

Case Name:

R. v. Woodcock

Between

**Her Majesty the Queen, Applicant, and
Ronald James Woodcock, Respondent**

[2006] O.J. No. 5186

Court File No. 8808-97

Ontario Superior Court of Justice

E.B. Minden J.

Heard: April 24-27, May 23-25, 31, June 1, June 16,
July 4, July 7, July 14, 2006.
Judgment: August 18, 2006.

(142 paras.)

Criminal law -- Evidence -- Admissibility -- Relevancy -- Voir dire -- Methods of proof -- Scientific evidence -- DNA -- Voir dire which concerned the admissibility of expert opinion evidence relating to mitochondrial DNA (mtDNA) analysis -- Evidence admitted, but the opinion to be conveyed to the jury was to be based upon the Caucasian sub-group only -- The Crown had established a threshold level of reliability with respect to the field of forensic mtDNA examination and analysis -- The benefit of the evidence to the fact-finding process outweighed the potential for prejudice or harm from the receipt of the opinion.

Voir dire during re-trial of Woodcock for two counts of first degree murder, four counts of attempted murder, and numerous other charges -- The voir dire concerned the admissibility of expert opinion evidence relating to mitochondrial DNA (mtDNA) analysis -- The general acceptance of the science of mtDNA was not in dispute, as ultimately the challenge to admissibility centered on two main issues: first, whether or not the proposed evidence satisfied the relevance hurdle, and second, whether the proposed evidence survived the cost benefit analysis mandated by the Mohan case -- If the evidence was admissible, the final issue to be determined related to the use of the database of mtDNA profiles and the manner in which the statistical information that concerned the profile in question ought to be expressed and conveyed to the jury -- The main events in question occurred on September 14, 1994 -- Two men were responsible for the shooting death, execution style, a man whose vehicle they stole -- Very shortly thereafter they drove in the vehicle to a sports store in Os-

hawa, Ontario -- One of the perpetrators shot and killed the storeowner, and also shot and wounded others present in the store -- The second man smashed gun display cases and removed numerous handguns -- Upon leaving the store, the two men re-entered the vehicle and left the scene -- They then abandoned the vehicle in a parking lot not far from the store -- From that location, they made their ultimate escape -- Police investigators recovered the vehicle the day after the murders -- The vehicle was photographed and examined by identification officers -- A blanket was found on the front seat of the vehicle and a hair was located on the blanket -- A vacuuming of the rear interior resulted in the finding of numerous hairs -- The mtDNA profile of the hair sample in question was compared to the mtDNA profile from a known sample obtained from Woodcock -- In the opinion of the scientists, the profiles were indistinguishable -- The Crown submitted that it had established all of the Mohan criteria, and that the expert opinion evidence was relevant to the central issue at trial, namely the identity of the perpetrator of the killings -- Woodcock contended that there was no evidence that linked the perpetrator of the crimes to the hairs in question -- He claimed that there were so many other possibilities as to the origin of the hairs as to render any nexus entirely speculative -- He alleged that mtDNA was not a unique identifier and the evidence, at its highest from the Crown's perspective, was to the effect that even if the jury could find that Woodcock might have been a donor, he belonged to a large group of randomly selected persons who could not be excluded as possible contributors to the questioned samples -- He submitted that there was a real danger that a jury, so familiar with the enormous identifying power of "regular" DNA, would be unable to assess the evidence objectively and cautiously, and that, in circumstances where the benefit was minimal, it was not worth the cost -- Finally, Woodcock submitted that were the evidence admitted, the Crown experts should be permitted to convey the results obtained by reference only to the "Caucasian" sub-group of the database because that was the only section of the database in which the mtDNA profile in question was located -- The use of the entire database as a basis for the statistical calculation would not be in conformity with the method utilized by all FBI examiners and could produce a misleading result -- HELD: Evidence admitted -- The Crown had met the evidential and legal burden to satisfy the Mohan admissibility criteria to a balance of probabilities -- It had established a threshold level of reliability with respect to the field of forensic mtDNA examination and analysis -- The benefit of the evidence to the fact-finding process outweighed the potential for prejudice or harm from the receipt of the opinion -- In light of all of the uncontradicted evidence which supported the reliability and validity of the science in question, there was no reason to conclude that the potential for increased discriminatory power impacted upon the question of admissibility -- That was a matter that went to the weight of the evidence, not its admissibility -- However, while reporting based upon the entire database was not scientifically or mathematically inaccurate, it would lead to the jury getting the wrong impression about the real statistical significance of the analysis -- Accordingly, it was ordered that the opinion to be conveyed to the jury was to be based upon the Caucasian sub-group only.

Counsel:

G. O'Driscoll, for the Crown

P. Rochman, for the Accused

RULING ON ADMISSIBILITY OF MITOCHONDRIAL DNA EVIDENCE

E.B. MINDEN J.:--

A. Introduction

1 This *voir dire* concerned the admissibility of expert opinion evidence relating to mitochondrial DNA (mtDNA) analysis. The first time evidence of this nature was the subject of an admissibility hearing in a Canadian court was the 1999 decision of *R. v. Murrin*¹. The primary focus in *Murrin* was the threshold reliability of the technique and science of mtDNA² as an aspect of the relevance criterion in *Mohan*³.

2 In the nearly seven years since *Murrin* was decided, scientists have largely resolved the reliability concerns and other uncertainties that were extensively debated and litigated in that case.⁴ This is no longer considered to be novel science: mtDNA examination and analysis have achieved a status of universal acceptance within the relevant community of forensic science. The jurisprudence reflects wide acceptance by the courts. While there have been no reported Canadian mtDNA cases subsequent to *Murrin*, there are over 100 American decisions upholding the admissibility of mtDNA analysis.

3 Accordingly, the focus of this *voir dire* was quite different from *Murrin*. The general acceptance of the science of mtDNA was not really in dispute. While evidence was led in relation to aspects of reliability as well as the criterion of properly qualified expert, ultimately the challenge to admissibility boiled down to two main issues: first, whether or not the proposed evidence satisfied the relevance hurdle, and second, whether the proposed evidence ought to survive the cost benefit analysis mandated by *Mohan*. Assuming the admissibility of the evidence, the final issue that fell to be determined related to the use of the database of mtDNA profiles and the manner in which the statistical information concerning the profile in question ought to be expressed and conveyed to the jury.

B. The Allegations, The Ongoing Investigation, The Mistrial

4 This is the re-trial of Ronald James Woodcock. He faces two counts of first degree murder, four counts of attempt murder and numerous other counts.

5 The allegations may be briefly summarized. The main events in question occurred on September 14, 1994. Two men were responsible for the shooting death, execution style, of Kenneth Thomas in Pickering, Ontario. The two men stole Mr. Thomas' motor vehicle. Very shortly thereafter, they drove in Mr. Thomas' vehicle to the area of Gagnon Sports Store in Oshawa, Ontario. There, while masked and armed with loaded firearms, they entered Gagnon Sports. One of the perpetrators shot and killed the storeowner, Roger Pardy. He also shot and wounded others present in the store. The second man smashed gun display cases and removed numerous handguns, the Crown theory being that this was the purpose of or motive for the robbery. Upon leaving the store, the two men re-entered the Thomas vehicle and quickly left the scene. They then abandoned the Thomas vehicle in a parking lot not far from Gagnon Sports. From that location, they made their ultimate escape by unknown means.

6 The identity of one of the perpetrators is known. At the first trial, Roshan Norouzali was convicted of two counts of first degree murder, four counts of attempt murder as well as other offences. His appeal to the Ontario Court of Appeal was dismissed, [2003] O.J. No. 3260. The main issue at

this re-trial is the identification of the other perpetrator. The Crown's case in support of the identification of Ronald Woodcock as the other perpetrator is largely based upon circumstantial evidence.

7 Police investigators recovered the Thomas vehicle the day after the incident at Gagnon Sports. The vehicle was photographed and examined by identification officers. A blanket was found on the front seat of the vehicle and a hair was located on the blanket. A vacuuming of the rear interior resulted in the finding of numerous hairs. Forensic examination was conducted of these items. At that time, however, mtDNA testing was not a part of forensic science. Following the Ontario Court of Appeal's ordering of this re-trial, police officers involved in the continuing investigation met with forensic examiners. They discussed the viability of additional forensic testing. These discussions included or were monitored by members of the Whitby Crown Attorney's Office.

8 On or about August 10, 2005, during the course of pre-trial motions, the Crown made application for an Order for the release of certain exhibits for scientific testing, including mtDNA examination. That application, unopposed, was granted and the Order was made. With a view to ensuring that the upcoming trial date would not be placed in jeopardy, timelines were discussed and agreed upon. It was anticipated that all of the tests would be completed, and the results reported and disclosed, well prior to the commencement of trial. Shortly after the aforementioned Order was made, Durham Regional Police investigators submitted the aforementioned hair samples to Molecular World Inc., a lab in Thunder Bay, Ontario, for purposes of forensic mtDNA testing.

