

'Strands in a cable: DNA reliance in circumstantial cases'

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“If the burglar was not the accused, then the burglar was someone who was wearing the accused’s dirty underpants, and most people prefer to avoid wearing other people’s unwashed underpants.

.....

In this case, the DNA evidence was the only evidence implicating the accused. Had there been any other evidence tending to implicate the accused which was not related to the DNA evidence, then I may have been satisfied of his guilt beyond reasonable doubt. However, I am not satisfied that guilt is the only available rational inference. There is, for example, a reasonable (albeit small) possibility that the burglar was someone else who was wearing unwashed underpants that had previously been worn by the accused.”

The Queen v King (No 2) [2016] ACTSC 121 (per Murrell CJ at [69]-[77])

I. Introduction

Scope

1. This paper focuses on the increasing prevalence of prosecution cases that rely upon DNA as the sole (or substantive) evidence to implicate the accused. Many practitioners will already be familiar with these cases. A common example is a burglary where the only evidence linking the accused is their DNA found on an object at the crime scene. With scientists now able to detect ever-smaller quantities of trace DNA, more suspects are being identified and prosecuted based on DNA evidence.¹
2. Yet, as the sensitivity of DNA technology increases, so do the problems. These include heightened risks of human error through contamination as well as the misinterpretation of irrelevant DNA (such as background or secondary transfer DNA).²
3. Secondary transfer DNA gained particular prominence after the High Court decision of *Fitzgerald v The Queen*.³ In *Fitzgerald*, the High Court sensationally acquitted a man convicted of murder in circumstances where the only evidence linking him to the crime scene was his DNA on a didgeridoo. *Fitzgerald* highlights the risks of misinterpreting DNA evidence and reinforces the need to be mindful of alternative explanations to account for DNA deposits on an item.
4. It is cases like *Fitzgerald* – cases where the only real evidence implicating the accused is a single DNA match – that this paper considers in detail. For ease of reference, these cases will be referred to as “DNA circumstantial cases”.

¹ Smith M & Mann M. *Recent developments in DNA evidence*. Trends & issues in crime and criminal justice (2015). Canberra: Australian Institute of Criminology at p.3.

² White D, Buckingham D, Clark D & McQueen H. *The use of DNA in criminal investigations*. Issues paper (2018). Wellington: NZ Law Reform Commission at p.130.

³ [2014] HCA 28 (“*Fitzgerald*”).

Structure

5. This paper is structured as follows:

Part II – Recap of principles for proving a circumstantial case
Part III – Secondary transfer and other hypotheses consistent with innocence
Part IV – Watch out for *Weissensteiner*
Part V – Relevant authorities for DNA circumstantial cases
Part VI – Limitations of DNA evidence
Part VII – Tips for cross-examining a forensic biologist
Part VIII – Conclusion

Qualification

6. Before delving into the subject matter, a word of qualification: this paper is not intended to be relied upon as a scientific source for DNA evidence. Rather, this paper discusses DNA evidence at a high level of generality and is only intended as a practical guide for practitioners who encounter these issues on a daily basis.

II. Recap of principles for proving a circumstantial case

7. DNA evidence is by its very nature regarded as “circumstantial evidence” as it relies upon an inference to connect it to a conclusion of fact (for example, from the presence of the accused’s DNA on the knife we can infer that he held it and used it to stab the victim). Such circumstantial evidence can be clearly contrasted with direct evidence of what a witness saw or observed at the crime scene.⁴
8. It follows that practitioners who encounter DNA circumstantial cases need to be familiar with the general principles outlined by the High Court in *The Queen v Baden-Clay*⁵ in relation to proof of a circumstantial case.

Summary of relevant principles

9. The principles in relation to circumstantial cases are well established. In *Baden-Clay*, the High Court (French CJ, Kiefel, Bell, Keane and Gordon JJ) quoted with approval the earlier authority of *Barca v The Queen* at [46].⁶

When the case against an accused person rests substantially upon circumstantial evidence the jury cannot return a verdict of guilty unless the circumstances are ‘such as to be inconsistent with any reasonable hypothesis other than the guilt of the accused. To enable a jury to be satisfied beyond reasonable doubt of the guilt of the accused it is necessary not only that his

⁴ For a helpful summary of the distinction between circumstantial evidence and direct evidence see *R v Sullivan (No 2)* [2018] ACTSC 300 (Elkaim J) at [14]-[16].

⁵ [2016] HCA 35 (“*Baden-Clay*”).

⁶ [1975] HCA 42 (“*Barca*”).

guilt should be a rational inference but that it should be **‘the only rational inference that the circumstances would enable them to draw’**.

10. The key principles in *Baden-Clay* can be summarised as follows: firstly, where the Crown case rests substantially on circumstantial evidence a jury cannot return a guilty verdict unless the Crown has excluded all reasonable hypotheses consistent with innocence.⁷
11. Secondly, for an inference to be reasonable it must rest upon something more than mere conjecture. The bare possibility of innocence should not prevent a jury from making a finding of guilt, if the inference of guilt is the only inference reasonably open upon a consideration of all the facts in evidence.⁸
12. Thirdly, all of the circumstances established by the evidence are to be considered and weighed in deciding whether there is an inference consistent with innocence reasonably open on the evidence. The evidence is not to be looked at in a piecemeal fashion (both at trial or on appeal).⁹
13. Fourthly, the defence is *not* required to establish that some inference other than guilt should be drawn from the evidence *nor to prove particular facts tending to support such an inference*.¹⁰ This is simply a reiteration of the fundamental principle that the Crown must prove the charge beyond reasonable doubt.¹¹
14. Finally, where an accused with peculiar knowledge of the facts declines to give evidence, “hypotheses consistent with innocence may cease to be rational or reasonable in the absence of evidence to support them when that evidence, if it exists at all, must be within the knowledge of the accused”.¹² This principle is derived from the earlier decision of *Weissensteiner v The Queen*.¹³ In a DNA circumstantial case, *Weissensteiner* has particular scope for application as explained in further detail at paragraph [39] below.

Unpacking *Baden-Clay*

15. In *Baden-Clay* the accused was charged with murdering his wife. At trial, the accused gave evidence denying any involvement in her death. The jury rejected this evidence and found him guilty of murder.
16. On appeal, the Queensland Court of Appeal found that there was a reasonable hypothesis that the accused was guilty of manslaughter but not murder, on the basis that he could have killed his wife in a physical confrontation without intending to kill her (for example, by striking her causing her to fall and hit her head on an object). The Court of Appeal allowed the appeal, set aside the verdict of murder and substituted a verdict of manslaughter.

⁷ *Baden-Clay* at [50].

⁸ *Baden-Clay* at [47] quoting *Peacock v The King* (1911) 13 CLR 619 at 661.

⁹ *Baden-Clay* at [47] quoting *R v Hillier* (2007) 228 CLR 618 at 638.

¹⁰ *Baden-Clay* at [62] quoting *Barca v The Queen* (1975) 133 CLR 82 at 105.

¹¹ *Baden-Clay* at [62] quoting *Knight v The Queen* (1992) 175 CLR 495 at 502.

¹² *Baden-Clay* at [50] quoting *Weissensteiner v The Queen* (1993) 178 CLR 217 at 227-228; [1993] HCA 65 (which was cited with approval in *RPS v The Queen* (2000) 199 CLR 620 at 633).

¹³ [1993] HCA 65 (“*Weissensteiner*”).

