Orders 1, 2 and 3 - Objection to All Evidence Concerning Stain 91 (Item 550) Including Evidence of Its Location in the Garage at the Beck Street Premises and Subsequent Forensic and DNA Analysis and Opinion Evidence Arising From It

231 The CCS referred to the location of Stain 91 and subsequent testing and DNA analysis (at [94]-[110] above).

232 The parties have provided very detailed written submissions concerning two interrelated topics:

(a) whether Stain 91 is human blood (MFIs16, 25 and 31);

(b) whether DNA analysis and opinion evidence concerning Stain 91 (Item 550) ought be admitted (MFIs29 and 32).

233 In addition to the written submissions, short oral submissions were made on these topics on 14 April 2014 (PT1232-1241).

A Topic-by-Topic Examination or an Overall Examination?

234 The written submissions of the parties approach the objection to this body of evidence in different ways.

235 The submissions of the Accused challenge particular aspects of the technical and scientific evidence at different points along the way, commencing with the location of Stain 91 in the garage at the Beck Street premises on 13 May 2010, the sampling methods used and subsequent analysis and conclusions, as well as the process of DNA analysis undertaken at FASS, the opinion evidence of Dr Walsh and the processes undertaken by Dr Walsh and Dr Perlin and the conclusions reached by them.

236 The Crown submissions approach these issues in two overlapping steps:

(a) the Crown submits that the combination of all the evidence surrounding Stain 91 (Item 550) is overwhelmingly capable of proving that the stain was blood, that it is relevant and admissible evidence with issues surroundings its deposition and composition being proper questions for the jury to consider and determine;

(b) the Crown case in relation to the relevance and significance of the presence of the mixed DNA profile found in the Accused's garage is straightforward - as part of the circumstantial case, the fact that a mixed DNA profile with the extant properties it has, including the number of contributors, the likely contributors (including evidence of the Y-Filer haplotype), the presence of certain alleles and peak heights of those alleles, the fact that the mixture can readily be explained by the presence of the DNA from a combination of the five deceased, is similar to other samples from the crime scene, and the associated likelihood ratios, can be used persuasively to link the Accused to the crime scene.

237 It may be seen that the competing approaches of the parties on the question of admissibility of this evidence call for some assessment as to the appropriate method to consider the objection in this case.

238 As will be seen, I prefer the Crown's approach of determining the admissibility issue having regard to what is said to be the overall and cumulative effect of the evidence. For example, it would be unduly narrow, and conducive to error, to focus tightly upon the question whether, in light of the evidence concerning the location and sampling of Stain 91, it ought be excluded given the evidence of witnesses that it is *"possibly blood"*. It is relevant to take into account, amongst other things, the evidence of DNA analysis which tends to confirm the presence of DNA, and thus human material, in Stain 91. The evidence adduced on the DNA issue is capable of shedding light upon the question as to whether Stain 91 is blood.

239 As will be seen, there is, in addition, non-scientific evidence arising from the alleged actions and statements of the Accused, which bears upon this topic as well.

Events Leading to the Location of Stain 91

240 The Crown submission on the admissibility of Stain 91 (MFI25) contains a useful summary of aspects of the evidence leading to the discovery of Stain 91. It is helpful to set out this part of the Crown submission (MFI25, paragraphs 3-10) (footnotes excluded):

> *"Forensic examinations in relation to Stain 91 during the execution of the search warrant at 4 Beck Street, Epping on 11 May 2010*
>
> *3. On 11 May 2010, police executed a Crime Scene Warrant at the accused's home at 4 Beck Street and a detailed forensic examination and search of the premises was conducted. The search continued until 15 May 2010. On 13 May 2010, the forensic examination included the garage, where a number of swabs and samples were obtained of stains and markings believed to be blood. Underneath furniture in the garage, police located a small amount of what appeared to be blood which was sampled and sent for DNA analysis.*
>
> *Evidence from forensic officers searching the garage*
>
> *4. At the Committal, evidence was called from biologists Melanie LeCompte and Nicole Campbell, who were then attached to the Forensic Biology Section. Ms LeCompte attended 4 Beck Street between 12 to 14 May 2010. Ms Campbell attended the premises on 13 and 14 May 2010. Ms Gerhard, who was also then a reporting officer in the Forensic Biology Unit, attended on 12 May 2010.*
>
> *5. Ms LeCompte gave evidence on 29 August and 30 August 2012. Ms Campbell was called as a witness on 13 November 2012. Ms Gerhard, together with the defence expert Dr Paula Hallam, gave evidence during the voir dire proceedings on 21 and 22 November 2013.*
>
> *6. The biologists that were present at the time gave evidence in relation to a briefing that was provided to the forensic officers prior to the start of the search on each of the mornings, the areas that were examined at 4 Beck St, and the details and procedure of the forensic examinations, in particular, with regard to the garage floor and Stain 91.*
>
> *7. The defence expert Dr Hallam did not have the advantage of any direct observation of the screening, detection, examination and swabbing of Stain 91. ...*

Briefing

8. The forensic biologists were explicitly tasked with conducting an examination at 4 Beck Street that was focussed on detecting blood evidence. Ms LeCompte gave evidence that the forensic officers who conducted the search of the garage were briefed in the morning of 13 May 2010 to 'look for blood and therefore anything that we possibly could believe that was blood we would test to see if there is the possibility that the stain is a blood stain'.

9. Ms Campbell stated that the information she received from Ms LeCompte on the drive to the premises of 4 Beck Street on 13 May 2010 was that they were going to concentrate the search on this particular day on the garage. She was further informed that, 'they believed that the occupant of the house had been in the garage and they wanted to see if there was any blood staining in it'. Ms Campbell stated that, 'a plan was formed that we would concentrate on the garage that day that we would be looking for any sort of blood staining on any of the furniture, on the floor or on any of the tools. Basically, all the contents of the garage was to be searched'. Ms Gerhard confirmed that the biologists were given particular instructions to screen the premises for blood.

Examination of the garage floor

10. Ms LeCompte gave evidence that the examination of the garage floor commenced at 4.45 pm. The searching team included Nicole Campbell and Jae Gerhard. The search started with a 'hands and knees' search of the floor, followed by a visual examination with white light and the application of a presumptive screening test for blood using the chemicals Orthotolidine ('Otol') and hydrogen peroxide. The evidence was that all officers were searching the floor in relation to discoloured areas and conducting testing thereof, with Ms LeCompte being primarily responsible for the note taking. Ms Gerhard gave evidence that on the portion of the floor that had been allocated to her, she would estimate that she conducted 300-400 Otol tests alone. Ms Gerhard gave a detailed description of what is involved in the two-step Otol test."

241 The Crown submissions then turned to the discovery of Stain 91 and what was done thereafter.

Submissions of the Accused on the Question Whether Stain 91 is Blood (MFI31)

242 I turn to the submissions advanced on behalf of the Accused. Although not attempting an exhaustive recital of them, it is appropriate to provide some detail to assist an understanding of the objection.

243 The submissions for the Accused pointed to evidence from a number of witnesses which was said to demonstrate difficulties which the Crown have on this issue. Put shortly, it was submitted that what was said to be a small and ill-defined stain on a dirty and dusty concrete garage floor, which gave a positive reaction to one presumptive test and a negative reaction to another (as to blood), with no control testing having been done of the stain and with no swabbing of an area around the stain raised very grave doubt that Stain 91 was in fact blood.

244 It was submitted that Stain 91 has to be blood, on the Crown case, as otherwise there is no link between the Accused and the murders of the deceased.

245 The Accused submitted that the evidence in relation to Stain 91 being *"possibly blood"* should not be admitted because it is not relevant.

246 Submissions were made in support of this proposition by reference to the evidence Ms LeCompte, Ms Campbell and Ms Gerhard, together with the defence expert witness, Dr Hallam. These submissions involved a number of propositions:

(a) there were limitations on presumptive tests and an absence of control and confirmatory testing;

(b) there was no guarantee that the stain, and nothing other than the stain, was swabbed in the process of obtaining Stain 91;

(c) the limited assistance of the appearance of the stain and its reaction to Otol;

(d) the absence of direct evidence as to how the stain was deposited;

(e) the biological source of the DNA cannot be determined.

247 The Accused submitted that one of the facts in issue in the trial is whether the stain found in the Accused's garage, 10 months after the killings, was blood from the deceased killed in the Boundary Road premises. In order to prove this, the Crown has to prove that the stain found in the garage is human blood containing the DNA of some or all of the deceased, and which the Accused deposited after he murdered them.

248 The Accused submitted that the question whether the stain found in the garage is actually blood, is a fact in the Crown circumstantial case against the Accused that is so fundamental to the process of reasoning in relation to his guilt, that it must be proved beyond reasonable doubt: *Shepherd v The Queen* [1990] HCA 56; 170 CLR 573 at 585. It is submitted that this conclusion of fact is an indispensable, intermediate step in the reasoning process towards an inference of guilt, so that the conclusion must be established beyond reasonable doubt.

249 Reference was made to *Davidson v R* [2009] NSWCCA 150; 75 NSWLR 150 at 165 [74] where Simpson J (Spigelman CJ and James J agreeing) said that an intermediate fact will be *"indispensable"* where the absence of evidence of that fact means there is no fit case to go to a jury.