9 On September 29, 2005, the parties indicated that as of that date, none of the recent forensic examination had led to any significant results. On October 21, 2005, both sides again stated they were prepared to proceed to trial. Jury selection commenced on November 7, 2005. Evidence commenced on November 14, 2005. On November 16, 2005, counsel advised the court that there had been a new and unforeseen development of considerable significance to the trial that would require their further consideration. The trial abruptly adjourned. Ultimately, on November 22, 2005, the parties jointly submitted that the new information had to be fully disclosed and assessed. This would take a substantial period of time, perhaps months. In addition, both sides submitted that the results of their inquiries could impact on trial decisions. In short, they agreed that the ongoing trial could not proceed and that there was no reasonable alternative other than the declaring of a mistrial. Having been apprised of the circumstances, I concurred and on November 22, 2005 declared a mistrial.

10 As I understand it, Molecular World Inc. had completed testing and had reported on what was considered to be the "first priority" group of hairs by late September 2005. However, the single hair^s that became the focus of the *viva voce* evidence on this application was part of a second group of submitted hairs, considered to be less likely to produce any significant results. Testing on this hair (and others) was not completed until the trial was underway. Communication to Crown Counsel of those results occurred late afternoon of November 15, 2005. This information was immediately disclosed to the defence and, as previously indicated, the following morning the matter was brought to the court's attention.

11 The mtDNA profile of the hair sample in question had been compared to the mtDNA profile from a known sample obtained from Mr. Woodcock. In the opinion of the scientists, the profiles were indistinguishable. The potential import of "the bottom line" was clear: this was said to be a new (and the only) item of forensic evidence directly linking Mr. Woodcock to the Thomas vehicle.

C. The Three Hairs

12 Subsequent to the mistrial, Crown Counsel disclosed to the defence all matters relating to Molecular World Inc., its scientists, and the work done in connection with this case. This application commenced on the basis of one single evidentiary hair found on the blanket in the front seat. During the course of the application itself, however, the Crown advised that the lab had conducted tests on other submitted hairs. This had resulted in similar findings in respect of two additional hairs said to have been part of the vacuuming from the rear of the vehicle.⁶ In the result, this application related to three evidentiary hairs.⁷

D. The Proposed Evidence

13 The Crown proposes for admission the opinion evidence of a molecular biologist, Dr. Amarjit Chahal, director and general manager of Molecular World Inc. of Thunder Bay, Ontario. Dr. Chahal is also a forensic analyst with expertise in both nuclear DNA and mtDNA extraction, analysis and interpretation. Scientists at Molecular World Inc. conducted examinations in respect of the submitted hairs. In two separate final reports, Dr. Chahal reported on the findings. The Crown seeks to tender Dr. Chahal's opinion that comparisons of Mr. Woodcock's mtDNA profile with that of the mtDNA profile of the three hairs in question resulted in a conclusion that Mr. Woodcock "could not be excluded" from a group of persons randomly selected as having been the donor of those three hairs. The Crown also seeks to tender Dr. Chahal's evidence as to the statistical significance of that conclusion, based upon what is said to be the generally accepted use of the FBI database of mtDNA sequences.

14 In addition, the Crown proposes for admission the opinion evidence of Dr. Leslie McCurdy, a forensic analyst with the Federal Bureau of Investigation (FBI) at Quantico, Virginia. His evidence, broadly speaking, related to the science of mtDNA examination and analysis, rather than the specific test results in this case. He also testified concerning the creation and general acceptance of the FBI mtDNA database and how it is used by forensic scientists to assist them and courts in the interpretation of mtDNA findings.

15 The defence called no evidence on this application.

E. Positions of the Parties

16 The Crown submits that it has met its onus of establishing all of the *Mohan* criteria. The proposed experts are properly qualified and the jury clearly requires their assistance on this issue. There is no exclusionary rule. The Crown has established reasonable reliability of all aspects of mtDNA testing and analysis. The Crown contends that the expert opinion evidence is relevant to the central issue at trial, namely the identity of the perpetrator of the killings. The three hairs in question are associated with the crime scene in circumstances in which they can be linked to the perpetrators. Other issues are matters of weight. Any potential for prejudice, including the defence concern about jurors misapprehending the limitations of mtDNA and its significant differences with nuclear DNA, can be adequately addressed by appropriate jury instructions.

17 As I have said, the challenge to the admissibility of this opinion evidence is essentially grounded in relevance and the cost benefit analysis mandated by *Mohan*. The defence position is that while at first blush the proposed evidence has the appearance of opinion evidence relevant to identity, when closely examined this evidence really has no relevance or only marginal relevance on that issue. It is said that unlike many of the reported decisions in this area, there is no evidence in this case linking the perpetrator of the crimes to the hairs in question. There are so many other possibilities as to the origin of the hairs as to render any nexus entirely speculative. In any event,

mtDNA is not a unique identifier and the evidence, at its highest from the Crown's perspective, is to the effect that even if the jury could find that Mr. Woodcock might have been a donor, he belongs to a large group of randomly selected persons who cannot be excluded as possible contributors to the questioned samples.

18 On the cost side of the ledger, the defence raises a number of issues associated with the jury understanding and assessing complicated scientific evidence, and more particularly, ensuring that they appreciate the crucial distinction between mtDNA and nuclear DNA evidence. It is submitted that it would take a significant amount of court time to try to delineate these matters, with no assurance that the jury would "get it". There is a real danger that a jury, so familiar with the enormous identifying power of "regular" DNA, will be unable to assess this evidence objectively and cautiously. In circumstances where the benefit is minimal, as in this case, it is not worth the cost.

19 Assuming the evidence were to be admitted, the defence contends that Dr. Chahal should be confined to expressing his opinion on the statistical significance of his findings in accordance with the method advocated by Dr. McCurdy, the other Crown expert. Specifically, Dr. Chahal should be permitted to convey the results obtained by reference only to the "Caucasian" sub-group of the database because that is the only section of the database in which the mtDNA profile in question was located. The use of the entire database as a basis for the statistical calculation would not be in conformity with the method utilized by all FBI examiners and could produce a misleading result.

F. Dr. Chahal and Molecular World Inc.

20 In view of the narrow focus of this *voir dire*, I propose only to summarize the evidence dealing with the qualifications of the experts and the lab.

21 The Crown called two witnesses from Standards Council of Canada relating to the accreditation and re-accreditation of Molecular World Inc. Accreditation occurred on July 22, 2004 and re-accreditation on March 23, 2006. Dr. Chahal was intimately involved with each process. In connection with each application, all relevant Canadian and international accreditation guidelines and standards were met. In particular, Molecular World Inc. was accredited for lab techniques relating to human DNA testing techniques, including mtDNA analysis.

22 Standards Council of Canada has never taken issue with any of the raw data from Molecular World Inc. testing or with the policies, procedures and techniques employed there. The cleanliness or suitability of its facilities has never been challenged. The qualifications and expertise of the staff have never been called into question. In connection with the accreditation and re-accreditation process, Dr. Chahal respected all actions required and recommended by Standards Council of Canada. He ensured that all recommendations were fully addressed in a timely fashion.

23 Dr. Bruce Lodge was the assessment team leader from Standards Council of Canada and has been the team leader involved in the accreditation for every DNA lab currently accredited in Canada and of approximately 20 labs in the United States. Dr. Lodge confirmed Dr. Chahal's evidence regarding Molecular World Inc.'s responses to all recommendations. In short, there were no serious and critical non-conformities with standards, including those requiring internal audits and other procedures to ensure operational integrity and independence. In addition, in his final report Dr. Lodge specifically commended Molecular World Inc. for its "extremely thorough and comprehensive case record review process" and for its "exceptionally well maintained" facility and level of awareness of potential problems of cross-contamination. He said he could not recall any lab he had ever seen that was any better and that, in fact, few attained this level.

24 Dr. Chahal testified for nearly three court days. I propose only to touch upon certain aspects of his evidence.

25 In 1991, Dr. Chahal received his M.Sc degree from the University of Guelph. In 1996, Dr. Chahal obtained a Ph.D. from the University of Guelph. Both degrees were in the field of molecular biology and genetics. His Ph.D. was in the field of Plant Mitochondrial Genetics and his work included the identification of mtDNA rearrangements in carrots. Thereafter, he continued his education at Children's Hospital at Charleston, South Carolina. For over two years, as part of his post-doctoral fellowship, he conducted DNA research on genetic disorders in humans and identified the DNA mutations associated with the Human Refsum disease (condition associated with metabolism in the body that results in degeneration of brain cells). This work, published in a peer review journal, involved extraction, amplification and sequencing of DNA associated with the disease. He pointed out that these are the same steps required in mtDNA testing. During this period, he estimated that he was involved in approximately 100 cases of mtDNA sequencing.