17. The High Court held that there was no evidence to support the manslaughter hypothesis. On the contrary, the accused's evidence at trial (that he had nothing to do with his wife's death) expressly excluded the hypothesis relied on by the Court of Appeal. The High Court concluded at [54]-[55]:

The evidence given in the present case by the [accused] narrowed the range of hypotheses reasonably available upon the evidence as to the circumstances of the death of the [accused]'s wife. Not only did the [accused] not give evidence which might have raised the hypothesis on which the Court of Appeal acted, the evidence he gave was capable of excluding that hypothesis.

The Court of Appeal's conclusion to the contrary was not based on evidence. It was mere speculation or conjecture rather than acknowledgment of a hypothesis available on the evidence. In this case, there was no evidence led at trial that suggested that the [accused] killed his wife in a physical confrontation without intending to kill her.

18. In so finding, the High Court overturned the decision of the Court of Appeal and reinstated the original verdict of murder.
19. The key takeaway from *Baden-Clay* is that for a hypothesis to be considered "reasonable", *there must be some evidential foundation to support the hypothesis. Speculation, conjecture or bare possibility will not suffice.* In particular, where the accused chooses to give evidence, this may have the effect of narrowing the range of hypotheses available upon the evidence.

Strands in a cable or links in chain?

20. There are generally speaking two types of circumstantial cases: "strands in a cable" and "links in a chain" cases. The key distinction between them is the standard of proof required for circumstantial facts in each.
21. The first category ("strands in a cable") is the most common. For this type of case, the Crown does *not* need to prove each fact or circumstance beyond reasonable doubt. Rather, the Crown can rely upon the totality of the evidence to prove the accused's guilt. Using the analogy of a cable, each piece of evidence may not be particularly damning when considered in isolation, but when the united force of all the strands of evidence are joined together it makes for a stronger case.
22. The second category ("links in a chain") refers to circumstantial cases where one of the facts relied upon by the Crown is so fundamental to the process of reasoning towards an inference of guilt that the fact must be proved beyond reasonable doubt. Such a fact is referred to as an "intermediate fact" being an indispensable link in a chain of reasoning toward an inference of guilt: *Shepherd v The Queen*.¹⁴ This type of case is dependent upon sequential reasoning. If one of the indispensable links in the chain cannot be proven beyond reasonable doubt then the entire case collapses.

¹⁴ (1990) 170 CLR 573 ("*Shepherd*").

23. In a DNA circumstantial case, the intermediate fact requiring proof beyond reasonable doubt will usually be that the accused's DNA was deposited on the item immediately before or during the crime. For example, in *Fitzgerald* the High Court held at [28]:

There was no dispute between the parties that it was an essential link in the prosecution's circumstantial case that the appellant's DNA was transferred by him to the didgeridoo during the attack. That circumstance was required to be proved beyond reasonable doubt.

24. However, where the Crown relies upon other circumstantial evidence (for example, CCTV or witness accounts) to place the accused at the scene, then it may not be required to prove beyond reasonable doubt that the accused's DNA was deposited on the item at the time of the incident.¹⁵

III. Secondary transfer and other hypotheses consistent with innocence

25. For DNA circumstantial cases, there will generally speaking be three categories of possible hypotheses consistent with innocence:
- a. Secondary transfer;
 - b. Contamination; or
 - c. Innocent explanation.

Secondary transfer

26. Of all the alternative hypotheses, secondary transfer has arguably the widest scope for application. First described in scientific literature in 1997,¹⁶ this theory holds that DNA can be transferred through an intermediary and then deposited onto an item without the person ever touching the item. By way of an example:

Malcolm and Tony shake hands. During the handshake, Malcolm's DNA is transferred onto Tony's hand. Tony then picks up a knife and in doing so deposits Malcolm's DNA onto the knife handle. Result: Malcolm's DNA is now on the knife handle without him ever touching it directly.

27. While at first blush this might sound like "CSI science", secondary transfer is now a well-established scientific phenomenon that has gained prominence as the sensitivity of DNA technology has improved. In *Fitzgerald*, the High Court held that secondary transfer was a reasonable hypothesis in light of evidence

¹⁵ See for example *Williams v The State of WA* [2017] WASCA 206 at [88] where there was other evidence linking the accused to the clandestine drug lab including photos from a doorbell camera and propensity evidence in relation to the production of methamphetamine. Accordingly, the Crown did not need to prove beyond reasonable doubt that the accused's DNA was deposited on the tape found in the drug lab in the course of attempting to manufacture the methamphetamine.

¹⁶ Van Oorschot RA & James MK. *DNA fingerprints from fingerprints*. *Nature* (1997); 387-786.

that the accused had shaken the hand of a co-accused at a boxing match in the hours before the murder. Hence it was a reasonable hypothesis that the co-accused had transferred the accused's DNA onto the didgeridoo without his knowledge.

28. Scientific testing in relation to the prevalence of secondary transfer is constantly evolving. In fact, recent scientific studies have confirmed that a handshake of a few seconds is enough to transfer a person's DNA onto the hand of an intermediary who can then transfer the DNA onto an object that the first person has never touched.¹⁷
29. In DNA circumstantial cases, practitioners should be alive to the possibility of secondary transfer for three main reasons:¹⁸
 - a. It could falsely link the accused to the crime;
 - b. It could introduce extraneous (or foreign) DNA into a forensic sample; and
 - c. It could lead forensic biologists to falsely conclude that DNA left on an object is the result of direct contact.
30. If you intend to go down this path you will normally need to cross-examine the forensic biologist about the possibility of secondary transfer. To that end, requiring the Crown to call their forensic biologist will be critical to establishing the evidential foundation for your hypothesis. Tips for cross-examining in this regard are set out at paragraph [110] below.

Contamination

31. In scientific terms, contamination refers to the detection of any DNA that is not immediately relevant to the crime being investigated.¹⁹ Scientists have identified four points in time when contamination may occur:²⁰
 - a. Before the crime is committed (this relates to normal "background" DNA and also includes secondary transfer DNA);
 - b. The interval between the crime and securing the crime scene (when first responders such as police and paramedics enter to treat a victim and in doing so may introduce extraneous DNA);

¹⁷ See for example: Cale C et al. *Indirect DNA transfer: The impact of contact length on skin-to-skin-to-object DNA transfer*. American Academy of Forensic Sciences annual meeting, Baltimore, February 21, 2019 (reported at <https://www.sciencenews.org/article/long-handshake-spread-your-dna-objects-you-didnt-touch>)

¹⁸ Cale C et al. *Could Secondary DNA Transfer Falsely Place Someone at the Scene of a Crime?* *Journal of Forensic Sciences* (2016); 196-203 at p.196.

¹⁹ Van Oorschot R et al. *Forensic trace DNA: a review*. *Investigative Genetics* (2010); 1-14 at p.11.