250 The Accused submits that the question whether the stain is blood is indispensable. If it cannot be proved that the stain is blood, the Accused submits that the stain is not relevant as there is no link to the murders. If the stain is not blood, it is submitted that it must not be placed before the jury.

251 The Accused submits that the very highest the experts can put it is that the stain is *"possibly blood"*. In light of the evidence given by expert witnesses at the committal proceedings and the pretrial hearing, it was submitted that it is now even less possible that the stain is blood, with the issue involving no more than speculation.

252 The Accused sought to rely upon *Armstrong v R* [2013] NSWCCA 113 as being illustrative of the dangers of the admission of presumptive testing. There, Harrison J (Simpson and Bellew JJ agreeing) stated (at [24]) that a presumptive test does not positively establish the presence of blood, and that the jury was arguably misled by a Crown submission that there was in fact blood found when the evidence in support of that submission did not rise above presumptive testing (at [29]).

253 Further submissions were made for the Accused pointing to aspects of the evidence of Dr Perlin, Mr Walton, Dr Walsh, Mr Goetz and Ms Neville. It was submitted that this evidence did not advance the Crown case that Stain 91 was blood.

254 It was noted that the Crown case was that Stain 91 involved at least three contributors mixed into the one sample (see [103] above). The Accused submitted that the Crown case that, because there were a number of contributors mixed into the sample, it was inevitable that they were mixed before being deposited on the garage floor, was pure speculation. It was submitted further that the manner of collection of the swab will affect the DNA analysis. It was submitted that Ms Campbell could not guarantee that she swabbed the stain, and the stain only, in taking the sample which is Stain 91.

255 The submissions summarised so far constituted the defence challenge to the relevance, and thus admissibility, of Stain 91.

Submissions of the Accused on the DNA Evidence (MFI29)

256 The Accused made separate and detailed written submissions directed to the exclusion of the DNA analysis and opinion evidence.

257 A range of topics were explored in cross-examination of Crown witnesses called at the pretrial hearing and, in particular, Dr Perlin. Not all challenges apparently made in the course of cross-examination, in particular of Dr Perlin, have translated into submissions for the Accused objecting to the tender of the evidence.

258 The Accused challenges the admissibility of the DNA evidence arising from Stain 91 (Item 550). It was submitted that, in order for this evidence to be relevant, the Crown has to establish:

(a) the stain swabbed in May 2010 in the Accused's garage was blood - if the Crown cannot prove that the stain swabbed is blood, there is no need to turn to the analysis of the DNA said to come from the stain;

(b) the blood-to-blood sample from the garage is the same as the sample from the crime scene - the Crown refers to *"evidence to evidence"* comparisons in the CCS (at [107] above) - the Crown seeks to establish that the samples came from the same source, being the victims' blood shared and mixed at the time of their deaths in the Boundary Road premises;

(c) the sample in the garage was a part of a larger sample from the crime scene - the alleged killer, the Accused, transported it from the Boundary Road premises to the Beck Street premises.

259 The Accused submitted that Item 550 was a degraded and inhibited sample, and a complex mixture of related people. These aspects are relevant to the analysis of the sample and how the results are interpreted.

260 The Accused submitted that Dr Perlin's TrueAllele program had not been validated for five-person related mixtures. It was submitted that TrueAllele had not been validated by FASS and, although a limited TrueAllele program is used, FASS is still in the process of preparing it and getting it ready for use. The Accused submitted that STRmix is the only validated program used by FASS.

261 It was submitted further that TrueAllele has not been validated for PowerPlex 21.

262 The Accused pointed to evidence that scientific staff from New South Wales Police and FASS carried out an evaluation of the Cybergenetics TrueAllele expert system and prepared an evaluation report for the Biologist Specialist Advisory Group ("BSAG"), a group with a senior representative from each of the Australasian jurisdictional forensic DNA laboratories. This group, in consultation with the Australasian Scientific Working Group on Statistics and Interpretation, identified that a move towards a continuous probabilistic model was the way forward for DNA interpretation and national standardisation (statement of Sharon Neville, 4 February 2014, Exhibit PTK1, Tab A). However, the Accused submitted that the BSAG evaluation process revealed a number of problems, including analytical artefacts, the modelling of stutter and other matters referred to in the Accused's written submissions on DNA evidence (MFI29, paragraph 43).

263 The Accused submitted that Dr Perlin's first report of 23 September 2013 was prepared before TrueAllele was validated.

264 A submission was developed that TrueAllele does not produce a relevant sample-to-sample comparison. TrueAllele generates likelihood ratios which are a measure of the extent to which the evidence changes beliefs in a hypothesis. A submission was developed by reference to the use by TrueAllele of inferred genotypes, and not actual evidence samples.

265 The Accused submitted that the TrueAllele analysis has no relevance to the fact in issue. It is entirely possible that one contributor to the garage mixture is the same as one contributor to the crime scene. However, the issue is whether all the contributors to the garage sample are found in the crime scene samples. The Accused submits that this is the only relevant hypothesis which supports the Crown case and that Dr Perlin's analysis does not address this question, let alone resolve it.

266 It was submitted further that TrueAllele is not capable of dealing with contributors who are related. It is not capable of dealing with a different number of contributors in each alternate hypothesis that the software considers. As a result, the likelihood ratios generated are said not to be relevant.

267 It was submitted further that the likelihood that individual persons may have contributed to the mixture is not relevant to the question of whether the sample is inevitably a combination of contributors, all of whom must be deceased to support the Crown theory.

268 The Accused submitted that TrueAllele will only answer the question it is asked. In this case, it was asked to identify the inferred genotypes for the deceased, and then identify the individual genotype in various evidence samples. It did not consider whether there were unknown contributors. It did not consider whether Brenda Lin's inferred genotype was in the mixture in the same manner. It did not consider if any other known reference sample, other than the Accused, was in the mixture.

269 The Accused submitted that the Crown case in relation to the DNA evidence may end up being that there are at least three contributors to Stain 91, with at least three in the major component or probably at least four or more taking into account minor contributors. The results of the Profiler Plus testing raised the possibility of interrelatedness amongst contributors based upon common alleles. Min Lin, Henry Lin and Terry Lin

could not be excluded as possible contributors to Stain 91 (see [101] above). The CCS noted that Mr Walton applied the RMNE formula, and determined that one in five people in the general population could not be excluded as a potential contributor. It was noted that Mr Walton adopted this formula due to uncertainty over the number of contributors to the mixed profile (see [101] above).

270 The Accused submitted that no expert who had given evidence at the pretrial hearing had determined the number of contributors to Item 550. Reference was made to the evidence of Mr Goetz, noting that he could not say there were five contributors in the mixture. Submissions were made, as well, on this topic by reference to the evidence of Dr Perlin.

271 Submissions were made by reference to the defence request to Dr Perlin to have Brenda Lin's sample tested using TrueAllele Casework. I note that Dr Perlin readily agreed to undertake this task. An adjournment of the pretrial hearing was allowed to permit the Accused's legal representatives to consider Dr Perlin's report in response to their request, and to take advice from their own expert advisor or advisors on the issues raised in it.

272 The Accused seeks to rely upon part of Dr Perlin's report dated 26 March 2014 as providing evidence of Brenda Lin's DNA being contained in Item 550, noting that this conclusion would mean that Item 550 cannot be linked to the crime scene, as Brenda Lin is alive (MFI29, paragraph 80).

273 The Accused made submissions concerning the concept of shadowing, mentioned in Dr Perlin's evidence with respect to this report. Further submissions were made by reference to Dr Perlin's report, the results of which were said to indicate that Brenda Lin was present in the crime scene samples and, in particular, Item 223, a swab taken from a wall in Bedroom 3 (the bedroom of Henry and Terry Lin). This sample was a direct swab of blood and it was noted that Brenda Lin was not present and did not bleed. This aspect was relied upon to challenge the reliability of Dr Perlin's evidence.

274 Submissions were made by reference to Dr Perlin's evidence concerning mixture weights. It was submitted that Dr Perlin's report of 26 March 2014 (Exhibit PTK20), being the report provided by Dr Perlin in response to the defence request (concerning Brenda Lin) made in the course of the pretrial hearing, provided an insight into the complexity of the mixture. Reference was made to concepts of shadowing and false positives, which were said to manifest the actual difficulties which TrueAllele has in dealing with five-person related mixtures which are compromised. It was said to constitute effectively an acknowledgement of an important area of imprecision in TrueAllele's capacities, being an imprecision previously demonstrated by the differing likelihood ratios in Dr Perlin's first two reports, and the error corrected in the third report that arose in applying an incorrect theta value.

275 The Accused noted that the Crown case is that the mixed profiles from Stain 91 (Item 550) and Item 626 (based upon PowerPlex 21 testing) are *"consistent, with a large amount of overlapping information, present in similar proportions"*. The Crown bases its case on this aspect on Dr Walsh, who said there was a *"very high degree of similarity for complex mixed profiles of this nature, particularly considering these observations under a proposition that the mixed profiles arose independently from each other"* (see [108] above).

276 The Accused submits that Items 550 and 616 are not, in fact, the same. There are features of the DNA profiles which are different. Peak heights and peak-height ratios, within and between loci, are different. There are 61 alleles in the mixed profile of Item 616. Those Item 616 alleles are present in the mixed profile from Item 550, but there are an additional 14 alleles designated in Item 550. It is submitted that the proportion of the allele distribution is not identical.