26 Between 1998 and 2000, he was employed as the assistant lab director at the National Legal Laboratory in Lansing, Michigan. His role was to review raw data of human DNA testing in relation to paternity, immigration, sibship and criminal incest cases. He estimated that he was involved in approximately 6,000 cases. Between 2000 and 2003, he was the director of the DNA diagnostics division at Vita-Tech Canada Inc. in Markham, Ontario. Once again, his responsibilities involved reviewing and reporting DNA test results, including human DNA testing in paternity and forensic cases. He also was involved in sequencing mtDNA from 3,000 minke whales for data base purposes. He stated that the mtDNA sequencing in these animals was in the same regions applicable to humans. He trained and supervised staff in these techniques.

27 Molecular World Inc. opened in August 2003. The lab's founder, reported to be a renowned professor of forensic sciences at Lakehead University, hired Dr. Chahal on a full-time basis, as lab director, general manager and reporting officer. As general manager, he runs and oversees the entire operation of Molecular World Inc.

28 As reporting officer, Dr. Chahal reviews and interprets mtDNA and nuclear DNA raw data, performs statistical calculations, prepares final DNA test reports and reports all paternity and forensic cases. As lab director, he supervises lab staff and ensures compliance with accreditation standards. He provides opinions to clients, lawyers and appears as an expert witness. He also serves as an assessor and an accreditation unit member, inspecting and accrediting other DNA testing labs on behalf of the American Association of Blood Banks (AABB).

29 Dr. Chahal is a member of the AABB and the Canadian Society of Forensic Services. He has attended conferences and workshops on various aspects of nuclear DNA and mtDNA testing, databanking and related expert testimony. Dr. Chahal has considerable technical experience in nuclear DNA and mtDNA testing and analysis and in reviewing the work of other scientists. While he has not published articles in peer review journals, the evidence suggested that relatively few scientists have done so. Dr. Chahal keeps abreast of all relevant scientific literature and all developments in the field. On at least one occasion he was a presenter on the topic of mtDNA.

30 Dr. Chahal has some experience with validation of "in-house" population databases as well, of course, of using databases previously validated by suppliers of DNA test kits.

31 In 2003, in Toronto, he testified for the defence in a sexual assault trial in connection with forensic nuclear DNA analysis. He has testified as an expert in two cases involving mtDNA analysis.

In the first, in 2005, he testified on behalf of the prosecution in a Nova Scotia preliminary hearing. It involved evidentiary hair shafts or shed hair and reference hair samples from the deceased. He conducted mtDNA testing and offered expert opinion evidence as to whether those evidentiary hairs could be excluded or could not be excluded as originating from the deceased or his maternal lineage. In the second case, in February 2006, he testified on behalf of the defence in a homicide trial in Kansas City, Missouri. That case also involved mtDNA testing of shed hairs and the offering of similar opinion evidence regarding exclusion. Molecular World Inc. performs forensic DNA testing for the Public Defender Service in Washington, D.C. This work primarily involves nuclear DNA testing but there are some requests for mtDNA testing as well.

32 I find that Dr. Chahal recognizes the importance of the scientific process, including the need for independent review. In that regard, he ensures that all cases are reviewed by him as well as by an external reviewer retained for that purpose. This process of two layers of independent review was followed in respect of the instant case. Dr. Chahal clearly addressed the similarities and dissimilarities between nuclear DNA and mtDNA. He is aware of previous reliability challenges including issues relating to contamination and heteroplasmy. He testified in a meticulous fashion concerning all aspects of the operation of Molecular World Inc. His responses were careful, logical and reasonable. He gave comprehensive responses and did not fence with counsel.

33 Dr. Chahal testified that Molecular World Inc. is available to be retained by both prosecution and defence in criminal cases, as well as in the context of family and civil litigation. It employs duly qualified scientists with considerable training and experience in DNA testing, including all aspects of mtDNA testing. There is no issue that Arlene Lahti, the scientist who performed the testing in question, was duly qualified to perform and report on these tests.

34 Since inception, Molecular World Inc. has submitted its raw data in forensic nuclear DNA and mtDNA cases to various recognized external proficiency testing bodies and there have been no reports of any errors. The College of American Pathologists has selected Molecular World Inc. to conduct "pre-testing" to develop baseline results in respect of samples before their general dissemination. Molecular World Inc. employs recognized, standard reagents in the extraction process and widely accepted instruments and software in the automated mtDNA sequencing process. In forensic cases, the sequence "calls" of the instrument are double-checked manually.

35 In short, in terms of qualifications, I found Dr. Chahal to be an impressive witness who operates an impressive facility.

G. Dr. Chahal's Overview of mtDNA Analysis

36 Dr. Chahal said anthropologists have used mtDNA for between 20 and 30 years. To his knowledge the first occasion in which mtDNA opinion evidence was accepted in the course of a trial was in 1996, in the United States. Since that time, the reliability of mtDNA analysis has gained general acceptance in the forensic area, both in the U.S. and in the U.K. He stated that in addition to the original forensic labs performing mtDNA testing -- namely the FBI lab and MITO TYPING in Pennsylvania -- other labs are now involved in this kind of work. He noted that there are over 100 publications concerning mtDNA analysis in peer review journals and testified that there is general acceptance in the scientific community regarding the validity of mtDNA analysis. He referred to two separate but complimentary forensic mtDNA guidelines, standards that are universally accepted by the forensic community. The first he referred to as "the F.B.I. Guidelines", more fully described as the Scientific Working Group on DNA Analysis Methods (SWGDM), F.B.I. Guidelines for

mtDNA nucleotide sequence interpretation. He described the second as "Guidelines for mtDNA Typing" issued by the DNA Commission of the International Society for Forensic Genetics. Neither set of standards has been challenged in any peer review journal.

37 It was his opinion as well that the scientific techniques used in forensic mtDNA analysis are generally accepted in the scientific community.

H. Testing Procedures at Molecular World Inc.

38 No real issue was taken with the testing procedures employed at Molecular World Inc. Dr. Chahal described in detail all of the steps taken to ensure separation of the evidentiary from the reference samples, as well as the steps to ensure that each of the three steps of the mtDNA testing is conducted in a separate room.

39 Sample preparation consists of washing the hairs to remove any external contaminants. The second step is DNA extraction. Manufacturers supply ready to use DNA isolation kits for this purpose. The kits contain pre-mixed reagents. Next is mtDNA amplification, using the Polymerase Chain Reaction process. A technique known as gel electrophoresis is employed to separate DNA according to size. The technique permits the scientist to verify, visually, that sufficient amounts (for sequencing) of intended mtDNA segments were amplified. This process frequently needs to be repeated ("re-amp"). Molecular World Inc. uses between 25 and 35 cycles, within the generally acceptable range to avoid amplification of hidden contaminant.

40 The amplified DNA in the targeted region is then purified with a ready to use kit. The synthetic material employed in the Polymerase Chain Reaction process is removed. At this point, mtDNA is sequenced, again, with a ready to use kit which includes a group of four synthetic, fluorescent dye labeled molecules, specific for each of the four nucleotides (A, C, G and T). Each of the components is visually depicted in a different colour. Each tag stops at different positions and these are reproduced by software. The automated procedure permits the scientist to discover and identify the actual order (sequence) of the bases in the particular molecule within each of the two targeted regions. The reading instrument is widely accepted for use in sequencing. The DNA base order on the mtDNA fragment is represented on a chromatogram. It is the order of the nucleotides that is used in forensic mtDNA identification.

41 Reliable sequencing verification is dependent upon clarity in the colour depictions. "Background noise" (attributable, for example, to degradation or a problem at any of the procedural steps) or an indication of more than one type of nucleotide at an individual peak (possibly due to heteroplasmy) may lead to a visual indication of one colour underneath another. In these cases, the instrument will not be able to make a clear call. This is one reason why the calls are also done manually.

I. Significant Differences Between Nuclear DNA and mtDNA

42 DNA "length" is one of the key differences between nuclear DNA and mtDNA. The far smaller pieces of mtDNA (16,569 bases as opposed to over 3 billion) means that it degrades less readily than nuclear DNA. The smaller pieces of mtDNA can survive over the years, which is why it is resorted to when nuclear DNA pieces have degraded. Unlike nuclear DNA, mtDNA is inherited maternally only. In addition, unlike the two copies ("loci") in nuclear DNA (one from each parent), there are hundreds or thousands of copies per cell of mtDNA.

43 Only two regions of mtDNA are known to be "variable" as between maternal lineage. These are known as Hypervariable I and Hypervariable II and are the only regions of forensic interest as they can differentiate between individuals. These two regions are comprised of approximately 800 of the 16,569 bases. In the sequencing process, Molecular World Inc. utilizes a scientifically accepted minimum number of base pairs within each of the two regions. Dr. Chahal observed that this is the "ideal" number, almost always available in known samples but not necessarily (due, for example, to insufficient quantity or degradation) in evidentiary samples. He testified that in connection with evidentiary samples, an "exclusion" can be based upon only partial data. More complete data is required in "cannot exclude" situations, where the data is verified twice, once in each of the two DNA strands of the molecule.

