was 4.32 m/s. Their average run speed over 20 m was consistent with a much larger sample of 1000 Australian females measured in 1985. The maximum speed was attained by a cadet who had been a hurdling champion at school. The average jumping speed, after a 4.5 m runup, was 4.11 m/s. The average jumping speed after a 5.0 m runup was 4.35 m/s. These run-up distances were recorded because the distance from the safety fence to the tip of the north ledge was 5.0 m, as measured with a tape measure. At the appeal, the CCA admitted and accepted faulty evidence from the defence that the distance was actually 5.6 m, based on inaccurate aerial photographs that included another rock ledge below the upper surface of the north ledge.

I subsequently compared the jumping and diving speeds of seven of the more athletically able cadets after a 4.0 m runup to the edge of a swimming pool. The average jump speed was 3.87 m/s and the average dive speed was 3.51 m/s. I concluded from these and other experimental results that a female of average athletic ability could not have leapt off the north ledge and landed head first in the crevice where Ms Byrne was found.

The defence obtained evidence from a Professor Pandy, an engineer at the University of Melbourne. He measured the running speed of two female students at the 4 m mark. One of them could run at a speed of 4.71 m/s and could jump at a speed of 4.88 m/s. The other could run at 5.28 m/s and jump at 4.83 m/s. These figures were averaged over three or four separate trials. The second student had a top run speed of 5.42 m/s at the 4.0 m mark.

His second student could run almost as fast as Florence Griffith-Joyner. Commonly known as Flo-Jo, she broke the world record in 1988 by running the 100 m sprint in 10.49 seconds. She was also famous for her long fingernails, her one-legged track suit and for dying in 1998 at the early age of 38. It was never proven, but it was widely suspected that her athletic ability and muscular physique were enhanced by steroid use.

World class athletes don’t run four metre races, but they are often timed every ten metres of a 100 m race. Flo-Jo took 2.0 seconds to reach the 10 m mark, and 3.1 seconds to reach the 20 m mark. Since it took her only 1.1 seconds to cover the second 10 m, she was accelerating rapidly from the start to at least the 20 m mark. In fact, she was still accelerating at the 30 m mark since she took 1.0 second to get from the 20 m mark to the 30 m mark. Using that data, I estimated that she must have been running at about 5.65 m/s at the 4 m mark, only slightly faster than Pandy’s best student. Flo-Jo used starting blocks and started with her back foot about 1 m behind the starting line.

What did the appeal court make of all this? They failed to notice that Pandy tested very good athletes, not females of average athletic ability, and they failed to recognise that a high speed, feet first jump results in a feet first landing, not a head first landing. Despite those serious omissions, the judge declared at 269 that:

The measurements of women running made by A/Prof Cross excluded the possibility of Ms Byrne having jumped to hole A from the northern ledge. However, those conducted with the more sophisticated equipment of Prof Pandy indicated she could.
He added at 272:

Although A/Prof Cross conducted more tests I am in no doubt that, because of the sophistication of his equipment, the tests conducted by Prof Pandy are more reliable.

No self-respecting scientist would ever make a claim like that. None of three judges of the appeal court, all reputed to be fiercely independent, paused to reflect on whether Professor Pandy might have made a mistake with his measurements. None of them investigated or queried or reported on the many possible sources of error when measuring the running or jumping speed of a person over a short distance. None of them queried or reported on the accuracy of the results or the methods used (if any) to test the validity of either my own or Pandy’s results. None of them considered that it was astonishing that one of Pandy’s students could run almost as fast as Flo-Jo, even without the assistance of starting blocks. Pandy spent two days taking his measurements according to his report. I spent several years on the problem, checking and double checking my results to make sure there were no mistakes. Pandy also admitted, under cross-examination, that his two female subjects had a long history of participation in athletic and sporting events. Caroline Byrne did not.

The judge also commented at 494:

The applicant contended that if appropriate assumptions were made, the minimum speed required for Ms Byrne to have jumped to hole A was 4 m/sec.