²⁰ *Ibid.*

- c. During the investigation of the crime scene and transportation of exhibits (i.e. from investigators touching or coughing over exhibits at the crime scene – also, exhibit collection devices such as fingerprint brushes can transfer DNA between exhibits); and
 - d. Within the laboratory (even with strict operating and cleaning procedures in place, DNA can still be transferred between exhibits and equipment in the laboratory).²¹
32. Recent studies have established that significant quantities of DNA are frequently transferred from crime scene exhibits to the inside of the packaging they are contained in during transit. In turn, DNA can also be transferred from the area of initial deposit to other areas of the same exhibit and other exhibits within the same package.²²
33. In *R v Hunt and Becirovic*,²³ Tilmouth DCJ observed the potential for contamination of exhibits in transit and storage (at [78]):
- The chain of evidence demonstrates the knotted plastic bags containing the 4-MCC and the single bag containing the small amount of cocaine, were lodged initially at the Adelaide Police Station Exhibit Property Section, and later removed to the Fingerprint Bureau ... [before] they were taken to the Forensic Services Branch... At these times the bags were transported together, so that the distinct possibility of contamination or secondary transfer from one plastic bag to another, or from inside the box cannot be excluded. So much was conceded by prosecution counsel to the point that the primary source of the DNA might have originated from within the box itself.
34. As with secondary transfer, in order to raise contamination as a reasonable hypothesis consistent with innocence it will be necessary to establish an evidential foundation for this hypothesis. This can be done by cross-examining crime scene investigators or forensic biologists to explore compliance failures with crime scene protocols and chain of custody procedures. It may also be helpful to call your own forensic expert to opine on the (in)adequacy of the procedures followed by forensic investigators during the police investigation.

Innocent explanation

35. As the heading suggests, this relates to an innocent explanation as to how the accused's DNA came to be on the object in question. The availability of this hypothesis will nearly always depend upon your client's instructions. Using the earlier example of the burglary, an innocent explanation would be that your client touched the object found inside the house at an earlier point in time (see

²¹ A recent case in the UK involved a man wrongly accused of rape before it was detected that contamination in the laboratory led to his wrongful identification. See <https://www.theguardian.com/law/2012/mar/09/forensics-firm-investigated-dna>

²² Goray M et al. *DNA transfer within forensic exhibit packaging: Potential for DNA loss and relocation*. Forensic Science International: Genetics Volume 6, Issue 2 (March 2012); 158-166.

²³ *R v Hunt and Becirovic* [2016] SADC 22. This decision was successfully appealed in *R v Becirovic* [2017] SASFC 156 due to the inadequacy of the trial judge's reasons. However, there was no adverse criticism in relation to the trial judge's comments about the possibility of contamination.

for example *The Queen v Wilton* discussed below at paragraph [57], where the accused gave evidence that he had previously come into contact with shopping bags found to contain cannabis).

36. The availability of this hypothesis will be impacted by the *nature* of the object in question. If the object is inherently moveable or small such as a soft drink bottle then the plausibility of this hypothesis will be greater. For example, it may be a plausible hypothesis that the accused innocently drank from the bottle and discarded it on the street before it was picked up by the unknown burglar who carried it into the house. While this may seem like an unlikely scenario, it would also be the perfect way for a burglar to deflect police attention by introducing an innocent person's DNA into the crime scene.
37. However, where DNA is found on a bulky fixed item inside the house such as a fridge or TV, it will be much harder for your client to provide an innocent explanation unless they had a legitimate reason for previously being inside the premises. Moreover, the presence of bodily fluids at the crime scene, such as blood in proximity to broken glass, will strongly support an inference that the accused injured themselves upon entry into the house.
38. There will be a fine balance between establishing an evidential foundation for an innocent explanation without the need to call evidence. As noted in *Baden-Clay*, the defence is not required to establish that some inference other than guilt should be drawn from the evidence *nor to prove particular facts tending to support such an inference*.²⁴ However, where the accused fails to provide a positive explanation to innocently account for how their DNA came to be on the object, then the potential application of *Weissensteiner* looms large. This is discussed in the section below.

IV. Watch out for *Weissensteiner*

39. When appearing in a DNA circumstantial case, it is important to be mindful of the potential application of *Weissensteiner*.²⁵ This case is arguably one of the most powerful weapons in the Crown's arsenal, yet experience suggests that most prosecutors fail to appreciate its significance or underestimate the adverse impact it can have upon a defendant who chooses to exercise their right to silence at trial.
40. In *Weissensteiner*, the accused was found in possession of a boat that belonged to two persons suspected of being dead. At trial, the accused exercised his right to silence. In summing up, the trial judge directed the jury that as the accused was the only person who could explain how he innocently came to be in possession of the boat, his refusal to give evidence meant that the jury could more safely infer that he was responsible for the deaths of the two owners. This direction was upheld on appeal and has become known as the *Weissensteiner* direction.

²⁴ *Baden-Clay* at [62].

²⁵ *Weissensteiner*, above n 13.

41. In *Weissensteiner*, the High Court (Mason CJ, Deane and Dawson JJ) explained the basis for the direction at [28]:

In particular, in a criminal trial, hypotheses consistent with innocence may cease to be rational or reasonable in the absence of evidence to support them when that evidence, if it exists at all, must be within the knowledge of the accused.

42. Fortunately for defence practitioners, *Weissensteiner* has been held to apply only in “rare and exceptional” circumstances.²⁶ As the High Court noted in *Azzopardi v The Queen*²⁷ at [68]:

It is to be emphasised that cases in which a judge may comment on the failure of an accused to offer an explanation will be both **rare and exceptional**. They will occur only if the evidence is capable of explanation by disclosure of additional facts **known only to the accused**. A comment will never be warranted merely because the accused has failed to contradict some aspect of the prosecution case.

43. Thus *Weissensteiner* can usually be distinguished on its very unusual facts. Importantly, it is also subject to the limitation that the innocent explanation must be perceived to be *only within the knowledge of the accused* and could not be the subject of evidence from any other person.

44. In a DNA circumstantial case, ascertaining the line between a *Weissensteiner* case can be very difficult. In *The Queen v King (No 2)*,²⁸ Murrell CJ declined to give a *Weissensteiner* direction in circumstances where the accused’s DNA was found on soiled underpants left at the crime scene. Murrell CJ observed at [73]:

Arguably, this was a “*Weissensteiner* case”. However, if there is any sensible line to be drawn between taking into account the failure of an accused to cast doubt on what may otherwise be the only rational inference and suggesting that the accused failed to give evidence because the accused believed that she or he was guilty, the **drawing of the line is fraught with difficulty**.

45. It is noteworthy that in *King (No 2)*, the Crown prosecutor conceded that an adverse inference should not be drawn from the accused’s silence.²⁹

46. In contrast, in *Donnelly v Richardson*³⁰ Fiannaca J held that it was open to the trial magistrate to give a *Weissensteiner* direction in circumstances where the accused’s DNA was found on a pickaxe used in a burglary.³¹ There was evidence that multiple people lived at the property and that the pickaxe had not been seen by the owner for about 12 months before the burglary. His Honour held at [101]:

²⁶ (2001) 205 CLR 50 (“*Azzopardi*”) at [68].

²⁷ *Ibid.*

²⁸ [2016] ACTSC 121 (“*King (No 2)*”).

²⁹ *King (No 2)* at [74].

³⁰ [2017] WASC 194 (“*Donnelly*”).

³¹ *Donnelly* at [102].

In other words, having regard to the evidence about the use and storage of the pickaxe, any innocent explanation for the appellant coming into contact with it would necessarily have been within his knowledge. Further, as the respondent submitted, at the very least, the appellant would have been aware of any innocent connection he had with the house or its occupants.

47. It is often said that “reasonable minds can differ” and one can expect that the application of *Weissensteiner* is largely going to depend upon the constitution of the court. Practitioners must come armed with a familiarity of the case law and ready to argue for/against its inclusion in a DNA circumstantial case.
48. One key factor to be mindful of when assessing the application of *Weissensteiner* is that it *cannot always be assumed that the accused had knowledge of how his DNA came to be on an object*. As will be noted below, there may be alternative explanations – including secondary transfer or contamination – that could account for the accused’s DNA on an object without their knowledge. This issue was considered by Fiannaca J in *Donnelly* at [103]:

I accept that if there was any reasonable basis to hypothesise that the appellant’s DNA came onto the pickaxe handle by secondary transfer, the foundation for the assumption that the appellant must have knowledge of any circumstances that would support such a hypothesis would be less secure. However, to draw any conclusion about that would be speculative, given that it was not a hypothesis relied upon at trial, there being no evidence about secondary transfer.