277 The Accused submitted that there were limitations on Dr Walsh's analysis. It was submitted that he had no specialised knowledge or experience in comparing complex mixtures. He had never made a comparative analysis

such as this before. It was this aspect which led to a s.79 objection to this evidence of Dr Walsh.

278 Dr Walsh was also unfamiliar with the performance of 3500s, a particular machine that works on PowerPlex 21. He did not have any direct involvement using those instruments. For the interpretation of the profiles, he was almost entirely reliant on the FASS staff. Dr Walsh sought advice in relation to criteria applied to interpret profiles, and stated that if there were questions regarding the profile designation itself, he would defer to the FASS laboratory.

279 The Accused developed a submission by reference to the additional 14 alleles in Item 550 which were not in Item 616. It was submitted, as well, that the fact that the sample comprised people who were related raised further difficulties when trying to establish similarities, and their significance.

280 Particular reference should be made to the following part of the Accused's written submission on the DNA evidence (MFI29, paragraphs 105-106):

> *"105. The evidence in this case will be that Brenda, Henry and Terry Lin spent significant time at the home and in the garage at 4 Beck Street, which was only 250 metres away from their house. All the deceased had been to 4 Beck Street. Min, Brenda, Henry and Terry had been in the garage. The children played in the garage. Kathy Lin's parents and Brenda Lin lived at Beck Street for around 10 months before the garage was sampled in May 2010. Numerous items from the Boundary Road house, from the newsagency, and Jimmy Hue were placed inside the garage before the garage was searched in May 2010. None of these items were filmed as police and forensic biologists moved them. With regard to these items, their nature, position, location, source and time of placement were not accounted for.*
>
> *106. There is therefore a very clear explanation for the presence of their DNA in the garage."*

281 I will return to this aspect later in the judgment. It is appropriate to observe at this point, however, that there was no evidence of these factual matters

adduced at the pretrial hearing. Further, these matters seem to foreshadow evidence which may be adduced at the trial which would be available to a jury to take into account in determining whether there is, in effect, an innocent explanation for the presence of DNA from persons including some of the deceased persons in the garage and, in particular, in Stain 91.

282 This aspect of the Accused's written submission appears to raise issues for a jury, and not matters bearing upon the question of admissibility.

283 As has been noted earlier (see [153], [157]-[159] above), the fact that the Accused advances these matters in submissions, as a possible alternative explanation for the presence of Stain 91 (and its DNA components), does not support the exclusion of the evidence. Indeed, it serves to fortify the view that the evidence ought be admitted, with the jury to assess the use to be made of this evidence, in light of all evidence adduced at the trial.

284 The Accused submitted that one of the significant failings of TrueAllele is that it cannot deal with related people. It was submitted that proportions in the profiles are not the same, with reference being made to parts of the evidence of Dr Walsh. The Accused noted that Dr Walsh made no statistical assessment of similarities.

285 It was submitted that there is no scientific basis upon which it can be concluded that Item 550 is relevantly similar to the crime scene sample.

286 The Accused submitted that there was no evidence upon which a reasonably instructed jury could conclude that the garage sample is relevantly or probatively similar to the crime scene sample. In order to have probative value, it was submitted that the similarities must advance the proposition that the DNA derived from blood at the crime scene. It is not in dispute that there are some generic similarities between the garage sample and the crime scene samples - the sample contains DNA, it is a complex mixture, it has multiple contributors, the contributors are male and

female and the samples contain a number of very common alleles. It was submitted, however, that DAL analysed about 640 samples from the crime scene and not one of these samples has the same DNA profile as Item 550, despite emanating supposedly from the same location.

287 The Accused submitted that a points of similarity approach has no scientific validity. It was submitted that comparing profiles does not involve adding up alleles in common.

288 The Accused submitted that it is not possible to determine if Items 550 and 616 were once part of the same mixture. It was submitted that there is no evidence that one sample is a sub-sample of the other sample. It was said that the Crown case has to be that Items 550 and 616 have come from the same pool of blood, but there is no evidence to support this.

289 With respect to the discretionary exclusion of the DNA evidence pursuant to ss.135 and 137 *Evidence Act 1995*, the Accused relied upon the following contentions:

(a) there is no true statistical phenomenon for something as complex as low template DNA profiles;

(b) TrueAllele is the *"new frontier"*;

(c) TrueAllele is a work in progress.

290 The Accused submitted that the time line of TrueAllele's analysis of the sample, and the time line of various TrueAllele studies, suggest the real possibility that TrueAllele is racing to provide a result in advance of proper scientific analysis and verification. It is said that its approach here is case specific, not conceptually or scientifically specific. It was submitted that the orderly development of reliable science and its implementation is evident from the significant work done by sanctioning jurisdictions before implementation.

291 The Accused submits that, no matter what the future holds for probabilistic analysis, it is clear that at this point the Accused in this case is the experiment and that it would be utterly unfair, unreliable and dangerous to admit this evidence.

292 Other matters are relied upon in support of discretionary exclusion were identified (without elaboration) (MFI29, paragraph 136):

(a) the quality of the sample involved;

(b) the complexity of the science involved in the matter;

(c) the emotional effect that the staggering numbers that TrueAllele generates will have on the jury;

(d) the subtlety of the distinction between the CCS and the notion of a sample-to-sample comparison;

(e) the probative value of the evidence is substantially outweighed by the danger that the evidence might cause or result in an undue waste of time;

(f) the probative value of the evidence is substantially outweighed by the danger that the evidence might be misleading or confusing;

(g) the evidence led by the Crown will have to be addressed by a significant defence case;

(h) there are contrary approaches to statistical analysis of DNA profiles (the work of Dr Mitchell and Professor Balding) which have not been explained or considered.

293 The Accused submits that the Crown's DNA evidence should not be admitted or, alternatively, should be excluded in the exercise of the Court's discretion.

Submissions of the Crown on the Question Whether Stain 91 is Blood (MFI25)

294 The Crown submits that the evidence is that the appearance of Stain 91 is consistent with an aged blood stain. The forensic scientists used a scale to describe stains and what could be seen of the stain is consistent with the characteristics of an old blood stain.

295 The Crown points to the joint report authored by Ms LeCompte, Ms Campbell, Ms Gerhard and Dr Hallam which states (paragraph 13):

> *"Whilst this stain did not exhibit a classic red-brown colour of a fresh or well-preserved blood stain the appearance of the stain fell within the expected range for an aged blood stain considering the surface upon which it was deposited, and the environmental conditions to which it may have been subjected."*

296 In response to the defence submissions concerning presumptive screening tests, the Crown submits that it is necessary to keep in mind that the area of the garage was not outdoors and that Stain 91 was in a well-protected area of the floor, under furniture. There was no evidence that the floor was in fact exposed to oxidising agents that would have generated a false positive. The Crown submitted that, in essence, the entire floor was itself a control, indicating that a false positive was highly unlikely.

297 The Crown emphasised that it does not rely on the presumptive test to establish that the stain was blood, but a combination of all the evidence. The strong reaction to Otol does not conclusively prove that the stain was blood, but it is a persuasive matter that a jury can consider.

298 With respect to the defence submissions concerning lack of confirmatory testing, the Crown submitted that there is no requirement for such a test. It

is not a precondition for admissibility. As there was a small sample, DNA testing would clearly yield the most information. It was noted that, in answer to a question in cross-examination as to whether, if confronted with a situation where a sample would be consumed by a confirmatory test for blood, a DNA test instead would be chosen, Dr Hallam, the defence expert agreed. The Crown submitted that what had occurred in this case accords with that approach.

299 With respect to the defence submission based upon the lack of a control test concerning Stain 91, the Crown submitted that control tests near the stain were not necessary, as the testing method employed on the floor was essentially a control test in itself, with reference being made to aspects of the evidence of Ms Campbell and Ms Gerhard.

300 The Crown noted that each of Ms Campbell and Ms LeCompte were cross-examined in relation to the measurements of Stain 91 and the level of care that was taken to ensure that only the stain itself, and not areas outside its edges, were swabbed. Ms Campbell confirmed that she would have ensured to swab the discolouration only, therefore avoiding the swab getting into contact with any of the surrounding areas.

301 The Crown submitted that Ms Campbell was a trained and skilled forensic biologist. It was her evidence that she tried not to get into any areas outside of the stain. She was at the scene to test stains and to perform this task.

302 It was submitted that there is no precondition for admissibility that the swab be taken from the stain only. If this were the case, the Crown observed that there would be very little forensic evidence of this nature admitted in criminal trials. Any perceived deficiencies with the sampling process could be explored before the jury, to be taken into account by the jury in assessing the evidence.

303 With respect to the defence submission that Stain 91 gave a negative reaction to Luminol testing, the Crown observed that the Luminol testing was not performed by the examining biologist, but by crime scene officers following the examination and swabbing of the garage floor. The Crown addressed the inconsistency in the positive result of Stain 91 to Otol testing as opposed to the negative reaction to the Luminol testing, referring in this regard to the evidence of Ms Gerhard.