44 In addition, nuclear DNA testing involves consideration of 23 discrete "markers" (or "chromosomes" or, for present purposes, "separate pieces of DNA") whereas mtDNA is considered as one marker (or "one piece" of DNA). In the context of analyzing data and occurrence in the general population, this has very significant ramifications in terms of the rarity of a match.

45 In terms of "uniqueness", apart from identical twins no two individuals are expected to have the same DNA profile. In regards to mtDNA, all maternal relatives are expected to have the same DNA profile, except for cases of "mutation", or a complete change in the DNA type over time. Dr. Chahal put this succinctly: nuclear DNA can be used as a "unique identifier" but mtDNA cannot because all maternal relatives have the same mtDNA type.

46 The DNA testing procedure is different as between nuclear DNA and mtDNA in that the separation of DNA markers (loci) is by size in the case of nuclear DNA, whereas actual sequence is determined in the case of mtDNA. In arriving at a profile in nuclear DNA cases, there are multiple DNA markers with appropriate designations of alleles for each marker (two copies or alleles, one from father and one from mother, per marker). In mtDNA cases, every base of the selected mtDNA region is sequenced and the scientist reports only the changes (in the "reference" and "evidentiary" samples) from the standard reference sequence ("The Anderson Sequence" or "Cambridge Revised Sequence"). In other words, the scientist will report changes in the nucleotides ("polymorphism") when compared to a known standard, employed in all labs, where those changes are the same for both the reference and evidentiary samples. Where the changes (from the standard reference) are the same at a particular position, it means those sequences are identical at that position. If changes to the standard reference are variable, then the two pieces of DNA are variable. Thus, as opposed to the "unique identifier" that is nuclear DNA, in mtDNA cases the scientist reports "exclusion", "cannot exclude" or "inconclusive".

47 Dr. Chahal stated that mtDNA is used only where nuclear DNA typing is unsuccessful or not possible. The relevant example was hair shafts or portions thereof, more particularly those that do not contain nuclear DNA but may contain sufficient mtDNA to permit testing.

J. Three Hairs and Conclusion of "Cannot Exclude"

48 Dr. Chahal employed the following widely accepted definitions of the three aforementioned categories:

- (a) Exclusion: If there are two or more nucleotide differences between the questioned and known samples, the samples are excluded as originating from the same person or maternal lineage.

- (b) Inconclusive: If there is one nucleotide difference between the questioned and known samples, the result is inconclusive. The word "inconclusive" means that the profiles in question can neither be "excluded" as originating from the same person or his/her maternal lineage nor "cannot be excluded" as originating from the same person or his/her maternal lineage.
- (c) Cannot Exclude: If the mtDNA sequences from questioned and known samples under comparison have a common base at each tested position, the samples cannot be excluded as originating from the same person or maternal lineage.⁸

49 In connection with the hair from the blanket (EV13), initial testing produced an inconclusive result that Dr. Chahal felt was likely to resolve on a second attempt. Further testing led to the removal of any uncertainty. There were no differences at either Hypervariable I or Hypervariable II between the reference sample (hair from Mr. Woodcock) and EV13, when compared with the standard reference sequence. This hair fell within the category of "cannot exclude", or as Dr. Chahal wrote in his report: "mtDNA profile from EV13 can not be excluded as originating from Ron Woodcock (see Reference Sample) or his maternal lineage".

50 Dr. Chahal arrived at the same conclusion with respect to the two hairs (EV35 and EV39) from the vacuuming of the rear of the vehicle.

51 Dr. Chahal also reported on other hairs from the vacuuming and concluded that the mtDNA profiles from those were "excluded" as originating from Mr. Woodcock or from other relevant persons associated with the case.

52 Finally, Dr. Chahal reported on a comparison of the mtDNA profiles of Ron Woodcock and Deryck Thompson. The result was "inconclusive" due to a single nucleotide difference. He also reported on a comparison between the mtDNA profiles from the three evidentiary hairs and that of Mr. Thompson. Once again, the result in all cases was "inconclusive" due to a single nucleotide difference between these mtDNA profiles.

K. The FBI Database and Frequency Estimates

53 Dr. Chahal testified concerning the FBI mtDNA population database. He said that this database was made available to the public in 2002, after careful scrutiny by the FBI and the scientific community. He testified that the database gained wide acceptance as a reliable population database for use in forensic casework where the inquiry relates to how rare a particular mtDNA type is in the general population. He said that all private labs employ this database with what is referred to as a "95% confidence interval", widely accepted by experts in statistics.

54 Dr. Chahal employed the accepted "counting method", entering the mtDNA profile in question into the database to search for the number of observations, if any, of the profile therein.

55 In the case of EV13 for the "combined ethnic groups" total of 4839 in the database, this produced a frequency result of 1 in 139. Applying the 95% upper confidence level produced a result of 1 in 104.

56 He reported in this fashion: The probability of a matching mtDNA haplotype from EV13 and Ronald Woodcock (based upon a known sample from him) to the mtDNA haplotype from a randomly chosen, unrelated, individual is 1 in 139. Applying the 95% confidence level, the estimate

would be 1 in 104. Expressed in terms of 95% confidence certainty, 99% of the unrelated general population can be excluded as the potential donors of sample EV13.

57 Employing only that portion of the database categorized as "Caucasian origin" produced a frequency of 1 in 48, or 1 in 36 with the 95% upper confidence level applied.

58 In the case of EV35 and EV39, the frequency estimates varied only slightly from the EV13 results.

59 All observations of the profile were located in the "Caucasian" sub-group. The profile was not found in any of the other ethnic classifications. Dr. Chahal maintained that while he was required to report figures based upon that sub-group, it was generally accepted that a scientifically reliable opinion is based on the results from the entire database.

L. Discriminatory Power of mtDNA

60 In terms of what he called its "probative value", Dr. Chahal stated that mtDNA testing is widely accepted by the forensic community. The FBI has used it since 1996 and results have been admitted into evidence on numerous occasions throughout the United States. While the "match power" is low, this is reliable genetic evidence. It cannot be used as a unique identifier. In most cases, 99% of the population is excluded as potential donors.

61 In cross-examination, Dr. Chahal agreed that the potential discriminatory power of forensic mtDNA analysis is likely to increase in future as technology affords scientists increased ability to detect heteroplasmy or if scientists were to discover other areas, beyond Hypervariable I and Hypervariable II, of variability within humans.

M. Independent Review

62 Dr. Chahal and the firm's independent, external reviewer examined all of the work done by the scientists. No raw data or calls were questioned or challenged, nor were any issues related to contamination or heteroplasmy raised. He and the independent reviewer adopted the contents of and signed the final report.

N. Evidence of Leslie McCurdy

63 Dr. Leslie D. McCurdy is a forensic mtDNA examiner at the FBI Laboratory in Quantico, Virginia. He has previous experience as a forensic mtDNA biologist.

64 Dr. McCurdy's testimony did not relate to the raw data, test results or reports generated by Molecular World Inc. The Crown called Dr. McCurdy to offer expert opinion evidence on a wide variety of issues associated with forensic mtDNA examination and analysis. He provided an historical overview as well as a summary of more recent developments in the scientific literature and in the field.

65 The first criminal trial in which mtDNA evidence was admitted took place in the State of Tennessee. That was in 1996. Since that date, Dr. McCurdy estimated that there have been between 100 and 150 criminal cases in which evidence of this nature was led. In virtually every instance, there was a ruling of admissibility.

66 Dr. McCurdy confirmed Dr. Chahal's testimony in several areas. These included the following:

- * Similarity between the science underlying mtDNA and nuclear DNA, generally based on the same principles of extraction, amplification, and purification. Crucial differences between nuclear DNA and mtDNA, particularly that mtDNA is not a unique identifier.
- * Types of evidentiary samples, hair shafts in particular, in which mtDNA testing is most commonly employed from a forensic perspective.
- * General acceptance of two variable regions of mtDNA (Hypervariable I and Hypervariable II) central to mtDNA examination and analysis. Possibility that discriminatory power of mtDNA may increase in future.
- * Presence in most human beings of heteroplasmy, both sequence and length, the role it plays in mtDNA sequencing. Qualified examiners can reliably type mtDNA in the face of heteroplasmy and contamination, provided it is below certain threshold levels.
- * Wide scientific acceptance based on peer review of all aspects of mtDNA examination, analysis, sequencing and sequencing comparison as well as the three "finding" categories (exclusion, inconclusive and cannot exclude) and parameters of each. Appropriate validation studies have confirmed reliability of the science.
- * Theory underlying "cannot exclude" and wide acceptance of how statistical significance is attributed to a conclusion within that category. Importance of lab accreditation, cleanliness, proficiency testing and independent review of all "cannot exclude" results.
- * Acceptance of examiner independently checking each instrument base call and ensuring sufficient evidentiary sample available for independent (defence) testing.
- * Wide use and general acceptance of FBI database. By January 2005, the FBI had addressed all published criticisms of the database. The database's categorization by means of ethnic sub-groups has been widely accepted. General acceptance of the search process ("counting method") relating to the FBI database for sequence comparison, and of the 95% confidence level.