49. His Honour’s passage reiterates the importance of adducing evidence to establish an evidential foundation for an alternative hypothesis consistent with innocence. In *Donnelly*, the defence counsel did not cross-examine the forensic biologist about the possibility of secondary transfer. As a result, the only alternative hypothesis left for the court to consider was that the accused had innocently touched the pickaxe at some time prior to the burglary, which in the absence of direct evidence from the accused gave rise to the application of *Weissensteiner*.

V. Relevant authorities for DNA circumstantial cases

50. This section considers relevant authorities for DNA circumstantial cases. The cases are set out in chronological order, starting with the seminal decision of *Fitzgerald*.

***Fitzgerald v The Queen* (DNA on didgeridoo)**

51. The High Court decision of *Fitzgerald v The Queen* is the leading authority for DNA circumstantial cases. In *Fitzgerald*, the accused was convicted of murder based solely upon evidence of his DNA on a didgeridoo located at the crime scene. The Crown case was that the accused was part of a group that forced entry into the house and attacked the deceased. The Crown relied upon the DNA evidence to infer that the accused was present at the house and

participated in the attack. Importantly, there was no other evidence linking the accused to the crime scene nor any evidence that the didgeridoo was used in the attack.

52. At trial evidence was adduced that about 8 hours before the murder, the accused attended a boxing match where he shook hands with a man called Sumner. It was not in issue that Sumner then visited the house where the murder occurred on two occasions in the hours after the boxing match. Sumner was charged with murder as a co-accused.
53. The hypothesis of innocence put forward by the defence was based on secondary transfer – namely, that the accused's DNA had been transferred onto Sumner when they shook hands at the boxing match and that Sumner then deposited the accused's DNA onto the didgeridoo when he visited the house. (Interestingly, Sumner's DNA was not found on the didgeridoo.)
54. The forensic biologist gave evidence at trial in relation to the possibility of secondary transfer. The High Court (Hayne, Crennan, Kiefel, Bell and Gageler JJ) summarised this evidence at [22]:

Dr Henry explained the differences between "primary" and "secondary" DNA transfer. A primary transfer occurs as a result of direct contact between a particular person and an object. A secondary transfer occurs when contact or trace DNA is transferred onto an object by an intermediary as a result, for example, of a handshake. Dr Henry gave evidence that the most likely way to obtain contact or trace DNA on an object was through primary, rather than secondary, transfer. **She also stated that a secondary transfer of DNA remains possible a few hours after contact between a person and an intermediary, and that an intermediary's DNA is not necessarily transferred at the same time**, although she was only aware of one example of this in the relevant literature. She accepted as a possibility that the appellant's DNA [on the didgeridoo] was the result of a secondary transfer.

55. The High Court allowed the appeal and entered a verdict of acquittal, finding at [36]:

.... The jury, acting reasonably, should have entertained a reasonable doubt as to the appellant's guilt. Alternative hypotheses consistent with the appellant's innocence, in particular the hypothesis that Sumner transferred the appellant's DNA to the didgeridoo on Sumner's first visit to the house on the day in question, were not unreasonable and the prosecution had not successfully excluded them. As the evidence was not capable of supporting the appellant's conviction for either offence, no question of an order for a new trial arose.

56. *Fitzgerald* reinforces the legitimacy of secondary transfer as an alternative hypothesis consistent with innocence. It is also a strong reminder that DNA evidence is inherently complex, can be prone to misinterpretation and should not be presumed to be conclusive evidence of direct contact with an object.

***The Queen v Wilton* (fingerprints on shopping bag)**

57. While not technically a DNA circumstantial case, *The Queen v Wilton*³² provides a useful example of an “innocent explanation” in the context of fingerprint evidence. In *Wilton*, the accused’s fingerprints were found on re-useable shopping bags that contained cannabis. The bags were found inside a car being driven by the accused’s half-brother (Hallion). The accused’s fingerprints were found on 10 of the 12 bags containing the cannabis.
58. The accused gave evidence at trial that he had no connection to the cannabis and that Hallion must have taken the shopping bags on one of the occasions when he visited the accused’s house. The accused also gave evidence that he regularly did the shopping (which would account for how his fingerprints came to be on the shopping bags). The jury rejected the accused’s innocent explanation and found him guilty of drug trafficking.
59. On appeal, the majority (Vanstone J with Bampton J agreeing) considered the strength of the fingerprint evidence at [28]:

I consider that the connection between the appellant and the crime is far greater in the present case than it was in any of the previous decisions mentioned. Here, there were multiple fingerprints on 10 of the 12 plastic bags located within the two plastic buckets and one of those buckets bore the appellant’s fingerprints. Having regard to the evidence of the fingerprint expert that subsequent dealings with plastic bags would likely have the effect of destroying prints already placed on them, the number of prints located was significant. It was also significant that 10 of the 12 bags bore fingerprints. The jury might have taken the view that the process of placing cannabis in plastic bags, weighing it and wrapping it, was an activity much more likely to result in the deposit of fingerprints than merely using a bag to shop. Therefore, the fact that almost all of the bags in the plastic buckets bore the accused’s fingerprints could have been considered by the jury to be significant.

60. The majority dismissed the appeal, determining that it was open to the jury to reject the innocent explanation offered by the accused at [31]-[32]:

.... The prosecution evidence summarised earlier was capable of excluding any reasonable hypothesis consistent with innocence. It is a necessary implication of the guilty verdict that the jury rejected the particular innocent explanation advanced by the appellant in his testimony. In the absence of credible evidence which the jury was prepared to entertain of an innocent explanation the jury was satisfied that the prosecution evidence was not only capable of, but did in fact, prove the appellant’s guilt beyond reasonable doubt. My own review of the evidence leads me to the same conclusion.

While, on its face, the appellant’s answer to the evidence incriminating him was not manifestly implausible, it was for the jury to assess all the evidence in the case. It cannot be said that its verdict was unreasonable or not supported by the evidence.

³² [2014] SASFC 96.

61. In dissent, Nicholson J concluded the opposite at [47]:

I have reached the view that it was not open to the jury (acting reasonably) to dismiss the appellant's account of how he routinely stored and dealt with reusable plastic shopping bags and the buckets, as being reasonably possible. Similarly, the uncontested evidence as given by the appellant and the fact that he and Mr Hallion shared the same mother (with whom the appellant lived), meant that it was not open to the jury to dismiss, if only as a reasonable possibility, that Mr Hallion had access to the appellant's house and its contents leading up to when the packaged cannabis was seized from Mr Hallion's van.

62. Nicholson J (dissenting) would have allowed the appeal and entered a verdict of acquittal – another example of how reasonable minds can differ, particularly in the context of the reasonableness of alternative hypotheses consistent with innocence.

***Sloan v The Queen* (DNA on stocking used in robbery)**

63. In *Sloan v The Queen*,³³ the accused was found guilty of robbing a store. Items suspected of being worn by the robbers were later located and tested for DNA. The accused's DNA was identified as the major contributor on a black stocking.³⁴ The Crown contended that the stocking was worn by the accused to cover his face during the robbery. There were also two other minor contributors of DNA on the stocking including an unknown female.