304 With respect to the defence submission concerning possible transfer and the possibility that the moving and clearing out of furniture and boxes during the search of the garage may have caused an item to move onto Stain 91 and thus being responsible for the stain, the Crown pointed to the evidence of Ms Campbell that she did not believe that this was the case *"as there was furniture already on top of that stain"*. Stain 91 was detected in a protected area. The Crown submitted that Stain 91 was not located in an area that could be regarded as a suitable thoroughfare for a person to travel through the garage to put out a refuse bin.

305 The Crown noted the defence submission that the biological source of the stain cannot be determined. The Crown submitted that the presence of a great deal of DNA information from Stain 91 is indicative that the stain is not from small amounts of trace DNA.

306 It was submitted, in any event, that proving the biological source of Stain 91 is not a precondition for admissibility. It was submitted that the defence contention that what could have been on this stain was skin cells, blood, saliva, semen or a mixture of those materials was simply an alternative hypothesis for a jury to consider. Putting aside what the Crown submitted was the inherent improbability of the deposition by a combination of licking or dribbling, ejaculation, bleeding or rubbing off of skin cells onto the identical tiny protected spot in the garage, the Crown submitted that a jury would be entitled to conclude, from all the evidence, that the stain was blood.

307 The Crown pointed to the joint report of the four blood experts (both Crown and defence) which observed that, in determining whether Stain 91 is of human origin, the DNA profile should be considered as it would assist in determining whether the stain has human origins.

308 It was noted that Ms Gerhard and the defence expert, Dr Hallam, possessed relevant qualifications to comment on the DNA result. They provided an addendum report addressing the DNA profile obtained from Stain 91, which resulted in the consensus position:

> *"Based on the DNA profile generated it is agreed that the stain is of human origin."*

309 Ms Gerhard stated that this opinion was based on the amplification test and the DNA analysis itself which is human specific.

310 The Crown submitted that Dr Hallam's evidence that there was a small amount of DNA recovered from Stain 91 should be considered in the light of Dr Hallam's vastly lesser degree of relevant experience to the other DNA experts who have described the DNA quantities as possessing a lot of information.

311 As part of its submission that the question of admissibility of evidence concerning Stain 91 involved consideration of all evidence bearing upon that question, and not a narrow enquiry focusing upon discrete parts of the scientific evidence, the Crown relied upon what is said to be the Accused's admissions to Witness A as to the need to account for the finding of blood in his garage. It was submitted that the jury would be entitled to find that the Accused had made admissions as to the presence of blood in that location give Witness A's statements that:

(a) the Accused planned to invent a story of some mechanical work with Min Lin in his garage to explain Min Lin's blood on the floor of the garage; and

(b) alternatively, he attempted to explain the blood on the garage floor as having originated from the prior ownership of the home by a vet with it being animal blood.

312 The Crown submitted that the fact in issue in this trial, the existence of which the evidence in question is said to be rationally capable of affecting, is whether or not the Accused committed the five alleged murders. It was submitted that the CCS makes clear (see [110] above) that the Crown case is that the stain on the garage floor links the Accused to the crime scene, because it is the blood of the deceased from that crime scene.

313 The Accused agrees that this is the relevant fact in issue.

314 The Crown submitted that, if the jury was satisfied that the stain was mixed blood from the crime scene, which the Crown contends is the overwhelming inference, this is powerful evidence in the Crown case. It is submitted that the evidence undoubtedly has the capacity to rationally affect, directly or indirectly, the assessment of the probability of the existence of the fact in issue.

315 The Crown contends that the overwhelming inference is that the stain is mixed blood from the crime scene. Alternatively, any assessment of competing hypotheses is a question of fact for a jury to resolve.

316 The Crown accepts that its case is that Stain 91, part of which became Item 550, is a blood stain yielding a mixed DNA profile from which the deceased cannot be excluded as contributors. The Crown accepts that the tribunal of fact would need to be satisfied beyond reasonable doubt that Stain 91 is blood, indeed blood from the crime scene, to use it to reason towards guilt. However, the Crown submits that such a conclusion is not an indispensable link in a chain of reasoning towards an inference of guilt of the type referred to in *Shepherd v The Queen*. The Crown submits that this not a *"link in the chain"* circumstantial case.

317 The Crown does not accept that a tribunal of fact would be confined in their consideration of that question to the evidence of the blood experts, being Ms Gerhard, Ms LeCompte, Ms Campbell and Dr Hallam. The fact that the experts put it no higher than *"possibly blood"* is, the Crown submits, of little moment. The experts have considered but a small part of the Crown case in expressing that expert opinion. The Crown notes that the jury will be asked to consider the Crown case in its entirety.

318 The Crown relies upon the following factors in establishing that the biological source of Stain 91 (Item 550) is human blood:

(a) the results of presumptive testing - specifically the strong positive reaction to an Otol test;

(b) the appearance of the stain, which is within the range of what might be expected of an aged blood stain;

(c) the method or mode of deposition of the stain - a transfer mechanism - being consistent with deposition from a *"wet"* source;

(d) the presence of human DNA;

(e) the presence of a mixed profile with three, four or more contributors;

(f) the presence in that profile of alleles consistent in all respects with the DNA profiles of the deceased;

(g) the similar DNA profiles resolved from what were blood stains at the crime scene, such as Item 616 - both in terms of the alleles present and the peak heights and ratios of the DNA mixtures;

(h) evidence indicating the presence of the Accused in the garage in the period shortly after the murders (his statement to police that he

cleaned up the dirty garage floor on the morning of Saturday, 18 July 2009 - see [55] above) - evidence of at least one opportunity to have deposited the blood from the crime scene; and

(i) admissions by the Accused to Witness A.

319 Whilst noting that the blood experts cannot state definitively that Item 550 is blood, the Crown submits that definitive proof is not the applicable legal standard. The blood experts jointly opine that it is *"possibly blood"* based on factors which they took into account. Their opinion is based upon the realms of scientific possibility. Their joint opinion forms part of a larger circumstantial Crown case.

320 The Crown submits that the tribunal of fact will also have before it the evidence of mixed samples from the crime scene, including Item 616 which was described by Dr Walsh as displaying a *"very high degree of similarity"* to Item 550, with Item 616 having been sourced from a swab of apparent blood stain on a mattress in the bedroom in which Henry Lin and Terry Lin were killed.

321 The Crown submits that the tribunal of fact will be entitled to engage their common sense in determining what possible sources of DNA could have yielded the DNA profile extracted from Item 550, with it being inherently unlikely to come from mixed saliva or mixed epithelial cells. In the circumstances, the Crown submits that it will be open to the tribunal of fact to be satisfied beyond reasonable doubt that Item 550 is blood, and that it is blood that has been deposited from the crime scene.

322 The Crown submits that the defence focus upon the blood experts' opinion that Stain 91 was *"possibly blood"* involves misconceived reasoning, which divorces impermissibly that expert evidence from other persuasive evidence in the Crown case which will be before the jury, including the presence of human DNA and the analysis of that DNA.

323 The Crown distinguishes *Armstrong v R* which relates to the use of the evidence, and not its admissibility.

324 The Crown submits that the two separate bodies of expert evidence concerning Stain 91 and DNA evidence, and any conclusions as to its biological origin as human blood, are inextricably connected. There is little or no significance in a blood stain being found in the garage of the Accused's home if it cannot be said to be the blood of one or more of the deceased. Similarly, there is little significance in a collation of the DNA of one or more of the deceased being found in the garage of the Accused's home unless it is in some way connected to the crime scene, most obviously as blood from the crime scene. The Crown submits that the evidence must be considered collectively in resolving each issue.

325 The Crown submits that the combination of all the evidence surrounding Stain 91 (Item 550) is overwhelmingly capable of proving that the stain is blood. It is relevant and admissible evidence having that clear capacity, with issues surrounding its deposition and composition being proper questions for the jury to consider and determine.

Crown Submissions Concerning DNA Evidence (MFI32)

326 The Crown submissions summarised the evidence in a manner which I accept and incorporate later in the judgment. The Crown then responded to the defence submissions concerning the DNA evidence (MFI32, paragraph 77ff).

327 By way of general observation, the Crown noted that challenges to scientific innovations are routine. Reference was made to the statement of Thomas LJ in *R v Reed* [2009] EWCA Crim 2698; [2010] 1 Cr App R 23 at [111] that there is no closed category where evidence cannot be placed before a jury, and that it would be wrong to deny to the law of evidence the advances to be gained from new techniques and new advances in science with particular reference, in this context, to DNA evidence.

328 The Crown submitted that there is nothing unfairly prejudicial in the DNA evidence. There is no inflammatory or emotional quality to the evidence. Directions will ensure that no improper use is made of the evidence. If the jury determined that the DNA evidence establishes a link between the Accused and the crime scene, this evidence is highly probative. There is simply no unfair prejudice against this that needs to be weighed in the balance.

329 Alternatively, if there be a risk that the evidence would be accorded more weight than it deserved, any such risk would be ameliorated by directions.

330 In response to the defence argument concerning Dr Walsh's evidence, the Crown submitted that it does not assert, and does not need to demonstrate, that Item 550 is the same as any of the crime scene samples. It is inevitable that there would be differences between the samples. The relevance, the Crown submits, arises from the connection to the crime scene.