The physics of the situation is concerned with the jump angle. A person can jump at any angle that he or she wants. If a person jumps vertically upwards, at an angle of 90 degrees, then he or she will land on the same spot as the jump spot. In the long jump, an athlete normally jumps at an angle of about 22 degrees to the horizontal to gain maximum horizontal distance. However, maximum horizontal distance when jumping off a cliff is attained at a jump angle of about 10 or 15 degrees. Those were the angles I assumed to work out the horizontal launch speed.

Another defence witness, Professor Ness, worked out that the horizontal launch speed could even be as small as 4.0 m/s, but that would require a jump angle of about 30 degrees, and an increase in the actual jump speed, even though the horizontal component of that speed is reduced. One could take the argument further. For example, if the jump angle was 80 degrees (almost vertical) then the horizontal launch speed would need to be only 2.7 m/s. However, the actual jump speed would need to be 15.5 m/s or 56 km/hr. Nobody jumps at 80 degrees or even 30 degrees when attempting to jump a long distance horizontally since they will land short, like a high jumper.

6. Throwing speeds

The physics of the initial throwing experiments indicated that higher throw speeds might be achieved if the throwers could avoid rotating the woman as she was thrown and if she was thrown in a more aggressive manner. That meant she would need to be thrown head first rather than side-on and that the thrower would need to push from shoulder height at a point on the woman’s backside. The technique became known as a “spear throw”. The experimental results indicated that Ms Byrne could indeed have been thrown in this manner at a speed of 4.5 m/s, provided that she did not resist and provided that the thrower could bench press 100 kg or more.
One of the male throwers managed to throw the female volunteer at a speed of 4.8 m/s and he needed to take only a few steps forward before throwing her into the pool. If he had taken a long run-up to the edge of the pool at a higher speed then he might have ended up in the pool himself. One of the throws was conducted while the woman remained limp, to simulate the effect of throwing an unconscious woman. The resulting throw speed was essentially the same as the previous three throw speeds where the woman cooperated by not struggling.

The appeal court did not like that experiment. The chief judge said at 275, 277, 322 and 483 that

One test was done where the female volunteer was asked to remain limp. However, even in this experiment she cooperated and facilitated her safe entry into the water. ... The video footage of the experiments suggests, as would seem inevitable, a level of compliance from the female participant. ... She endeavours to be limp in the arms and legs but can be seen diving out of the throw. ... No effective experiments were done to ascertain whether an unconscious Ms Byrne could have been thrown the required distance.

Despite having no formal qualifications in physics, the judge is effectively claiming here that he is an expert in the subject and that Newton’s first law of motion cannot be correct. The limp throw experiment was perfectly valid, despite the above reservations. What a person does after being thrown has no effect whatsoever on the launch speed attained by the throwing action. Neither does it have any effect on the subsequent speed or trajectory through the air. In a similar way, a person falling through the air cannot change his or her speed by flapping or flailing the arms and legs, unless the fall is from a very large height. The CCA dismissed the experiment as having no relevance, thereby expressing an opinion outside their field of expertise. That is the one thing that experts are never allowed to do in court. The legal system therefore has a fundamental flaw, in that there is a double standard regarding the admissibility and the interpretation of expert evidence.

Had the CCA thought logically about the throwing experiments, they might have concluded that these experiments were irrelevant anyway. The jumping and diving experiments showed that Ms Byrne would not have been able to land head first and 11.8 m out from the cliff, unaided. An even more bizarre comment was made by the CCA (at 766) in connection with the available run-up (the distance from the safety fence to the edge of the cliff) as opposed to the actual run-up distance taken by the thrower.

During the trial, a run-up of 4 m was described by A/Prof Cross as a “maximum” for a “spear throw”, for the reason that “anything more than 4 m, the thrower would run the risk of propelling himself over the edge when he threw.” Given that the run-up was more than 4 m, this evidence from A/Prof Cross, if accepted, raises serious doubt that Ms Byrne could have been spear thrown from the northern ledge.