64. At trial, the defence counsel put forward an alternative hypothesis that the accused's DNA had been deposited onto the stocking during a sexual encounter with the unknown female contributor. Counsel phrased the hypothesis as follows at [44]:

“... why would you exclude another possible inference and, that is, that the major contributor has contributed either saliva or semen, it is during a sexual encounter with the female, she is unknown, so it is some unknown female; that is how the DNA from the major contributor gets onto the stocking.”

65. On appeal, the court (Beech-Jones J with Bathurst CJ and Price J agreeing) rejected the “sexual encounter” hypothesis put forward by the defence at [58]:

Overall the evidence strongly suggested that the major contributor's DNA on the stocking was placed there during or as part of the placing of the stocking over the head of an offender during the robbery. No doubt the realisation that, other than using it as a mask during a robbery, there was no realistic explanation for Mr Sloan's DNA being on the stocking **was the reason for the salacious and somewhat desperate alternative hypothesis that was placed before the jury on behalf of Mr Sloan**. That hypothesis at least had the virtue of seeking to explain how a large amount of DNA from Mr Sloan came to be on the stocking.

³³ [2015] NSWCCA 279 (“*Sloan*”).

³⁴ A black hooded jumper was also found and tested for DNA and while the accused's DNA could not be excluded as a contributor, neither could it be determined whether his DNA was a minor or major contributor on the black jumper: *Sloan* at [32]-[33].

66. The court then considered the possibility of secondary transfer and the application of *Fitzgerald* at [67]:

However *Fitzgerald* does not assist Mr Sloan. As noted by the Crown, no possibility of secondary transfer arose in this case in relation to the stocking. There was no evidence proffered of any occasion when secondary transfer could have occurred. The possibility of secondary transfer onto the stocking was rightly disclaimed by Mr Sloan's Counsel during the trial. Otherwise for the reasons stated the totality of the evidence did not raise an alternative inference about the circumstances in which Mr Sloan's DNA was deposited onto the stocking to that contended for by the Crown.

67. In *Sloan*, defence counsel at trial had expressly excluded the possibility of secondary transfer which meant that it was not left to the jury to consider. Further, there was no evidence to support the “sexual encounter” hypothesis aside from the nature of the item itself (being a stocking, usually worn by a woman) and the presence of the unknown female’s DNA found on it.

The Queen v King (No 2) (DNA on soiled underpants found at scene)

68. In *The Queen v King (No 2)*,³⁵ the accused’s DNA was found on a pair of soiled underpants left at the scene of a burglary. The accused’s DNA was extracted as the major contributor on the waistband of the soiled underpants.

69. At trial, the accused declined to give evidence. However, defence counsel cross-examined the forensic biologist about the possibility that the accused had worn the underpants before they came into possession of the unknown burglar. This evidence was summarised by Murrell CJ at [35]-[36]:

Ms Stone accepted that it was “possible” that the major contributor [i.e. the accused] had worn the underpants some time prior to the offence and that someone else had worn them more recently. She could not exclude that scenario as a “reasonable possibility”. She conceded that the minor contribution could have been deposited directly by wearing.

Based on her visual observations, Ms Stone formed the lay opinion that the underpants had not been washed. She said that washing can remove cells and reduce the DNA yield by washing DNA away.

70. Whether the underpants had been washed became an important issue. In this respect, Murrell CJ observed at [69]:

The underpants were not washed after the accused’s DNA was deposited on them; had they been washed, it is unlikely that Ms Stone would have collected such a rich sample of the accused’s DNA from the underpants. If the burglar was not the accused, then the burglar was someone who was wearing the accused’s dirty underpants, and most people prefer to avoid wearing other people’s unwashed underpants.

³⁵ [2016] ACTSC 121.

71. His Honour concluded that the Crown had failed to exclude the alternative hypothesis that the accused had worn the underpants on a prior occasion. Accordingly, Murrell CJ proceeded to acquit the accused, finding at [77]:

In this case, the DNA evidence was the only evidence implicating the accused. Had there been any other evidence tending to implicate the accused which was not related to the DNA evidence, then I may have been satisfied of his guilt beyond reasonable doubt. However, **I am not satisfied that guilt is the only available rational inference. There is, for example, a reasonable (albeit small) possibility that the burglar was someone else who was wearing unwashed underpants that had previously been worn by the accused.**

72. *King (No 2)* is a reminder that the defence is not required to establish that some inference other than guilt should be drawn from the evidence *nor to prove particular facts tending to support such an inference*.³⁶ In this case, there was no direct evidence that the accused had actually worn the underpants on a prior occasion, rather, the court held that it was a rational inference that was open on the evidence. Further, as already noted at paragraph [44] above, the court declined to give itself a *Weissensteiner* direction, although Murrell CJ held that this was “arguably” such a case but as the Crown had conceded it should not apply, the court declined to do so.
73. Interestingly, the forensic biologist did not test the faeces stains on the underpants (nor the faeces stains on the floor near where the underpants were found). This was because faeces is generally regarded as a poor source of DNA due to the presence of bacteria which causes DNA to degrade. Had the accused’s DNA been found in the faeces then it follows that there would have been a much stronger inference that the accused was present at the scene. However, in this case, only the waistband of the soiled underpants was tested so the producer of the excrement remained a mystery.

***Donnelly v Richardson* (DNA on pickaxe used in burglary)**

74. In *Donnelly v Richardson*,³⁷ the accused’s DNA was found on a pickaxe located at the scene of a burglary. The pickaxe belonged to the owner of the house who had not seen it for about 1 year before the burglary. The pickaxe was found on top of a safe that had been moved but was unopened. DNA testing revealed a mixed profile with the accused as the major contributor.
75. The accused declined to give evidence. The trial magistrate found that the accused had attempted to open the safe with the pickaxe and was therefore guilty of the burglary. In reaching his decision, the magistrate gave a *Weissensteiner* direction, drawing a negative inference against the accused as he had not provided an explanation as to how his DNA came to be on the pickaxe. (The application of *Weissensteiner* was upheld on appeal and is considered further at paragraph [46] above).

³⁶ *Baden-Clay* at [62].

³⁷ [2017] WASC 194 (“*Donnelly*”).

76. On appeal, the possibility of secondary transfer was raised as an alternative hypothesis to account for the accused's DNA on the pickaxe. This was raised despite defence counsel having failed to cross-examine the forensic biologist about secondary transfer at first instance. Fiannaca J held at [78]:

In the present case, apart from the lack of expert evidence that might support the possibility of secondary transfer, there was no evidence at all to support a hypothesis that the appellant's DNA might have been transferred onto the pickaxe handle by an intermediary. There was no evidence that the appellant had any connection with Mr Thompson's residence or any of its occupants, or with anyone who may have had a connection with the residence or any of the occupants. There was no evidence that, on the day of the offence or soon before it (bearing in mind it occurred in the early hours of the morning) the appellant shook someone's hand or by some other means transferred his DNA to such another person who was then involved in the burglary.

In short, there was no evidence of any means, other than by primary transfer (i.e. by direct contact), which would explain the appellant's DNA being found on the pickaxe.

77. His Honour dismissed the appeal, concluding at [85]:

For the reasons I have given, considering the evidence as a whole, it was an inference reasonably open in this case that the appellant's DNA came onto the handle of the pickaxe as a result of him using the pickaxe in an attempt to open the safe. In the absence of any other reasonable inference, it was open to the magistrate to find that fact proved beyond reasonable doubt. As I noted in outlining the principles, in this context a reasonable inference must rest on something more than mere conjecture. In my respectful opinion, the appellant's submissions raise nothing more than a bare possibility of innocence, based on conjecture.