331 In response to the defence submission on the issue of similarity, the Crown submits that evidence of similarity is routinely admitted. The illustration is provided of evidence of identification being admissible in a circumstantial case, even where it is weak evidence: *Festa v The Queen* [2001] HCA 72; 208 CLR 593 at 611 [56].

332 The Crown referred expressly to the decision of the Court of Appeal (Criminal Division) in *R v Dlugosz and Ors* [2013] EWCA Crim 2; [2013] 1 Cr App R 32 in support of this submission.

333 The Crown submitted that, in the present case, Dr Walsh's opinions about the similarities between Item 550 and other crime scene samples are analogous to evidence allowed in *R v Dlugosz*. It was submitted that Dr Walsh's appropriate caution when expressing those opinions was apparent, and the limitations on the evidence would be crystal clear to the

jury. The experts themselves were at pains to point out the limitations. The Crown noted that Mr Goetz and Ms Neville, coming as they do from a rubric of statistical reporting, had referred the Crown to Dr Perlin, having noted the *"interesting similarities"*. The provision of Dr Perlin's statistical evidence did not mean that evidence of the noted similarities is inadmissible.

334 The Crown joins issue with a number of particular submissions advanced on behalf of the Accused, contending at different points that the submissions are not supported by the evidence. It was submitted that the defence contention that a degraded sample causes real limitations to a TrueAllele analysis is not supported by the evidence. Further, the Crown submits that degradation is a known phenomenon that is routinely observed, and taken into account, in the process of DNA profile interpretation and analysis.

335 In response to the defence submissions that TrueAllele had not been validated for five-person related mixtures, the Crown referred to the 2013 New York State Police Crime Laboratory System TrueAllele Validation Addendum (four-person mixture and familial study) which extended the TrueAllele validation beyond three-person mixtures (Exhibit PTK2, Perlin, Tab 9). The Crown submitted that this study concluded that the validation findings supported and extended the previous New York State Police data for low template samples and three-person mixtures, and strongly recommended the current methods of autosomal STR interpretation be replaced by TrueAllele for mixtures involving related and unrelated individuals.

336 The Crown submitted that what is clear from the validation is that all of the data is capable of being reliably used. The increased complexity of the samples was accounted for, and a reduction in match statistics is the result of any less clear-cut separation of genotypes because of shared alleles in family members or for mixture weight similarities.

337 The Crown pointed to a 2014 publication in which Cybergenetics, in collaboration with the Kern Regional Crime Laboratory in California, assessed TrueAllele's capacity to deal with five-person mixtures: *"TrueAllele Genotype Identification on DNA Mixtures Containing Up to Five Unknown Contributors"* (Exhibit PTK2, Perlin, Tab 10).

338 The Crown submitted that the validation studies contained in the evidence provide clear support for TrueAllele's robustness and suitability for analysing the complex data in this case. Stringent validation has included shared alleles and multiple contributors up to five. What those studies illustrate is that where the capacity of TrueAllele to extract information is logically and necessarily reduced by levels of complexity, this is reflected in lower and hence more conservative LRs and not in any compromised data. More complex samples produce more conservative results.

339 The Crown points to Ms Neville's evidence in which she expressed her belief that TrueAllele is capable of carrying out an interpretation of a complex mixture such as has occurred in this case (PT907).

340 The Crown noted that Dr Perlin had been cross-examined upon the basis that TrueAllele could not be adequately tested because it was a *"black box"*. The Crown observed, however, that no submission had been made on this topic by the Accused.

341 The Crown submitted, in any event, that both Ms Neville (PT894) and Dr Perlin (PT587) had rejected the characterisation of TrueAllele as a *"black box"*.

342 The Crown referred to the decision in *R v Karger* [2001] SASC 64; 83 SASR 1, where Mullighan J rejected a challenge to the admissibility of evidence obtained by way of a Profiler Plus system upon the basis, inter alia, that it was a *"black box"* (at 96-100 [449]-[465]).

343 The Crown submitted that it was not accurate to state that Dr Perlin's first report had been completed before PowerPlex 21 validation. Further, the Crown pointed to evidence from Ms Neville concerning the BSAG report and the introduction of STRmix at FASS, none of which involved a critical conclusion or rejection or non-validation of TrueAllele.

344 Contrary to the defence assertion, the Crown submitted that Dr Perlin did in fact make an evidence-to-evidence comparison, which he explained in some detail in evidence. He made this comparison by reference to genotypes. The same process of inferring genotypes was applied to each of the samples. The inferred genotypes were then used for the purposes of comparison. The raw data of the samples was necessarily converted into information (the inferred genotypes) that could be used in the formulation of an LR. The mathematical underpinning of the LR calculation was described in evidence.

345 In response to the defence submission that there had been no consideration of whether Brenda Lin's genotype was in the mixture, the Crown pointed to Dr Perlin's supplementary report (Exhibit PTK20) in direct response to the defence request (Exhibit PTK19) dealing with the reference sample of Brenda Lin. Ultimately, Dr Perlin provided a probability figure and concluded that *"in light of all the data, Brenda Lin, there's no statistical support for Brenda Lin having contributed her DNA to item 550 or item 616"* (PT1088).

346 In response to the defence submission that there was no evidence of the number of contributors to the garage mixture, the Crown submitted that there was consistency across the evidence of all the experts that there were at least three contributors. The evidence was summarised in the following way (MFI32, paragraph 170):

Expert	Item 550
Clayton Walton	At least 3 in the major (2 males, possibly one female)
Robert Goetz	At least 4 (at least 2 males)
Sharon Neville	Possibly 4
Dr Simon Walsh	550A: at least 3 (Terry, Henry, Min Lin) 550B: at least 4 (Terry, Henry, Min Lin, Yun Bin Lin)
Dr Mark Perlin	3, 4 or 5

347 In response to the defence submission that Dr Perlin had not referred to *"shadowing"* in earlier reports, the Crown noted that Dr Perlin explained that the presence of a relative at a lower match statistic may result in a *"false positive"*. To address this issue, Dr Perlin used a *"peeling"* process to provide further clarity in relation to any statistical support for the presence or absence of the DNA profile of Brenda Lin in Items 550 and 616. The Crown referred to evidence given by Dr Perlin concerning shadowing.

348 The Crown indicated that it did not seek to rely on evidence of *"peeling"* in evidence in chief at the trial. The Crown would necessarily rely on this evidence to rebut any defence suggestion that there is scientific support for the presence of Brenda Lin's DNA in Items 550 and 616. The Crown submits that, in light of the material in Dr Perlin's most recent report, to do so would be misleading. In these circumstances, the Crown submitted that it was not necessary for there to be any ruling on the evidence derived from the *"peeling"* process at this stage.

349 With respect to the defence argument that there is an alternative hypothesis or competing inference available to explain the mixed DNA sample in Stain 91 (see [280] above), the Crown submitted that to assert that the mixed sample from the garage came to be there by way of family members' overlaying DNA samples, from disparate biological sources at separate times, is manifestly absurd. In any event, the Crown submits that these are questions of fact for the jury to determine with the assistance of directions. The availability of a competing inference does not make the evidence inadmissible.

350 The Crown responded to the defence submission that TrueAllele was not validated and that it constituted a *"work in progress"*. The Crown submitted that TrueAllele is not an unfinished product. It is a highly validated method that has been in use, in its current 25th version, for over five years.

351 Reference was made to evidence of 20 TrueAllele validation studies having been done, five of them peer reviewed. It was noted that low template, complex three, four and five person mixtures were studied in the Kern Report (Exhibit PTK2, Tab 10).

352 The Crown submitted that TrueAllele is validated, and has been accepted in other jurisdictions on numerous occasions. In addition to Dr Perlin's evidence given in more than 20 trials, there have been a number of admissibility hearings in different overseas jurisdictions. These include:

(a) *Commonwealth v Foley* (2012) 38 A.3d 882 - evidence admitted at first instance with the decision being affirmed by the Superior Court of Pennsylvania;

(b) *R v Duffy and Shivers* [2012] NICC 1 - Hart J of the Northern Ireland Crown Court allowed Dr Perlin to give evidence with respect to TrueAllele results;

(c) *Commonwealth of Virginia v Brady* (unreported, Virginia Circuit Court, 17 December 2013) - the Court overruled an objection to evidence from Dr Perlin of TrueAllele analysis;

(d) *R v Broughton* (unreported, Oxford Crown Court, 29 June 2010) - Eccles J excluded TrueAllele evidence, notwithstanding his view that *"this evidence is capable of being admitted in evidence in the United Kingdom"*, with his Honour indicating that reasons would

later be given but with this (for reasons unknown) not having occurred;

(e) *California v Lawton, Langston and Harper* (unreported, Superior Court of California (Kern County), 1 October 2013) - the Court admitted evidence concerning TrueAllele analysis.

353 The Crown noted that, whenever there is a new advance in DNA technology or analysis, there is inevitably a challenge to the admissibility of the evidence garnered as a result. The Profiler Plus kit was challenged extensively at first instance in South Australia before the decision of Mullighan J in *R v Karger*.

354 In *R v McIntryre* [2001] NSWSC 311, Bell J considered the admissibility of opinion evidence regarding DNA results using the Profiler Plus system. Her Honour declined to exclude the evidence, referring to *R v Karger*.

355 The Crown pointed, as well, to *R v Fuller* [2013] SADC 150, where a challenge to STRmix evidence was rejected and the evidence admitted.