67 Dr. McCurdy differed from Dr. Chahal on the in court reporting of final results. The FBI always searches the entire database and reports out on the number of occasions a profile was observed within any particular ethnic sub-group as well as the size of that particular sub-group, reporting both the count and the revised number after the 95% confidence level is applied. If the profile were not found within any of the three largest sub-groups in the database (Caucasian, African American and Hispanic), the report would specifically reflect that. If the profile were not observed in any of the other sub-groups, the report would only refer to the three largest sub-groups, those being the three major population groups across the United States.

68 Any frequency calculation, based upon a finding of a profile within any sub-group, would be based only upon the total number in that particular group and not upon the total count of the database. Keeping the groups separate produces a higher or more conservative frequency estimate as opposed to using the total number of each sub-group. Dr. McCurdy stated that for purposes of the final report "you'd never look at it as whole -- keep the groups based on self-reported backgrounds or ethnicity".

69 Dr. McCurdy maintained that FBI mtDNA examiners use this recognized approach to reporting statistical information in court consistently throughout the United States. The underlying premise is this: "it is more conservative, meaning more beneficial to the individual on the defence side, we are allowing for more possible matches, or possible donors of this sample." While there is nothing "wrong" mathematically and scientifically with using the total number, it is, in his opinion, a question of what is the most appropriate application of the database in this particular context.

70 In re-examination, Dr. McCurdy said that reporting final results in court has been the subject of peer review articles. He emphasized, again, that while it is not scientifically or mathematically invalid to use the total number, it "may be misleading" to do so, having regard to this particular application.

O. The *Mohan* Criteria

71 The four criteria, emanating from *Mohan*, for the admissibility of expert opinion evidence, are relevance, necessity, lack of any other exclusionary rule and a properly qualified expert. The Crown has the burden, on a balance of probabilities, to satisfy these criteria.

72 In *R. v. J.(J.-L.)*,⁹ the Supreme Court of Canada amplified these criteria. Now referred to as the "re-formulated *Mohan* criteria", cost benefit analysis and reliability are to be viewed as categories separate and distinct from that of relevance.¹⁰

73 In *R. v. Terceira*, the Ontario Court of Appeal said this¹¹ about the limited nature of the screening process in the post-*Mohan* world:

The trial judge's function is limited to an overview of the evidence proffered in order to be satisfied that it reflects scientific theory or technique that has either gained acceptance in the scientific community, or if not accepted, is considered otherwise reliable in accordance with the methodology validating it. The trial judge will be required to hear sufficient evidence to determine reliability as a preliminary matter. Moreover, the trial judge must not pass judgment on the particular application of the methodology by the expert. This is a question of weight to be determined by the jury. The trial judge must restrict his inquiry to determining whether the proposed novel scientific technique or theory has a foundation in science, as determined.

P. Relevance

74 The defence attack focused on what is said to be the absence of a link between the perpetrators of the crimes and the three hairs from the Thomas vehicle. The defence submits that this amounts to a fatal or nearly fatal flaw on the question of relevance. In light of the inherent weaknesses and frailties, the proposed evidence does not amount to some evidence tending to establish identity.

75 In support of this argument, the defence points to some of the reported mtDNA authorities in which an item or object found to contain hair(s) was shown, through other evidence, to have been worn, carried, used or touched by the crime's perpetrator. For example, in *Murrin*, police investigators found three hairs left by the killer at the crime scene, in the victim's underpants.¹² Other illustrations of this, drawn from the American authorities, include:

- * Hairs found on a navy hooded sweatshirt discovered near the crime scene along what was believed to be the perpetrator's escape route where witnesses generally described the perpetrator as having worn a hooded sweatshirt.¹³
- * Hairs found at the crime scene on a binding or ligature used by the perpetrator to bind his victim.¹⁴
- * Hair found on a piece of duct tape used in the robberies to restrain victims.¹⁵
- * Hair from a "Columbia" hat with holes cut in it as a mask, recovered from an abandoned stolen car, where surveillance cameras took photos of a man, identified as the accused, wearing the hat.¹⁶
- * A hair found on a glove, also containing the victim's blood, discovered on a street not far from the scene of a fatal stabbing where the accused was shown to have purchased a similar pair of gloves from a nearby store shortly before the killing.¹⁷

76 It is argued that in each instance there could be little doubt about the probative value of the opinion evidence on the issue of the identity of the perpetrator. In each case, an expert compared the known mtDNA profile to the mtDNA profile from an evidentiary sample that other evidence reasonably tended to show was connected to both the crime scene and the perpetrator.

77 The defence rightly concedes that the three hairs in question were associated with the crime scene. There can be no doubt that the Thomas vehicle must be viewed as either inextricably linked to the crime scene or as actually forming part of it. Clearly, the perpetrators were inside the motor vehicle after the killing of Mr. Thomas as well as immediately before and after Gagnon Sports. From the defence perspective, however, that is not dispositive. What is entirely absent, the defence contends, is any evidence tending to make it more likely than not that the hairs in question came from one of the perpetrators of the crimes.

78 In support of that submission, the defence makes the following points. First, the three hairs were found inside the Thomas vehicle. Unlike the aforementioned examples, none of the relevant hairs was found on or associated with any specific item or object that could be directly linked to the perpetrator. Nor was there anything intrinsically unique about the hairs such that they could be said to be any more likely to have been deposited by the assailant as opposed to someone else.

79 Second, issues of continuity and possible hair transfer render it virtually impossible for the Crown to establish where the hairs were prior to their discovery or when they were deposited there. For example, the blanket was likely folded and packaged by police and by scientists. The hair originally could have been deposited on the underside of the blanket long before the events in question. It would be impossible to say that it was more likely than not that the perpetrator had left one of his hairs on the top of the blanket when he entered or exited the vehicle.

80 Third, in any event, mtDNA testing revealed the presence of 45 hairs from approximately ten contributors. Numerous other persons had been present inside the vehicle. There is no evidence to suggest who may have deposited the hair and when. Anyone within a large pool of people could have been the contributor. It was argued that this point was further highlighted by the fact that mtDNA profile comparisons between known samples from Deryck Thompson¹⁸ and Mr. Woodcock and between Deryck Thompson and the evidentiary hairs led to an "inconclusive" result.

81 Relevance is the underlying principle for the reception of all evidence.¹⁹ Expert opinion evidence, as with other evidence, must relate to a material fact in issue and must have some probative value.

82 To be relevant, an item of evidence must have some tendency, as a matter of logic and human experience, to make the proposition for which it is offered more likely than that proposition would appear to be without that evidence.²⁰ Relevance has also been defined in this way: it is enough if the item could reasonably show that a fact is slightly more probable than it would appear without that evidence.²¹ As long as the evidence offered has some or any tendency, as a matter of logic and human experience, to prove a fact in issue, the evidence is relevant.²² This is a low threshold. The proffered evidence need not establish a particular proposition or even make it more likely than not. Nor must it be capable of an exclusive inference. The item of evidence will meet the relevance threshold if it has some or any tendency to make the proposition for which it is advanced more likely than the proposition would be in the absence of the evidence.²³

83 Of equal importance is the contextual nature of relevance. Relevance depends on the facts in issue and must be considered and determined in the context of the entire case and the positions of the parties.²⁴ In short, relevance need not and should not be considered in isolation. Its proper determination is based upon all of the circumstances of the case. Put another way, a fact can have bearing on another fact or contribute to the proof or disproof of another fact. It can do so alone or it can do so in combination with other facts.²⁵

84 In my view, the defence submission sets the relevance bar too high and fails to take into account its contextual nature.

85 First, as I have said, the defence submission is to the effect that the inference or inferences that might be drawn from circumstantial evidence associated with the hairs is lacking in strength and cogency. But that is not the standard that must be met. Assuming there exists some evidence from which a link between the hairs, the offences and the perpetrator might be inferred, the threshold relevance test has been met. Of course, the question of whether or not that link in fact has been established is for the jury. At this stage, the evidence need not lead to an inference of any particular strength. The evidence providing the threshold link may be minimal. In my view, so long as there exists some evidence capable of such a common sense inference, relevance has been established.