78. This case highlights the pitfalls for counsel in defending these types of matters. In particular, where the accused declines to give evidence then the application of *Weissensteiner* looms as a real possibility. Further, *Donnelly* reinforces the need to establish an evidential foundation for an alternative hypothesis consistent with innocence. In this case, defence counsel failed to cross-examine the forensic biologist about the possibility of secondary transfer which meant that in the absence of any evidential foundation, it was not left open as a reasonable hypothesis consistent with innocence.

***The Queen v Pfennig* (DNA on pyjama top)**

79. In *The Queen v Pfennig*,³⁸ the accused's DNA was found on a pyjama top belonging to a 10 year old murder victim. The victim was last seen wearing the pyjama top on the night that she was abducted from her home. The pyjama top was later found and tested for DNA. Expert evidence indicated that the pyjama top had been submerged in a river and thoroughly washed with water by the time it was found. The accused lived near the victim and his daughter was also friendly with the victim.

³⁸ [2018] SASFC 27 ("*Pfennig*").

80. The accused argued at trial that secondary transfer was a reasonable hypothesis on the basis that his DNA could have been transferred to his daughter and then to the murder victim when both girls were playing together.
81. The accused was found guilty of murder by a judge alone trial. On appeal, the court (Stanley J with Kourakis CJ and Peek J agreeing) summarised the secondary transfer hypothesis at [60]:

The appellant's hypothesis is that it was a reasonable possibility that his DNA was transferred to his daughter Petra and then to Louise who transported the appellant's DNA to her home some time in 1982 where it persisted until it was then transferred to the pyjama top some time after Louise received it on Christmas Day 1982. The appellant contends that it is reasonably possible his DNA from two different samples from the pyjama top then persisted on the garment despite its immersion into the Onkaparinga River and its subsequent rinsing in tap water.

82. The court proceeded to reject the secondary transfer hypothesis at [61]:

The trial judge rejected that hypothesis as fanciful. In my view, the judge was correct to do so. Given the state of scientific knowledge, the basis of the hypothetical tertiary transfer and the time involved, together with the existence of the appellant's DNA on two separate locations on the pyjama top are so unlikely that I consider the trial judge was correct to exclude the appellant's hypothesis as a reasonable possibility. The last possible contact between Petra Pfennig and Louise was at the pool party in late November / early December 1982. Further, the evidence does not demonstrate that any contact occurred between them on that occasion or on any other occasion in 1982 that would have given rise to transfer of the appellant's DNA to Louise. As I say, Louise did not come into possession of the pyjama top until Christmas Day 1982. The pyjama top was machine washed before Louise's abduction.

83. A key basis for the court in rejecting the secondary transfer theory was the expert evidence in relation to DNA "persistence" – that is, it was of particular significance that the accused's DNA was still on the pyjama top after it had been immersed in a river and washed thoroughly under a tap. In relation to this issue, the court held at [62]:

The issue of persistence becomes particularly relevant to the question of when the appellant's DNA came to be deposited on the pyjama top. One scenario is that the appellant's DNA survived the immersion of the top in the Onkaparinga River and its subsequent rinsing with tap water. The other scenario is that the appellant's DNA came to be deposited on the pyjama top after those events. In my view, either scenario excludes any innocent explanation for the deposit of the appellant's DNA on the pyjama top as a reasonable possibility. On the former scenario, for the reasons I have explained already, the tertiary transfer hypothesis can be excluded as a reasonable possibility. On the latter scenario the deposit of the appellant's DNA on the pyjama top after its immersion in the Onkaparinga River and its subsequent rinsing with tap water can only be explained by his role in the abduction and murder of Louise, given the circumstances in which the top came to be found by KD on her front lawn.

84. It should be noted that there was other circumstantial evidence linking the accused to the murder victim including that he lived near the victim's house, he knew the victim, he used to walk the streets at night and he spoke with a German accent that was similar to that heard on the phone telling a witness where items of the victim's clothes could be found. Accordingly, this was not a typical "DNA circumstantial case" in the sense that there was a considerable amount of other circumstantial evidence implicating the accused.

***Adams v The Queen* (DNA on breast of child complainant)**

85. In *Adams v The Queen*,³⁹ the accused's DNA was found on the breasts of a child complainant. The accused worked as a carer at a youth shelter where the complainant was residing. The complainant reported a number of sexual allegations against the accused including that he touched and licked her breasts while he was on duty one evening. At trial the accused was acquitted of three sexual offences but found guilty of the fourth.
86. On appeal, one of the key issues related to the presence of the accused's DNA on the complainant's breast. There was evidence that the complainant had asked for and handled the accused's mobile phone on the night of the incident giving rise to the possibility of secondary transfer. In considering this hypothesis, the court (Campbell J with Hoeben CJ at CL and N Adams J agreeing) held at [128]:

Of the three possible modes by which the appellant's DNA could have been deposited on the complainant's breasts we can put to one side completely the hypothesis that the test results indicated a residue of DNA after saliva had been washed off. The jury rejected that hypothesis completely. This then leaves direct transfer, or secondary transfer. I repeat, as Mr Walton pointed out, his results said nothing about the relative likelihood of one means of deposit over the other. Given the many imponderables, he explained in his evidence, generally direct transfer might be more likely because it is a simpler or easier process. **But secondary transfer could not be excluded as a reasonable possibility for the reasons he fully rehearsed. And there was a proper evidential foundation in the present case supporting the hypothesis of secondary transfer.** The complainant had handled the applicant's mobile telephone and other objects touched by him during the night of 29 to 30 January 2013 because it was common ground they had spent time together including at the computer when she got up. **Not only was this reasonable hypothesis consistent with innocence not excluded beyond reasonable doubt, but it had an affirmative foundation in undisputed evidence.**

87. The court ultimately allowed the appeal and acquitted the accused of the fourth count. The court held that there was no rational explanation for the jury to acquit the accused of three of the four counts other than doubts as to the complainant's credibility. The court held that in those circumstances, the jury's verdict for the fourth count was unreasonable and should be quashed.

³⁹ [2018] NSWCCA 303 ("*Adams*").

The Queen v Sullivan (No 2) (DNA on knife used in robbery)

88. In *The Queen v Sullivan (No 2)*,⁴⁰ the accused's DNA was found on a knife that was used in a robbery. At trial, the accused did not give evidence. Defence counsel put forward an alternative theory that the accused's brother (Rhys) was responsible for the robbery based on other items of clothing observed during the robbery which contained Rhys' DNA on them (namely a pair of shoes and balaclava).
89. Elkaim J acquitted the accused on the basis that the Crown had failed to exclude a number of alternative hypotheses consistent with innocence in relation to how the accused's DNA came to be on the knife. His Honour held at [107]:

The most persuasive of these facts is clearly the presence of the accused's DNA on the knife. This evidence must be treated with considerable caution. I should however note that I am satisfied that the reliable DNA profile identified on the knife did emanate from the accused. **What I cannot reach any conclusion about, let alone beyond reasonable doubt, is whether the DNA on the knife was a product of a primary, secondary or tertiary transfer.**

I can reach no conclusion about the time when the DNA was deposited on the knife nor can I reach any conclusion as to whether or not it was deposited there directly by the accused or whether it had travelled to the knife through one or more intermediary sources. **The police did not ask the accused's parents if the knife was from their household. If it had been then both the accused's and his brother's DNA might have been deposited on it in either a primary or secondary transfer.** There are clearly alternative hypotheses consistent with the accused's innocence. The situation here is not dissimilar to that which existed in *Fitzgerald v The Queen*.