356 The Crown referred to authorities, including *R v Karger* at [179], which emphasised the roles of the prosecution, defence counsel, expert witnesses and the trial Judge in the process of adducing expert DNA evidence, addressing the jury and giving directions to the jury in a manner intended to reduce or remove any tendency of such evidence to mislead, prejudice or confuse the jury.

357 Reference was made to *R v MK* [2012] NSWCCA 110; 223 A Crim R 572, where the Court of Criminal Appeal allowed a Crown appeal from the exclusion by a trial Judge of mixed DNA evidence involving a major component and a weak minor component, with the Profiler Plus kit having been used as well as Y-Filer testing. There was uncertainty surrounding the number of contributors. The Crown referred to the decision of the High

Court in *Aytugrul v The Queen* [2012] HCA 15; 247 CLR 170 in support of the admission of the evidence in the present case.

358 The Crown submitted that, if there was any prospect of a danger that the jury would attribute weight to the DNA evidence that was unjustified because it was complex evidence, directions would ensure that that was not the case.

359 The Crown submitted that the evidence of DNA analysis was relevant and that it was the product of appropriate expertise. It was submitted that it should be admitted, with scope for any appropriate challenge to the evidence being available by way of cross-examination, evidence from defence experts and submissions concerning the evidence.

360 It was submitted that the evidence in this trial was not collected from a sterile environment, but from a garage floor and a biologically complex crime scene. Complexity is inherent in any such collected profile and information is lost if human methods of interpretation are applied.

361 In a complex mixture such as Item 550, it was noted that much data is lost in the calculation of LRs because of the complexity of the mixture and the application of arbitrary thresholds. The DNA evidence extracted from evidence items undoubtedly contains relevant information.

362 The Crown submitted that TrueAllele's significant advantage over human methods is that it uses all of the data obtained in the analyses performed, and assigns corresponding probabilities to different hypotheses that explain the data. TrueAllele calculates an accurate result based on the entirety of the available data. In addition, there is no prospect of contextual bias as the analysis is an objective one, a situation reflected in the LRs generated.

363 The Crown submitted that the DNA evidence is relevant, admissible evidence and ought not be excluded on any discretionary basis.

Summary of the Evidence of Mr Walton, Mr Goetz, Dr Walsh and Dr Perlin

364 The Crown submissions (MFI32) contain a summary of the evidence of Mr Walton, Mr Goetz, Dr Walsh and Dr Perlin which I consider (for the purpose of this ruling) to be accurate, and incorporate in this part of the judgment.

365 Mr Walton gave evidence of the steps he had taken in the laboratory in respect of the testing of Item 550. The first round of testing conducted on Item 550 did not return a result. Item 550 was then subjected to a process of robotic automation called Microcon, which allows the washing of the DNA to try to remove inhibitors. A second amplification process took place which permitted more effective testing and results.

366 Mr Walton outlined the process of Y-filer, Identifiler and PowerPlex 21 testing. His evidence on 28 March 2014 (PT1015) involved an explanation by him of the concepts of threshold, artefacts, stutter and post-stutter. Mr Walton concluded that there were no alleles present in Item 550 that could not be accounted by reference to the combined DNA profiles of the deceased.

367 Mr Walton gave evidence about the number of contributors to Item 550. The statistical opinions expressed by Mr Walton were summarised in a table contained in the Crown written submissions (MFI32, paragraph 13) which constitutes an accurate summary. That table is reproduced below (excluding footnotes):

Report	Opinion	Genetic kit	Calculation
Report 2 (16 December 2010) and **Report 6** (9 July 2012)	Approximately 1 in 5 people in the population cannot be excluded as major contributors to the mixture.	Profiler Plus/ Identifiler testing	Random Man Not Excluded ('RMNE')
Report 6 (9 July 2012)	All patrilineal related male relatives and approximately 1 in 760 unrelated males in the general population cannot be excluded.	Y-filer testing	Counting method
Report 8 (16 October 2013)	Approximately 1 in 210,000 people in the Australian Southeast Asian population cannot be excluded from the major component of this mixture. Approximately 1 in 730,000 people in the Australian Caucasian population cannot be excluded from the major component of this mixture. Approximately 1 in 620,000 people in the Australian Aboriginal population cannot be excluded from the major component of this mixture.	PowerPlex 21 testing	RMNE

368 Mr Goetz stated that each of the alleles designated in Items 47, 223, 550 and 616 were consistent with alleles in the reference samples of the five deceased. He described the similarities between Items 550 and 616 as (PT 673):

> *"... interesting, because I've looked at thousands of profiles over the years ... and to see two that are that similar, it is quite interesting."*

369 Mr Goetz later described his use of the term *"interesting"* as meaning that the similarities *"have some sort of scientific merit"*. However he was unable to attribute statistical significance to the similarities. Mr Goetz later stated:

> *"... I found the similarity between the profile in the house on the mattress in particular and the profile in the garage to be unusual, that is why it was interesting because the amount of alleles that*

were there were similar, the peak heights were similar, and you don't tend to see that in two in theory unrelated scenes".

370 Mr Goetz did not agree that the samples were *"low template mixtures"*. He considered that the sample *"had a reasonable quantity of DNA present"* (PT708).

371 Mr Goetz was of the view that there were at least three, and possibly four or five contributors to Item 550 (PT684). He later stated that *"there are at least four"* (PT690). Concerning the possibility of five persons, Mr Goetz said (PT684):

> *"... the relationship between the mattress and the garage, it is throwing doubt on the whole possibility you are dealing with related people in the garage and therefore you could not be sure that you are dealing with only four people. It could be five".*

372 Mr Goetz considered that the DNA profile taken from Item 550 showed signs of relatedness amongst contributors (PT 688). He considered that the sample in the garage (Item 550) was a stronger sample than the sample from the bedroom mattress (Item 616) (PT686).

373 It was Mr Goetz's belief that the validation of TrueAllele by FASS had been completed, but had not been written up. He stated that, in part, FASS had moved in another direction, utilising STRmix, due to considerations such as cost and the length of time TrueAllele took to generate results. A concern about the reliability of TrueAllele was not a factor and he agreed that he considered TrueAllele to be a reliable system (PT707). Mr Goetz was confident in the results generated by TrueAllele (PT708).

374 In re-examination, Mr Goetz was asked concerning the comparative validation of STRmix and TrueAllele (PT707):

> *"Q. In terms of comparison between STRmix and TrueAllele is either system more validated than the other insofar as you are aware?*

A. In my opinion probably TrueAllele is. It has been around a lot longer and has been used in overseas cases. It has undergone scrutiny by overseas experts and had a couple of documents written about the validation of it. To me it probably had more inspection of the system than STRmix had. Given another year STRmix would have probably been just the same."

375 Dr Simon Walsh is an important witness in the Crown case. The Crown written submission described his background and experience in the following way, which I consider to be accurate (MFI32, paragraph 36) (footnotes excluded):

> *"Dr Walsh holds the position of Chief Scientist at the AFP in Canberra. He has been employed with the AFP since November 2006. In 2009, Dr Walsh completed a PhD in forensic science on the topic of 'Evaluating the role and impact of forensic DNA profiling on the criminal justice system'. Dr Walsh has been involved in the field of forensic DNA and forensic criminal casework for almost 20 years, and has regularly interpreted complex mixed DNA profiles. Dr Walsh has published widely, and given evidence in Court on numerous occasions. He is the co-author of three books, two of which have been published (with the third awaiting publication): 'Forensic DNA Evidence interpretation' and 'Case Study in Forensic Science'. Dr Walsh maintains membership of a number of relevant professional organisations and holds the position of adjunct Professor at the University of Canberra Dr Walsh is a pre-eminent DNA practitioner in Australia and New Zealand. The Crown relies on Dr Walsh's experience in interpreting complex DNA samples in the forensic area."*

376 Dr Walsh's experience and training are of particular significance given the s.79 objection taken to part of his evidence.

377 Dr Walsh considered the results obtained by FASS from the Profiler Plus, Identifiler, Y-Filer and PowerPlex 21 for Item 550 and compared them to other items from the crime scene that he considered similar, namely Items 47, 224 and 616.

378 Dr Walsh initially interpreted Item 550 relying on two separate profiles obtained by FASS as a result of two amplification processes. Profile 550A was obtained on 10 June 2010 following amplification with the electrophoreses system, whilst Profile 550B arose from a further

amplification on 18 June 2010. Dr Walsh expressed the opinion that Profile 550A contained the profile of at least three different individuals that could be explained by Terry, Henry and Min Lin. In relation to Profile 550B, Dr Walsh concluded that this profile arose from at least four individuals, with the additional DNA present in that sample being explained by Yun Bin (Irene) Lin further to Terry, Henry and Min Lin.