86 The perpetrators killed Mr. Thomas and stole his vehicle within a few hours of using it in connection with the Gagnon Sports robbery, which occurred a relatively short distance from where Mr. Thomas was killed. It must be remembered that this was a private, family motor vehicle and was ordinarily used as such. It was owned and operated by Mr. Thomas, apparently for his own purposes. On the morning in question, he used it in connection with various personal errands. In no way can this be said to have been a public vehicle in the sense of members of the public having unfettered and unrestricted access to it. Like any other private motor vehicle, the number of persons who would ever actually enter or ride in it would be few, relatively speaking.

87 There was no direct evidence as to where in the vehicle the perpetrators positioned themselves after they killed Mr. Thomas. However, the evidence indicated that following the incident at Gagnon Sports the perpetrators occupied the front seat of the vehicle. This would have put each of them in very close proximity and perhaps in direct physical contact with the blanket found on the front seat.

88 The day following the incident at Gagnon Sports, the Thomas vehicle was found within one kilometer of that location. It was parked and locked. The police secured and seized the vehicle. There was no evidence tending to suggest that the interior had in any way been tampered or interfered with between the shootings at Gagnon Sports and the time police discovered the vehicle.

89 In these circumstances, the fact that hairs said to have been contributed by approximately 10 persons other than Mr. Woodcock were found inside the vehicle does not render "irrelevant" the evidence that Mr. Woodcock could not be excluded as a possible donor of the three hairs, one of which was where or very near to where the perpetrators sat.

90 However, this is not the only evidence in the relevance mix. In approaching the question of whether there exists some evidence of a link between the hairs and the perpetrator, it is important that the evidence in question not be considered in isolation. All of the circumstances, cumulatively, must be considered.

91 The front portion of the Thomas vehicle contained nuclear DNA, from bloodstains, belonging to Roshan Norouzali, one of the known perpetrators. These stains were on the front dash and interior door handle on the driver's side. There was evidence to the effect that in the course of smashing gun cases inside Gagnon Sports he sustained a cut and had bled. Norouzali's DNA was also found on a shard of glass inside Gagnon Sports. Thus the premises of Gagnon Sports and the Thomas vehicle provided a strong circumstantial link between Norouzali and the two homicides.

92 It seems to me that any evidence tending to link Mr. Woodcock to Norouzali in and around the time frame of the two killings may, depending on the context and circumstances, also bear on the question of a link between the hairs in the vehicle and Mr. Woodcock.

93 Two men jointly perpetrated these crimes. They arrived at Gagnon Sports together, in the same stolen vehicle. They were both masked. Inside Gagnon Sports, they acted crisply, methodically and in concert, each with a clearly defined role. There were obvious aspects of planning and deliberation. The shootings were particularly ruthless and brutal. The perpetrators stole approximately eleven handguns. There was evidence in support of the Crown's theory that access to the handguns was the motive for all of these crimes. They departed Gagnon Sports together, in the same stolen vehicle. It was mid-afternoon, September 14, 1994.

94 It is in this overall context that the evidence linking Norouzali and Mr. Woodcock must be viewed. Significantly, shortly after 9 a.m. on the morning immediately following these two killings, Norouzali and Mr. Woodcock were observed, together, in London, Ontario. They drove in a motor vehicle, from one location to another.

95 In addition, there was circumstantial evidence of their continued association culminating in their arrests on March 10, 1995, in St. Thomas.

96 The nature of the association evidence must be considered. The three subsequent robberies ruled admissible as similar fact evidence provided cogent evidence of a continuous joint criminal enterprise between the two men. Perhaps most significantly in that regard was the evidence that two firearms stolen from Gagnon Sports were brandished and used during the course of these three robberies. As well, there was some evidence from which it could be inferred that Mr. Woodcock had a unique role in the other robberies and that it paralleled the role played by the first of the two perpetrators to enter Gagnon Sports.

97 The evidence of association between Norouzali and Mr. Woodcock, then, commenced early on the morning following the mid-afternoon, September 14, 1994 robbery at Gagnon Sports and concluded with their arrest in connection with the robbery in St. Thomas, approximately six months later. It is to be emphasized that Mr. Woodcock pleaded guilty to the St. Thomas robbery. There is no issue of identity in respect of that robbery or of his association with Norouzali. Nor for the purposes of this application is there doubt that at the time of their arrest in St. Thomas, they were in joint possession, along with Deryck Thompson, of two handguns stolen during the incident at Gagnon Sports.

98 As I have said, the question of whether or not the three hairs can be convincingly linked to Mr. Woodcock is ultimately one for the jury assuming there is some basis upon which it could be said that the evidence, *in totality*, advances that proposition even to some degree. Having regard to the crimes in question, the timing, duration and nature of the evidence of association between one of the known perpetrators and Mr. Woodcock must be factored into the mix when considering whether there exists any evidence that one of the perpetrators of Gagnon Sports could realistically have been the donor of the three hairs. On that question, the association evidence takes on added force by reason of the joint possession and use as between the perpetrators of the St. Thomas robbery of the two stolen handguns.

99 It may very well be that the evidence capable of linking the crime scene hairs to Mr. Woodcock does not share all of the clarity, cogency and distinctive features of the evidence of linkage found in other cases. As well, in any particular case, the virtual absence of a relationship between an item of evidence and the proposition sought to be established might lead to a finding that the proffered evidence is irrelevant.

100 However, in my view, no reasonably informed member of the public would say that all of these circumstances taken together do not as a matter of logic and common sense constitute some evidence bearing on the question of whether or not the hairs were deposited by Mr. Woodcock and that the proposed opinion evidence that he could not be excluded as the source of the hairs would be of no assistance to a jury on the crucial issue of identification.

101 All of the matters ably pointed out by Ms. Rochman are, it seems to me, legitimate matters to be canvassed in cross-examination. She could be correct that their cumulative effect may well lead the jury to determine that the evidence of the hairs and the associated expert opinion evidence does little, if anything, to advance the inquiry. That is a matter for them. Given the possible inference of a link between these hairs and Mr. Woodcock, I am unable to conclude that the proposed evidence is nothing more than a red herring and that I should prevent the jury from hearing it. The evidence is logically relevant. I conclude that the relevance criterion has been met.

Q. Cost Benefit Analysis

102 In *Mohan*, Sopinka J. noted that a determination of logical relevance does not end the inquiry. He discussed the next step as follows:

This further inquiry may be described as a cost benefit analysis, that is "whether its value is worth what it costs": see *McCormick on Evidence*, 3rd ed. (1984), at p. 544. Cost in this context is not used in its traditional economic sense but rather in terms of its impact on the trial process. Evidence that is otherwise logically relevant may be excluded on this basis, if its probative value is overborne by its

prejudicial effect, if it involves an inordinate amount of time which is not commensurate with its value or if it is misleading in the sense that its effect on the trier of fact, particularly a jury, is out of proportion to its reliability. While frequently considered as an aspect of legal relevance, the exclusion of logically relevant evidence on these grounds is more properly regarded as a general exclusionary rule: see *R. v. Morris* (1983), 7 C.C.C. (3d) 97, 1 D.L.R. (4th) 385, [1983] 2 S.C.R. 190 (S.C.C.). Whether it is treated as an aspect of relevance or an exclusionary rule, the effect is the same.²⁶

103 The exercise has subsequently been described in this manner:

The trial judge, acting as gatekeeper, may exclude logically relevant expert evidence because its cost exceeds the perceived benefit. The case law identifies factors used to measure the cost-benefit of the proffered evidence in relation to the criteria of relevance, necessity and reliability. The factors are not amenable to a hierarchical list. There are, however, divergent opinions as to the application of a particular criterion in the context of different factual circumstances. To determine the admissibility of the evidence, courts weigh the strength or cogency of the evidence versus its potential prejudice in the sense that it may be used by the trier of fact for an impermissible purpose, may create prejudice or confusion or may render a trial inefficient...The trial judge may also consider the strength of the expert's ready-made inference to resolve a material issue, the relative importance of the issue in the case that the proposed expert evidence tends to prove, or whether the opinion raises fresh collateral issues.²⁷

104 I will commence with a discussion of the potential the proposed evidence has for prejudice.

105 Before doing so, I turn to an aspect of prejudice raised in *Murrin* that does not concern us here, namely the question of mtDNA sample available for defence testing. In conducting the testing, the prosecution's lab in *Murrin* used up the entirety of the sample. None was available for independent testing.²⁸ In this case, Molecular World Inc. was able to conduct all of its testing in such a manner that there were samples remaining in respect of each of the three hairs in question. As I understand it, in connection with the hair (EV13) that was the subject of the first report, sample was actually conveyed, at the instance of the defence, to an independent lab in the United States for the purpose of defence testing. In connection with the remaining two hairs (EV35 and EV39), the subject of the second report, the prosecution will do likewise upon request.²⁹

106 In addition, all of the Molecular World Inc. test results, including raw data, were provided to the defence. I understand that Dr. Chahal has made himself available to confer with Ms. Rochman and that counsel has availed herself of this opportunity on at least one occasion.