90. Interestingly, Elkaim J appears to have accepted the reasonable possibility that the knife came from the accused's family house without any direct evidence to support this theory. Rather, his Honour relied upon the omission by the police in failing to ask the accused's parents if they recognised the knife as the basis upon which to find that the hypothesis was reasonably open.

Wurramara v Blackwell (DNA on cigarette found in a stolen car)

91. In *Wurramara v Blackwell*,⁴¹ the accused was charged with unlawfully using a motor vehicle. The car had been stolen for a period of about 12 hours before it was located by police rolled on its side. Four young men were seen jumping out the windows of the car and running away. None of the young men could be located by police. A forensic examination detected the accused's DNA on a cigarette butt found inside the vehicle.

⁴⁰ [2018] ACTSC 300 ("*Sullivan (No 2)*").

⁴¹ [2018] NTSC 89 ("*Wurramara*").

92. The trial judge at first instance found the accused guilty of unlawfully using the vehicle. On appeal, the court (Kelly J) accepted that the DNA evidence was sufficient to establish that the accused had been present inside the vehicle at *some time* during the 12 hour window. However, her Honour held that the trial judge ought to have had a reasonable doubt as to whether the accused *knew* the car was stolen at the time. Her Honour held at [49]:

The evidence establishes that the car was stolen at some time between “the evening prior” and shortly before the rollover when someone called police to report the erratic driving. **All the DNA evidence establishes is that the appellant was in the car at some point after the car was stolen. It does not establish that he was in the car when those things which the Crown relies on to establish guilty knowledge occurred.** Given that potential window of 12 hours or more during which the appellant could have been in the car, in the absence of the impermissible reliance on his personal experience of what cars boys from Angurugu drive (or any evidence to that effect), the trial judge, acting reasonably, **must have entertained a reasonable doubt about whether the appellant was present in the car when it was rolled, and therefore must have entertained a reasonable doubt about whether the appellant knew the car had been stolen when he was present in the car.** Hence the trial judge, acting reasonably, must have entertained a reasonable doubt about whether the appellant intended to unlawfully use the car.

93. At first instance the trial judge had taken judicial notice of the “fact” that “young boys in Angurugu don’t own or travel in cars like the vehicle that was stolen” to infer guilty knowledge on the part of the accused. (Angurugu is a remote Aboriginal community on Groote Eylandt in the Northern Territory.) On appeal, Kelly J held that it was not open to the trial judge to take judicial notice of such a matter as it was not a matter of incontestable fact but rather the trial judge’s *belief*. This constituted an additional basis to allow the appeal.

***Davies v The Queen* (DNA on bottle found near crime scene)**

94. In *Davies v The Queen*,⁴² the accused’s DNA was found on a bottle containing accelerant located next to the burnt door of a church. At trial, the DNA evidence was admitted over objection. The accused was found guilty of arson. On appeal, the accused challenged the DNA admissibility ruling.
95. The court (Kaye, McLeish and T Forrest JJA) held at [184]:

Before the trial judge, the applicant contended that the probative value of the DNA evidence was low and that there was a danger of the jury being unduly impressed by it, which gave rise to unfair prejudice which outweighed its probative value. In this context, he argued that the prosecution case was consistent with innocent transfer of the relevant DNA onto the bottle, which was an ordinary commercially produced beverage container. He further argued that the small quantity of DNA made the evidence insufficiently probative.

⁴² [2019] VSCA 66 (“*Davies*”).

The judge rejected these arguments. He considered that the possibility of innocent transference had to be considered in the light of the evidence of the applicant and his car both having been in the vicinity of the church at the relevant time. In contrast, there was no evidence that gave rise to a real risk of transference. In that regard, the judge distinguished *Fitzgerald v The Queen*, in which the possibility of transference by shaking hands was raised on the evidence and held not to have been excluded by the prosecution ... The judge concluded that the probative value of the DNA evidence, if accepted, was very significant and outweighed the risk of unfair prejudice, which could be ameliorated by directions.

96. The court affirmed the trial judge's ruling on the admissibility of the DNA evidence at [187]:

... Taken with other evidence, the DNA evidence was capable of supporting an inference that the applicant placed the bottle on the church step in the course of committing the offence the subject of charge 3. It was probative of the fact that a person 46,000 times more likely to be the applicant than a random member of the Australian Caucasian population had touched the bottle. In that context, Ms Jelic gave evidence that it was highly unlikely that two siblings, unless they were identical twins, would have the same DNA profile. **There was nothing in the evidence to suggest that the applicant had touched the bottle in any other context, or that his DNA could have been placed on the bottle by means of transference from a third party.** The strength of the relevant evidence, and the significance of the matters relied on by the applicant, fell for consideration by the jury, but if the DNA evidence were to be accepted, it carried significant probative weight, as the judge held.

97. As noted in the excerpt above, there was other evidence linking the accused to the crime scene, not simply his DNA on the accelerant bottle. Accordingly, *Davies* can also be distinguished from a typical DNA circumstantial case which relies substantially upon a single DNA match.

VI. Limitations of DNA evidence

98. This section provides a brief overview of the key limitations of DNA evidence. These limitations have been identified from a review of the case law on this topic. Given that DNA technology is constantly evolving, it is possible that these limitations may be overcome in years to come.

No reliable method for determining “age” of DNA or when it was deposited

99. Scientists are presently unable to determine the *age* of DNA nor estimate *when* it was deposited on an object.⁴³ This can have significant implications for a DNA circumstantial case. It also provides fertile ground for cross-examination of the Crown forensic biologist.

⁴³ See *Pfennig* at [35] and *Fitzgerald* at [25].

100. In *Fitzgerald*, the forensic biologist gave evidence on this issue, summarised at [25]:

Dr Henry stated that recovering DNA from an object does not indicate the time of its deposit on the object from which it is retrieved. With current technology, DNA cannot be "aged". She also stated that DNA could accumulate over a period of time, days or even weeks, and she accepted that contact or trace DNA could have been on the didgeridoo for some time before the attack.

101. It should be noted that some factors may limit the timeline for when DNA could have been deposited on an object. For example, where an object has been exposed to running water (i.e. clothing in a washing machine), then it may increase the probability that the DNA was deposited after the exposure to water. To this end, the notion of DNA "persistence" becomes important. In *Pfennig*, evidence was given at [56]:

In relation to the topic of persistence, Ms Mitchell gave evidence that there have been studies that have found that DNA may not persist after washing of clothing on which DNA has been deposited, or may be significantly degraded as a result. Mr Blankers gave similar evidence.

102. In *Adams*, the court considered the likelihood that the accused's DNA would have persisted on the child complainant's breast if she had taken a shower afterwards (albeit the evidence in relation to whether the complainant had actually had a shower was unclear).⁴⁴

No reliable method for determining biological source of DNA

103. Generally speaking, scientists are unable to determine the biological source of DNA.⁴⁵ While there are presumptive tests for saliva, semen and blood (which identify certain enzymes and proteins found in bodily fluids) this is not determinative proof that the DNA came from that particular bodily fluid.
104. In *Fitzgerald*, it was of critical importance that the Crown could not prove that the DNA came from the accused's blood on the didgeridoo, notwithstanding that there was a presumptive test which indicated the presence of blood and a noticeable "reddy-brown" stain which visually resembled blood. The evidence did not exclude the reasonable possibility that the accused's DNA was deposited *underneath* the "reddy-brown" stain, summarised at [19]:

A qualified forensic expert, Dr Julianne Henry, gave evidence at the trial for the prosecution. She explained that Sample 3B came from an area on the didgeridoo showing "reddy-brown stains" which had been removed using a scalpel. The sample consisted of two separate "bloodlike stains", one having a diameter of 2 millimetres by 1 millimetre and the other a diameter of less than 1 millimetre. Dr Henry **said that even if the abovementioned "reddy-brown stains" were in fact blood (as indicated by a presumptive test), that circumstance did not prove that the DNA in Sample 3B derived from**

⁴⁴ *Adams* at [131]-[132].