379 Dr Walsh gave evidence concerning similarities with other samples from the crime scene. He undertook a comparison between Item 550 and Item 616 following PowerPlex 21 testing. Whilst Dr Walsh stated that his familiarity with the PowerPlex 21 kit, and the associated capillary electrophoreses machine 3500s, is limited due to the recent introduction of the kit, his experience with the performance of the established kits informed his ability to interpret PowerPlex 21 data. Dr Walsh was asked (PT934):

> *"Q. When you did consider item 550 against item 616, what was your opinion about the relative similarity of those two mixed profiles?*
>
> *A. Well, my opinion is that they are similar. There was a high level of consistency between the two profiles, a high level of overlapping information"*

380 The following similarities between Item 550 and Item 616 were observed by Dr Walsh and were considered significant:

(a) all 61 alleles designated in Item 616 were present in Item 550;

(b) there was an observable similarity between those samples in terms of the proportions of the alleles they have in common;

(c) there was no example of a considerable departure from the general consistency;

(d) each sample was in itself a complex mixture arising from at least three contributors;

(e) there was no association or reason for these profiles to be similar.

381 The cross-examination of Dr Walsh focused on, inter alia, dissimilarities observed between samples. Dr Walsh acknowledged the presence of dissimilarities, but maintained his position. Dr Walsh was of the opinion that *"there is a lot more similar information in there than there are dissimilar pieces of information"* (PT941).

382 A challenge was made to Dr Walsh in cross-examination concerning his capacity to express an expert opinion in relation to similarity (PT942):

> *"Q. You just - I mean, really this is your evidence: "I've looked at it, I'm an expert and I reckon they are relatively similar"; that's it, isn't it?*
>
> *A. I would probably summarise it a little differently. I would say that what I am looking at are two objective pieces of scientific data, each of which are highly complex with a high amount of information. To generate any of those complex pieces of data can only occur under a certain limited amount of circumstances."*

383 The Crown relies on Dr Walsh's expertise in the area of forensic DNA interpretation and submits that he is qualified to comment on the observed similarities between Item 550 and Item 616, which he considers significant, without the provision of a statistic. I will return to this topic.

384 In relation to the haplotype present in Item 550 that was consistent with Min, Terry and Henry Lin, Dr Walsh consulted the *"Y chromosome haplotype reference database"*, the largest of its kind (PT982-983).

385 The evidence reveals Dr Perlin's substantial background and expertise in the area of DNA mixture interpretation. He is the Chief Scientific Officer and Chief Executive Officer of Cybergenetics, a bio-information company based in Pittsburgh, PA, United States which was formed 20 years ago.

Dr Perlin is an expert on DNA mixture interpretation and the likelihood ratio. He holds a PhD in computer science, a PhD in mathematics and a medical degree.

386 TrueAllele is the software system developed and employed by Cybergenetics and Dr Perlin. It is currently in its 25th version, and has remained the same since 2009. The software in its first form was designed 20 years ago.

387 TrueAllele applies a probabilistic method of DNA typing. The system objectively infers genotypes from the entirety of the data. Contrary to the defence submissions, the Crown submits that is this one of the qualities of the TrueAllele system. It means that there is no loss of information due to thresholds, and that the system looks at the data without considering any of the known reference samples. These inferred genotypes then allow comparisons to be made with other evidence items of reference samples, producing a match statistic in the form of a likelihood ratio, that is the probability of a match.

388 Having considered the evidence given by Dr Perlin over several days, there is force in the Crown submission that the probabilistic method utilised with TrueAllele represents a strength, and not a weakness, in assessing issues relevant to the admissibility of the evidence.

389 Dr Perlin gave evidence concerning the relationship between evidence items, inferred genotypes and reference samples.

390 Cybergenetics received electropherograms ("EPGs") for Items 550, 616, 13, 47, 205, 221, 223, 224 and 229, and the reference samples from the five deceased, the Accused and Brenda Lin, together with all of the results of the Profiler Plus, Identifiler, Y-Filer and PowerPlex 21 testing runs.

391 TrueAllele requires the human operator to provide a range of contributor numbers to be considered prior to the start of the computer process. For

Item 550, three, four or five contributors were assumed. The number of peak heights that are observed are a decisive factor in this consideration. TrueAllele can be set to assume any number of contributors up to 10. Once a sufficient number of contributors are assumed, the behaviour of the system is the same statistically (PT626) and the system does not overstate (PT790).

392 Dr Perlin explained that the way the system expresses the challenge to use all of the information results in a conservative approach, a negative log likelihood ratio ("LR").

393 The probability statistics (LRs) provided in Dr Perlin's updated report dated 21 March 2014, taking into account the higher theta value (co-ancestry coefficient), are reflected in the following table (MFI32, paragraph 76):

Reference	**Item 550**
Yun Bin LIN	28.5 thousand times (Asian person)
	1.68 million times (Caucasian person)
Yun Li LIN	289 times (Asian person)
	15.7 thousand times (Caucasian person)
Min LIN	226 thousand (Asian person)
	367 million (Caucasian person)
Henry LIN	2.21 Billion times (Asian person)
	1.73 trillion times (Caucasian person)
Terry LIN	50.4 quadrillion times (Asian person)
	80.8 quintillion times (Caucasian)
Item 47 [door handle]	Item 550
Contributor to 550 matches a contributor to 47: 1.08 billion (relative to an Asian population) 1.4 trillion (relative to a Caucasian population)	
Item 223 [bedroom wall]	Item 550
Contributor to 550 matches a contributor to 223: 4.29 million (relative to an Asian population) 7.33 trillion (relative to a Caucasian population)	

Reference	Item 550
Item 616 [bedroom mattress]	Item 550
Contributor to 550 matches a contributor to 616: 1.11 quadrillion (relative to an Asian population) 4.23 quintillion (relative to a Caucasian population)	

Decision

394 I commenced an examination of this topic (at [234]-[239] above) by noting the competing approaches of the Accused and the Crown to the admissibility of evidence concerning Stain 91 and subsequent DNA analysis and LR evidence arising from Item 550.

395 It will be recalled that the Crown invited an approach which considered all matters bearing upon the relevance of this evidence, both scientific and non-scientific. The Accused, on the other hand, focused upon what were said to be particular weaknesses, or areas of vulnerability, with respect to discrete aspects of the scientific evidence.

396 The primary question to be considered is the issue of relevance under ss.55-56 *Evidence Act 1995*.

397 It is necessary to identify the facts in issue in the trial to allow an assessment of the question whether the evidence, if accepted, could rationally affect (directly or indirectly) the assessment by the tribunal of fact (the jury) of the probability of a fact in issue in the proceeding: *Smith v The Queen* at 654 [7] (at [150] above). The parties agree that the following formulation identifies the facts in issue for this purpose.

398 The ultimate fact in issue in the trial is whether the Accused committed the five alleged murders. The Crown contends that the stain on the garage floor (Stain 91) links the Accused to the crime scene because it is the blood of the deceased from that crime scene. If the jury was satisfied that

the stain was mixed blood from the crime scene, the Crown contends that this is powerful evidence in the Crown case.

399 Questions of relevance require careful analysis, and identification of the process of reasoning that is invited: *Evans v The Queen* at 529 [23] (at [151] above).

400 Although questions of relevance may raise nice questions of judgment, no discretion falls to be exercised: *Smith v The Queen* at 653 [6]. The relevance test is to be given a broad ambit and the test is not a narrow or stringent one: *Evans v The Queen* at 546-547 [95]-[96] (at [152] above).

401 I have set out in some little detail the arguments advanced on the question of admissibility of this evidence. The further the Court has proceeded to assess the competing arguments, the clearer is the response, in my view, to the initial question concerning the relevance of the evidence.

402 It is necessary to keep in mind the areas of scientific and non-scientific evidence which bear upon the relevance issue. The non-scientific evidence should not be overlooked. Firstly, the Accused informed police that he had undertaken some cleaning of the garage floor on the morning of Saturday, 18 July 2009. That aspect presented both opportunity for the deposition of material (which may be said to relate to the crime scene), together with a stated desire to clean the garage floor at a time of some significance to the case. Secondly, there is the evidence of conversations said to have occurred between the Accused and Witness A, including the need to find explanations for blood on the garage floor.

403 These matters are not raised, of course, for the purpose of expressing any view concerning the weight to be given to this evidence. What they demonstrate, however, is that it would be erroneous to consider, in an unduly narrow fashion, the issue of relevance of the evidence concerning Stain 91 and the DNA evidence.

404 The submissions of the Accused are directed almost entirely to the reliability of the evidence and the weight to be attached to it. There is scope for argument concerning the strengths or weaknesses of various pieces of evidence along the way, commencing with the location of Stain 91 on the garage floor and concluding with the opinions expressed by Mr Walton, Dr Walsh and finally, Dr Perlin. These are, in truth, areas which may be challenged or explored in the presence of the jury, with the ultimate weight to be attached to the evidence, and the conclusions to be drawn from it, being matters for the jury.

405 I do not think that *Armstrong v R* assists the present objection. The present case involves far more than presumptive testing of blood.

406 Submissions which advance suggested alternative explanations or competing inferences with respect to the suggested presence of DNA of the deceased on the garage floor are not issues which bear upon the relevance objection (see [153] above).

407 I accept the common submission of the parties that it would be necessary for the jury to be satisfied beyond reasonable doubt that Stain 91 contained blood from the crime scene, for the purpose of evidence arising from this source operating against the Accused at trial. However, this issue is not to be determined solely by reference to the scientific evidence, with other areas of evidence already mentioned to be taken into account, together with such further evidence as may be adduced at the trial which bears upon that question.