107 I have already alluded to the circumstances leading to the mistrial. I would merely point out that this *voir dire* and trial have been scheduled with a view to ensuring ample time for both sides, but particularly the defence, to digest and address all aspects of the mtDNA evidence.

108 Thus on the overall question of prejudice, I must consider the absence of prejudice in these two respects.

109 Ms. Rochman raises several aspects of possible prejudice. First is the concern that the jury will find this scientific evidence highly complex, confusing and difficult to follow. It will, of neces-

sity, include a thorough canvassing of the differences between nuclear DNA and mtDNA, the application of the differences to this case, and a crash course touching upon difficult concepts in the area of statistics. Second, it may be difficult, if not impossible, to prevent the jury from drawing the inaccurate conclusion that this is a "typical DNA case" and from assuming, for all practical purposes, that the reported findings indicate "a match" between the hairs and Mr. Woodcock. Third, even if best efforts are made to deal with these matters, there is no way to ensure juror comprehension of the evidence generally, and in particular of the significant limitations of the proposed evidence. Fourth, all of this will consume considerable court time and, even taking the Crown's case at its highest, is not worth the candle given the aforementioned concerns.

110 In *R. v. M.(B.)*³⁰, Justice Rosenberg observed that the trial judge should be cautious about excluding expert evidence simply because the field is of some complexity and may lead to both parties calling experts. He said (at para. 93) this was not a sufficient ground to exclude the evidence:

We do not ensure the continuing vitality of the jury system by underestimating the intelligence of jurors.

111 He noted that in *Terceira*, on the question of experts using frequency numbers in a nuclear DNA case, Finlayson J.A. disposed of the argument that the probative value of this evidence was outweighed by its potential for unfair prejudice by reference (at p. 20) to Dickson C.J.C.'s comments in *R. v. Corbett*³¹:

The very strength of the jury is that the ultimate issue of guilt or innocence is determined by a group of ordinary citizens who are not legal specialists and who bring to the legal process a healthy measure of common sense. The jury is, of course, bound to follow the law as it is explained by the trial judge. Jury directions are often long and difficult, but the experience of trial judges is that juries do perform their duty according to the law. We should regard with grave suspicion arguments which assert that depriving the jury of all relevant information is preferable to giving them everything, with a careful explanation as to any limitations on the use to which they may put that information.

112 In any event, I do not regard this as a case that could develop into a serious battle of experts on a highly contentious issue. The proffered opinion relates to but one of many items of circumstantial evidence. As I have said, this particular piece of evidence may be attacked in numerous ways that have nothing to do with mtDNA extraction or analysis. While on a few occasions they seemed to lapse into unhelpful jargon and unduly complicated explanations, the two experts for the most part testified in a manner that was designed to educate and inform. They used demonstrative aids to clarify much of what they described. Their evidence was thorough and balanced. They were not resistant to cross-examination. Indeed, the Crown experts agreed with many if not most of the propositions put to them in cross-examination. They stressed the need to ensure that the jury was alerted to and acutely aware of the limitations of mtDNA evidence. Significantly as well, they underscored the importance of expressing their opinions in a manner that was careful, conservative and fair to the accused.

113 Counsel's preparation for the evidentiary portion of this voir dire was extensive and thorough. They demonstrated a clear grasp of the salient issues and undoubtedly will provide considerable assistance in developing them for the jury. Crown Counsel has indicated that during examina-

tion-in-chief of the experts, he proposes to clearly elicit the various concerns previously mentioned so as to ensure that these are placed before the jury at a very early stage. I have no doubt that this, combined with Ms. Rochman's effective cross-examination, will make the jury keenly aware that this is very much unlike a "typical DNA case".

114 Moreover, as I indicated during the course of oral submissions, I propose, following submissions of counsel at the appropriate time, to deliver a mid-trial instruction prior to the jury hearing any of the proposed expert evidence. This would include an instruction to the effect that this is a case involving mtDNA and not nuclear DNA, and that the two are very different. Accompanying this would be a clear warning as to the limitations and parameters of this evidence, highlighting the fact that unlike nuclear DNA, mtDNA is not a unique identifier and does not have the exclusionary power or potency of nuclear DNA. The jury will be directed to the manner in which mtDNA scientists express their findings (such as "cannot exclude"). In other words, they will be told up front that the nature of the science is such that mtDNA can never be used to conclusively identify an individual.

115 Subject once again to submissions of counsel, I also propose to deliver final instructions that would include an overview of this body of evidence, the positions of the parties relative to it, and a repetition of the associated cautions and warnings (including the fundamental differences between nuclear DNA and mtDNA) that the jury, by that stage, will have heard on a number of occasions. This will be accompanied by general instructions on the use and limits of expert evidence, an admonition against being overwhelmed by the aura of scientific infallibility of the evidence, and the need to apply their common sense to all of the evidence on the issue to determine its value as an item of circumstantial evidence.³² They are to consider this as an item of circumstantial evidence, no more and no less, and are to assign it whatever weight they deem appropriate. Included as well will be an instruction on the need to consider all of the evidence cumulatively when considering the ultimate question of whether or not the Crown has met the burden of proof beyond a reasonable doubt.

116 Given that the significant differences between nuclear DNA and mtDNA will be thoroughly and repeatedly emphasized, a related aspect of prejudice -- overwhelming the jury -- will be satisfactorily addressed. As Justice Henderson stated in *Murrin*³³:

As for the possible prejudicial effect of the evidence, it is important to note that the probability of two individuals having the same mtDNA sequence is far higher than is the case with nuclear DNA. That goes a long way to avoid the possibility of the jury being overwhelmed by the "mystic infallibility" of the evidence. In the words of Meleragni, *supra*, the evidence, if accepted, will not prove identity conclusively but will simply stand as a piece of evidence to be incorporated into a large puzzle.

117 These aspects of potential prejudice have been canvassed in a number of the American authorities that were cited. Almost universally it has been held that traditional means can be employed to adequately address prejudice. In general I find the reasoning in these cases persuasive. In my view, the potentially prejudicial aspects of the proffered evidence can be effectively controlled and reduced by the combination of measures I have canvassed. I propose to seek counsel's input in the developing of instructions -- mid-trials and finals -- that will serve this particular purpose.

118 I anticipate that the canvassing of this body of expert evidence and the related issues may extend the trial by approximately one week, perhaps slightly more.

119 As I have said, counsel are experienced, competent and familiar with the key issues arising from the expert evidence. I am confident they will assist the jury in following and understanding the evidence and the limitations of the evidence, and that they will assist the court in crafting appropriate jury instructions that will, in a comprehensible manner, alert the jury to the warning signs so as to ensure that the fact-finding process will not be distorted. I am satisfied the jury will not be unduly distracted or misled.

120 Taking everything into account, for the reasons indicated, I do not consider that the tendering of this evidence will be especially costly in the *Mohan* sense. Given the nature of the proffered evidence as well as the overall body of evidence that I understand to constitute the Crown's case, I acknowledge that it is somewhat difficult to assess the extent of the benefit that may be associated with this evidence. That said, I think it is at least capable of playing an important role, one way or the other, in the jury's task relative to the central issue. There can be no doubt about the importance of the issue to which the proposed evidence relates. It is, in effect, the crucial if not the only real issue of substance that the jury will be asked to resolve: the identity of the second perpetrator of the killings. It cannot be said that the time requirements are out of proportion to the importance of the issue to which the evidence relates.

121 As I have said, this is not novel science. For several years, evidence of mtDNA analysis has been routinely admitted throughout the United States. There was no real reliability-based challenge. Based upon the evidence on this application, it would appear that the totality of the peer review journal publications leaves little, if any, room for questioning the validity and reliability of the science and technology related to mtDNA examination and analysis.

122 Some time in the future, the discriminatory power of mtDNA, from a forensic perspective, may be greater than it is at present. It is to be expected that technology will improve and databases will increase in size. Accordingly, as Ms. Rochman submitted, it is possible that a person whose mtDNA profile cannot today be excluded may, some time in the future, have her or his profile excluded as a contributor to the particular evidentiary sample. In light of all of the uncontradicted evidence supporting the reliability and validity of the science in question, I see no principled reason to conclude that this potential for increased discriminatory power should impact upon the question of admissibility. Nor does it take the evidence below the relevance threshold. It is another matter that may relate to the interpretation of the significance of the forensic test results. In short, it is a matter that goes to the weight of the evidence, not its admissibility.

123 The Crown has established a threshold level of reliability with respect to the field of forensic mtDNA examination and analysis.

R. The Other *Mohan* Criteria

124 There is no applicable exclusionary rule.

125 The evidence is necessary. For reasons already canvassed, I do not think the jury will be overwhelmed or that the fact-finding process will become distorted.

126 The experts are duly qualified. They will assist the trier of fact in arriving at an informed, independent conclusion.