⁴⁵ See *Pfennig* at [35] and *Fitzgerald* at [19].

blood because the DNA may have been "under the stain", ie placed on the didgeridoo at an earlier time. She agreed with counsel for the prosecution that the "reddy-brown stains" may have "contributed nothing" to Sample 3B

105. Ultimately, the High Court determined that the Crown's contention that the DNA was derived from the accused's blood could not be made out beyond reasonable doubt, concluding at [36]:

On Dr Henry's evidence, including that extracted above, the prosecution's main contention, that the appellant's DNA in Sample 3B **derived from the appellant's blood, was not made out beyond reasonable doubt.**

106. *Fitzgerald* reinforces the notion that even where a presumptive test concludes the presence of a bodily fluid, it cannot be assumed that the DNA sample was derived from that particular bodily fluid.

No reliable method for determining how DNA was deposited

107. There is no reliable scientific method to determine the way in which DNA is deposited on an object.⁴⁶ For example, there is no reliable way to determine if the DNA was deposited by way of direct transfer or secondary transfer.
108. While many forensic biologists will be inclined to say that DNA is more likely to be deposited on an object by way of direct transfer, as it involves only one transfer event and less variables, by the same token they will generally be unable to give a precise assessment of probability. In the words of the forensic biologist in *Adams* at [67]:

"[r]eally I can't, in taking all those factors into account, say which method – which scenario is the most likely. Directly transfer is usually the most likely just because it's the easiest. There's only one transfer event so there's less factors affecting it. Whether that transfer is skin cells or saliva, in this particular case, I can't say. The possibility of saliva being on there and then washed off, leaving only a little DNA is possible, as is direct skin cell transfer and even though it may be less likely, secondary transfer is still a possibility. I just can't say how likely any of them are over the other."

109. Exposing the limitations of scientific methods for determining how DNA came to be deposited on an object can significantly undermine the strength of the Crown case. An example of how to cross-examine on this precise issue is set out in the next section below.

⁴⁶ Helmus J et al. *DNA transfer – a never ending story. A study on scenarios involving a second carrier.* International Journal of Legal Medicine (2016) 130; 121-125 at p.121.

VII. Tips for cross-examining a forensic biologist

110. Cross-examining a forensic biologist can be a challenging experience, particularly for a junior practitioner. However, it's important to remember that the key to a successful cross-examination is to *simplify* the science for the tribunal of fact, whether it be a judge or jury. In your closing address, you want to be able to explain the key strengths or weaknesses of the DNA evidence in an intelligible and easily understandable way.
111. Generally speaking, one of the key objectives for cross-examining a forensic biologist will be to get them to concede the possibility of your alternative hypothesis consistent with innocence (i.e. secondary transfer). This will help you to establish (at least in part) the evidential foundation that you need to leave the hypothesis open to the jury for consideration in deliberations.
112. It is unclear whether simply extracting a concession that secondary transfer is "possible" – without evidence of a factual scenario in which it could occur (i.e. such as the handshake at the boxing match in *Fitzgerald*) – will be sufficient to raise secondary transfer as a reasonable hypothesis consistent with innocence. However, it's important to remember that *Baden-Clay* is authority for the proposition that the defence is *not* required to prove facts to support an inference other than guilt – which would suggest that the defence is not required to prove facts to support a factual scenario in which secondary transfer could occur.⁴⁷
113. When cross-examining a forensic biologist, it can be helpful to use a simple hypothetical example to illustrate your point before applying it to the particular case at hand. Below is an example of an actual cross-examination outline prepared by my NAAJA colleague, Elana Scoufis. I'm grateful to her for allowing me to reproduce it. The case involved a defendant who was charged with indecently assaulting a complainant by grabbing her crotch from behind. The defendant's DNA was found on the complainant's skirt along with two unknown contributors. The extract begins after cross-examination in relation to the DNA sample and process of laboratory analysis:

Establishing possibility of secondary transfer

- Q. *It's possible for a person to touch an item and leave their DNA on it?*
- Q. *That is described as primary transfer?*
- Q. *But it's not necessarily the case that when someone touches an item they leave their DNA on it, correct?*
- Q. *I'm going to ask you about a hypothetical scenario between a person I will call Bob and another person I will call Jerry. Let's say Bob came into contact with Jerry. Bob might leave his DNA on Jerry, correct?*
- Q. *Then say Jerry touched an object. It's possible that Jerry could leave Bob's DNA on that object, isn't it?*
- Q. *That's called secondary transfer?*
- Q. *And it's accepted as part of forensic science that secondary transfer is something which can and does regularly occur?*

⁴⁷ *Baden-Clay* at [62].

- Q. *And in that scenario, a “false” connection is made between Bob and an item, given that Bob has never personally come into contact with that item, correct?*
- Q. *So, in that scenario, the item upon which DNA could be left would obviously include clothing?*
- Q. *And in incidents of secondary transfer involving clothing, would it be ordinary to expect that the owner of the clothing would be the major contributor?*
- Q. *And that Bob and Jerry would be minor contributors?*
- Q. *It’s possible that Bob in that scenario could be the major contributor?*
- Q. *Secondary transfer is something that occurs in the ordinary course of life?*
- Q. *Secondary transfer can occur when people shake hands?*
- Q. *It can occur when people use a handrail?*
- Q. *It can occur when people share a drink?*
- Q. *It’s fair to say that it can occur in a number of different situations?*

Application to case

- Q. *I’d ask you to turn your attention to the findings you recorded on page [X] of your statement. You wrote that the DNA sample was taken from the front region of the white skirt?*
- Q. *Relying on the evidence that you’ve just given about secondary transfer, you’d agree, wouldn’t you, that this sample is consistent with the possibility that the defendant’s DNA was left on the skirt as a result of secondary transfer?*
- Q. *In other words, it’s possible that the defendant never personally touched the skirt, correct?*

114. In the above example, the forensic biologist made all of the appropriate concessions and the defendant was ultimately acquitted on the basis that secondary transfer was a reasonable hypothesis consistent with innocence.

VIII. Conclusion

- 115. This paper has sought to outline the increasing trend of prosecution cases that rely upon DNA as the sole (or substantive) piece of evidence implicating the accused. As DNA technology continues to improve, it is likely that even more cases will be prosecuted on DNA evidence alone. Yet as our ability to detect ever-small quantities of DNA progresses, so do the risks associated with the misinterpretation of DNA evidence.
- 116. It is apparent that DNA evidence is inherently complex and should not be presumed to be conclusive proof of direct contact with an object. The question arises whether judicial notice can be taken of these limitations or whether specific jury directions are warranted to address the risks associated with the misinterpretation of DNA evidence. In the meantime, practitioners on both sides of the bar table would be well served to be mindful of the limitations of DNA evidence when appearing in such matters.

117. Feedback and comments are welcome. Please email the author at:
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