408 I am not persuaded that any submission advanced by the Accused warrants the exclusion of evidence concerning Stain 91 and the DNA analysis and LR opinion evidence of Dr Perlin upon the basis that relevance has not been demonstrated for the purpose of ss.55 and 56 *Evidence Act 1995*.

409 The question of discretionary rejection of the evidence under ss.135 or 137 *Evidence Act 1995* then arises.

410 As *R v Burton* at [134] makes clear (see [156] above), s.137 requires two separate assessments and a judgment:

(a) an assessment of the probative value of the evidence sought to be adduced by the Crown;

(b) an assessment of the danger of unfair prejudice to the Accused that may be caused by its admission; and

(c) a judgment as to whether any such danger outweighs the probative value of the evidence.

411 This process has regard to the potential probative value of the evidence. The function of the Judge is to assess the extent to which the evidence has the capacity to bear upon the proof of the fact or facts in issue: *R v Burton* at [160]-[161] (see [158] above).

412 The availability of alternative explanations or competing inferences are not to be taken into account (see extracts from *R v Burton* at [157]-[159] above).

413 Applying these principles, I assess the probative value of the Stain 91 and DNA evidence as being substantial.

414 An assessment of the danger of unfair prejudice involves the concept of *"unfair prejudice"* as explained in pertinent authorities (see [160]-[161] above).

415 Arguments which sought to challenge the reliability of the blood and DNA evidence, and the suggestion of alternative explanations or competing inferences, do not demonstrate the danger of unfair prejudice in this case.

416 Beyond those matters, the Accused pointed to a number of matters in support of discretionary exclusion under ss.135 or 137 (see [289]-[292] above).

417 I express my broad agreement with the Crown submissions made with respect to these issues, and make the following additional comments.

418 The fact that aspects of the scientific evidence, including DNA analysis and LR opinion evidence from Dr Perlin, may be complex is not a reason to exclude it. The Courts have recognised that the development of modern science has given rise to areas of evidence of some complexity in jury trials in the criminal courts. As is made clear in *R v Karger* at 44 [179], *Aytugrul v The Queen* at 183-187 [20]-[34] and *R v MK* at 583 [48], the complexity of evidence of this type is not a reason to exclude it.

419 The contemporary jury system operates upon the basis that a jury will be assisted by witnesses, counsel and the trial Judge in understanding expert evidence given, by appropriate examination and cross-examination by counsel, and the making of submissions by reference to the evidence by counsel, with the task of the trial Judge including the giving of directions to assist the jury by reference to the evidence and submissions.

420 It may be taken that there are aspects of this case which will require counsel and myself, as trial Judge, to undertake our respective duties in a careful and diligent manner. For the purpose of ruling upon the present objection, I will approach the issue upon the basis that the jury will receive that assistance in this trial.

421 The various criticisms of the testing process with respect to Stain 91, and the Crown responses to those criticisms, will no doubt be the subject of evidence before the jury, to assist the jury in its fact-finding function in that respect. Those are matters which may be explored before the jury, but do

not warrant exclusion under ss.135 or 137: *R v Ngo* [2001] NSWSC 595; 122 A Crim R 467 at 469 [7].

422 The evidence of Mr Goetz, Ms Neville, Mr Walton, Dr Walsh or Dr Perlin does not, on its face, raise any question concerning the validation of the TrueAllele system. Indeed, the evidence of the Australian witnesses serves to fortify a conclusion that TrueAllele is accepted by objective experts in the field in this country. The evidence contradicts any suggestion that TrueAllele constitutes a *"black box"*, a concept floated in cross-examination, but not advanced in the submissions of the Accused. Validation is not a legal concept. It is a shorthand term which may be called in aid when evidence of this type may be challenged upon the basis that it involves new, or relatively new, scientific processes.

423 Absolute certainty of result or unanimity of scientific opinion is not required for admissibility: *R v Gilmore* (1977) 2 NSWLR 935 at 939-941.

424 The evidence adduced at the pretrial hearing provides strong evidence of validation of TrueAllele in the United States of America, and its use by well-known law enforcement agencies in that jurisdiction. The validation evidence is contained in Exhibit PTK2, and extends to a range of validation studies by reputable bodies. The validation studies include a study entitled *"TrueAllele Genotype Identification on DNA Mixtures Containing up to Five Unknown Contributors"* (February 2014) carried out by Cybergenetics and the Kern Regional Crime Laboratory, Bakersfield, California (Exhibit PTK2, Perlin, Tab 10). This study has direct relevance to the circumstances of the present case.

425 In addition, there is evidence of judicial determinations in the United States of America and the United Kingdom, where objections to evidence from Dr Perlin concerning TrueAllele analysis have been overruled. These aspects of the evidence fortify a conclusion that Dr Perlin's evidence ought not be excluded upon the basis that it is, in some way, the product of a

scientifically unformed or incomplete process not worthy of admission at a criminal trial. The evidence suggests the contrary.

426 I note that although Dr Perlin was cross-examined on these matters, no defence evidence was called or tendered which served to undermine the validation evidence adduced by the Crown.

427 The evidence from Mr Goetz, Ms Neville, Mr Clayton and Dr Walsh has a cumulative effect which supports its admission in the trial. No challenge was made to the credibility of these witnesses in the substantial pretrial hearing at which each was cross-examined in some detail. Each of these witnesses explained the processes undertaken by them in a manner which was, on the face of it, conservative and cautious.

428 The Accused has not called any witness at the pretrial hearing apart from Dr Hallam. The position is to be contrasted with other cases where defence expert witnesses were called to give evidence on voir dires concerning admissibility of DNA evidence: *R v Karger*; *R v McIntyre*; *R v Gallagher* [2001] NSWSC 462 and *R v MK*.

429 The evidence of Dr Walsh concerning similarities between Items 550 and 616 does not involve a statistical comparison. I am satisfied, however, that it constitutes admissible expert opinion evidence. Dr Walsh is highly qualified in the field. He explained, in some detail, the factors taken into account in his opinion concerning similarity. This conclusion is supported by *R v Dlugosz*, where the Court allowed non-statistical expert DNA evidence to be given. I am satisfied that the necessary foundation has been demonstrated for the purpose of s.79 *Evidence Act 1995* for evidence of this type to be given, in particular by Dr Walsh.

430 Short conclusions may be expressed with respect to the Accused's submissions concerning ss.135 and 137 (at [289] and [292] above).

431 As to [289](a), there is no evidence that Item 550 was, in fact, low template DNA. The evidence of Mr Goetz and Dr Walsh does not support this proposition.

432 As to [289](b) and (c), the evidence does not support a conclusion that TrueAllele *"requires more work"* and is *"a work in progress"*. The evidence reveals that the process is established and validated and has been used by reputable agencies and admitted into evidence in courts in other jurisdictions.

433 As to [292](a), the quality of the sample involved has permitted a range of detailed examinations to be undertaken, as illustrated in the evidence adduced at the pretrial hearing. Any issue concerning sample quality may be taken up, if considered appropriate, before the jury.

434 As to [292](b), the science involved is complex, but the courts have adjusted to this phenomenon, as cases such as *R v Karger*, *Aytugrul v The Queen* and *R v MK* illustrate. The jury is entitled to receive assistance from counsel and the trial Judge, with appropriate directions to be provided by reference to the evidence and submissions.

435 As to [292](c), the use of large numbers as part of the LR evidence resulting from the TrueAllele process will be a topic for explanation and assistance during evidence, submissions and directions to the jury: *Aytugrul v R* [2010] NSWCCA 157; 205 A Crim R 157 at 186 [162]; *Aytugrul v The Queen* at 186-187 [32], 203-204 [75].

436 As to [292](d), I do not detect readily a distinction between the CCS and the evidence, but any issue in this respect is capable of clarification in the course of the trial.

437 As to [292](e), I am not persuaded that there is a danger that the evidence might cause or result in undue waste of time so as to warrant exclusion

under s.135(c). The evidence is not of peripheral relevance. It has significant probative value.

438 As to [292](f), I am not persuaded that there is a danger that the evidence might be misleading or confusing so as to warrant exclusion under s.135(b). It is to be expected that the evidence will be given in the manner foreshadowed during Dr Perlin's evidence at the pretrial hearing. The presentation of the evidence, and its use at the trial, will involve the witness, counsel and myself as trial Judge, in assisting the jury with appropriate directions.

439 As to [292](g), the suggestion that there may be a need for a significant defence case is not a basis for excluding the Crown evidence. Nor does it assist with respect to the s.135 objection. The witnesses called by the Crown were cross-examined in detail at the pretrial hearing, so that the Accused ought be aware of the case he has to meet, and to adduce evidence in the defence case if it is considered appropriate to do so.

440 As to [292](h), the fact that there may be contrary or alternative approaches to statistical evidence does not point to exclusion of the Crown evidence. This topic was touched upon in cross-examination of Dr Perlin, with his responses referring to the work of Dr Mitchell and Professor Balding (PT1143-1148, 1157, 1159). No evidence was called by the Accused on these aspects.

441 Having undertaken the assessments under s.137 referred to in *R v Burton* at [134], I record my judgment that the probative value of the evidence is not outweighed by the danger of unfair prejudice to the Accused.

442 In summary, the evidence under challenge is relevant and admissible, and I am not satisfied that any discretionary basis has been demonstrated for its exclusion under ss.135 or 137 *Evidence Act 1995*.