The argument here was put by a person who had no idea at all about the physics of the problem. I explained that the throwers in my experiments needed to take only a few steps, in which case there was no risk of the thrower going over the edge. I also explained that if the thrower had taken a run-up of more than 4 m then he would run the risk of falling off the cliff when he threw Ms Byrne. The argument put by the CCA was that “if the available run-up was more than 4 m then the thrower would have gone over the edge.”
7. Conclusion

The mistakes listed above are just a small sample of those in the CCA judgment. Nevertheless, the sample is sufficiently large to demonstrate that expert evidence presented in a court can easily be misinterpreted by learned judges, the problem being that their learning is generally very limited when it comes to the sciences.

As a scientist, I am used to the fact that my scientific work gets criticised almost every time I send off a paper for publication. That happens to almost all scientists. However, I have never previously been criticised in the manner that the appeal judges adopted. The judges focused primarily on my motivation for undertaking the work, and virtually ignored the scientific work itself. In the process, they misjudged my motivation badly and they did not even attempt to evaluate the important experimental results concerning diving speeds. The results indicated that Ms Byrne did not commit suicide. The evidence was a central issue in the trial, yet it was largely ignored by the judges as if it was of no consequence at all.

I contend that the science remains valid and that the appeal judges came to scientifically invalid conclusions, given their lack of scientific qualifications and the lack of scientifically valid objections to any of my work. That type of criticism is unacceptable in the scientific world. It should not be accepted in the legal world either. The bottom line is this: the reliability and validity of scientific evidence cannot be determined with any confidence by people who have no qualifications in the relevant or a related science. There is probably no scientist anywhere in the world who would disagree with that. For the same reason, expert witnesses in courts of law are not permitted to comment on matters outside their field of expertise.

Part of the problem in the present case was that the scientific results were not familiar to anyone. In particular, there were no known or standard measurements of running, jumping, diving and throwing speeds relevant to the case. Nevertheless, the measurements and calculations that I undertook were quite straightforward and did not involve any advanced knowledge of physics. Anyone with any knowledge of elementary physics would have understood them. The judges clearly did not and did not even make any serious attempt to understand them, nor did they examine any of my scientific reports in any significant detail. Instead, they relied almost exclusively on the book I wrote for the lay person.

The solution to this problem, as I see it, is that evidence based on scientific opinions or experiments or calculations should be evaluated in the first instance by experts in the field and it should involve lively discussion and debate between those experts. The experts can even remain anonymous, as is the usual case in the scientific world. That way, scientific data and opinions can be judged on their merit, not on the perceived motivation or the past experience of the author. Furthermore, the experts should be given sufficient time to perform a valid assessment. In my own case, I was given Professor Pandy’s report to examine only one day before I gave my own evidence at the trial. I was told that this procedure is common in the legal profession and is commonly described as an “ambush”. That procedure has no place in any scientific investigation. It highlights a flaw in the legal system itself where the basic objective of the main actors tends to be to win the case rather than to search for the truth.

In 2005, the Hon G L Davies9, Justice of Appeal in Queensland, recommended a similar solution to the problem, commenting that:

If we were to start afresh to design a system for the resolution of questions involving expertise, we would probably start with the idea that an expert, or a panel of experts,
should decide such questions. If someone were to suggest to us, as a possible system, one in which a person who had no expertise would decide such questions after hearing competing arguments from opposing experts, we would dismiss it as bizarre.

Professor Faigman specifically targeted the lack of expertise of judges in that respect. He concluded\(^1\) that:

> Judges, on the whole, have little training in, knowledge of, or inclination to learn science. Scientifically illiterate judges pose a grave threat to the judiciary’s power and legitimacy. Like all ignorance, scientific illiteracy casts knowledge into the shadows, where only forms can be made out and detail is impossible to discern. Scientifically illiterate judges abdicate power and shun responsibility. In the twenty-first century, no judge will deserve the title if he or she does not know science.

Faigman is not alone in his assessment of judges. Professor Joseph Nicol\(^{10}\) was even more scathing when he commented that:

> Appellate decisions often are simply appalling in the degree of scientific naivete displayed. The scientific illiteracy of nearly all lawyers is a disgrace to their profession.

Our legal system surely deserves a better way of evaluating scientific evidence than evaluation by non experts with little understanding of fundamental scientific principles. It might then deserve to be known as a justice system.

References