S. Conclusion on *Mohan* Criteria

127 Having carefully considered the proposed evidence, I conclude that its benefit to the fact-finding process outweighs the potential for prejudice or harm of receiving the opinion.

128 The Crown has met the evidential and legal burden to satisfy the *Mohan* admissibility criteria to a balance of probabilities. Therefore, the proposed evidence is admissible.

T. FBI Database and The Frequency Estimate

129 I turn lastly to the question of the FBI database and how the numbers may be reported to the jury.

130 As I have said, Dr. Chahal testified that while he was required to report the search results based on sub-categories within the database, the reporting out of numbers based on the entire database is acceptable. On the other hand, it was Dr. McCurdy's considered view that while this less conservative approach of reporting is mathematically and scientifically valid, it runs the risk of "misleading" a jury in the context of a criminal case.

131 Beyond what I have already indicated, Dr. McCurdy did not expand upon his use of the word "misleading". It may be, as the prosecutor contended, that by this he meant that according to the FBI's general approach to reporting, consistent with other aspects of the FBI's standards and protocols, a jury ought only to be apprised of the statistical calculation that was most conservative in the sense of most beneficial to the criminal defendant. In other words, as a matter of mathematics and science, it was valid to report either or both ways. One could appropriately report based upon each sub-category and/or upon the total of all of them. In any event, it is argued that this approach may be predicated on the FBI's selection ("for administrative purposes") of the three largest ethnic sub-groups when reporting in the United States and a concern that some of the other sub-groups are numerically under-represented in the database. Accordingly, it is not a question of scientific validity but rather a question of general application that, according to the FBI's view, called for the most conservative approach to be placed before the jury.

132 I point out once again that Dr. McCurdy testified that FBI examiners employ this as a uniform, standard approach to reporting. He did not suggest, nor do I find, that Dr. Chahal's method is not reasonably reliable, from a mathematical perspective.

133 The Crown did not take the position that the jury ought only to hear the number resulting from the use of the entire database. The Crown submitted that both numbers ought to be placed before the jury, together with explanations in support of each. He submitted that the entire area is fertile ground for cross-examination in connection with the significance of the results and the question of the weight to be attached to the scientific findings.

134 Despite the fact that it is the FBI database that is routinely used in mtDNA cases, the authorities do not reflect a uniform approach to this question.³⁴ In some instances, it would appear that the calculation was based upon the results obtained from a search of the entire database.³⁵ In others (including *Murrin*³⁶), it appears as if the reported calculation was based only upon the particular ethnic sub-group in question. In still others, the reports do not make clear which approach was used. Interestingly none of the mtDNA cases I have read result in the admission of both calculations, leaving it to the jury as a matter of weight.³⁷

135 I would not, as a matter of law, hold that only the most conservative or cautious statistical approach should be placed before the jury. My conclusion is based entirely upon the evidence heard on this application and the submissions based upon that evidence.

136 I have read and re-read Dr. McCurdy's evidence. While Mr. O'Driscoll's suggested interpretation of what Dr. McCurdy said is reasonable and may be accurate, I am simply unable to make a finding in this regard. It is possible that he meant something else entirely. Nor can I say that I prefer Dr. Chahal's evidence on this point to that of Dr. McCurdy. Dr. Chahal did not claim to have any special expertise in statistics nor in the history, development or intended use of the FBI's database.

137 What I am left with is this. As Ms. Rochman emphasized, Dr. McCurdy was the Crown's expert. He is a longstanding member of the FBI and an mtDNA examiner with special expertise in all aspects of the FBI database. He testified clearly that to his knowledge all FBI examiners routinely report on the FBI database in the same way. They do not report based upon the entire database. I took him to say that at least amongst FBI mtDNA examiners this is the recognized, accepted method of using this database. He was asked about this on at least three occasions -- during examination-in-chief, cross-examination and again in re-examination. Significantly, it was Crown Counsel who twice elicited this evidence. Dr. McCurdy stated categorically and consistently that while reporting based upon the entire database is not scientifically or mathematically inaccurate, it would lead to the jury getting the wrong impression about the real statistical significance of the analysis.

138 It was open to Dr. McCurdy to qualify or modify his position in this regard. Particularly in re-examination, Dr. McCurdy was given an open-ended opportunity to do so. He could well have maintained that any risk of misleading the jury could be ameliorated by the presentation of an analysis in support of both numbers, first from the application of the entire database and second, in a case such as this, from an application restricted to the Caucasian sub-group. He did not do so, nor did he suggest that he was aware of any case where such an approach was taken.

139 In addition, I am concerned that admission of numbers based upon the two approaches would lead to spending an undue amount of time on rather complex evidence regarding the FBI database and, more particularly, on the relative merits of two different statistical approaches to the same database by two different Crown experts. Dr. McCurdy would undoubtedly indicate to the jury that in his opinion one approach may be misleading, the other not. Assuming the correctness of the Crown's interpretation, further time would then be spent explaining what was meant by "misleading" and on whether or not the FBI's "conservative approach" based on fairness to the accused was the more appropriate one to be followed.

140 In the end, the jury would be left to wonder why it had been given a numerical result and statistical approach that the Crown's acknowledged expert on the FBI database felt was potentially misleading, particularly when the entire issue could have been avoided. I would observe that in all the circumstances it is difficult to foresee the jury, if given the option, preferring an approach said by the FBI examiner to run the risk of producing an unfair result. Moreover, the Crown might well be left in the untenable position of urging the jury to adopt an approach arguably not as "fair" as the one advocated by the Crown's own expert.

141 I appreciate that the application of one approach over the other is of some statistical significance as it applies to the results in this particular case. However, on balance I see rather minimal advantage or purpose in these inquiries but there is a real potential that they could cause the jury to become unnecessarily confused and sidetracked. The probative value is overborne by the potential for prejudice.

142 For these reasons, I conclude that the opinion to be conveyed to the jury is to be based upon the Caucasian sub-group only. This may be revisited, depending upon the defence approach to these issues before the jury.

E.B. MINDEN J.

cp/e/qlesm/qlcem/qlkjg/qltl

1 [1999] B.C.J. No. 2715 (B.C.S.C.).

2 *Ibid*, at paras. 67 to 88.

3 (1994), 89 C.C.C. (3d) 402 (S.C.C.).

4 These included issues associated with heteroplasmy (the relatively common presence of two or more mtDNA sequences in an individual), contamination, recombination, and paternal leakage. See *Murrin, supra.*, note 1, at paras. 90 to 124.

5 Referred to as "EV13" in Molecular World Inc.'s Report, dated November 15, 2005 (Exhibit 10).

6 As a consequence of this development, the application was adjourned, on consent, so that the defence could make further inquiries relative to these two additional hairs.

7 The parties agreed that no further *viva voce* evidence would be required. Molecular World Inc.'s report, dated May 30, 2006, relating to the two additional hairs, EV35 and EV39, (as well as other hairs and samples) was entered, on consent (Exhibit 21) together with other agreed facts (Exhibits 22 and 23).

8 Also factored into the latter definition is the following widely accepted view: "If heteroplasmy is observed in both questioned and known samples and all non-heteroplasmic nucleotide positions are identical, a common maternal lineage cannot be excluded. If heteroplasmy at a particular nucleotide position is observed in a questioned sample but not the known sample or vice versa, and all other tested nucleotide positions are identical, a common maternal lineage cannot be excluded".

9 [2000] 2 S.C.R. 600.

10 Sopinka, Lederman, Bryant, The Law of Evidence in Canada, Second Edition Supplement (2004), at section 12.30.5, p. 96 ff.

11 *R. v. Terceira* (1998), 123 C.C.C. (3d) 1, 15 C.R. (5th) 359 (Ont. C.A.), at para. 64, aff'd [1999] 3 S.C.R. 866, 142 C.C.C. (3d) 95, 32 C.R. (5th) 77.

12 *R. v. Murrin*, *supra*, note 1, at para. 3 and para. 9.

13 *State of Connecticut v. Pappas*, 776 A.2d 1091 (Conn. 2001).

14 *Magaletti v. State of Florida*, 847 So. 2d 523 (Fla. Dist. Ct. App. 2003).

15 *U.S.A. v. Coleman*, 202 F. Supp. 2d 962 (U.S. District Court, Eastern District of Missouri, 2002).

16 *United States v. Beverly*, 2004 FED App. 0136P (6th Cir.) (United States Court of Appeals for the Sixth Circuit, May 12, 2004).

17 *Wagner v. State*, 864 A.2d 1037 (Court of Special Appeals of Maryland, January 3, 2005).

18 See *infra.*, at para 52. Deryck Thompson was one of three men (including Norouzali and Mr. Woodcock) arrested at the scene of the so-called "St. Thomas" robbery. He was described, during submissions, as a person who at some point was of interest to the police in connection with Gagnon Sports and, during the first trial, was the subject of "other suspects" evidence: see my Ruling, dated September 19, 2005, on Discreditable Conduct Evidence, at paras. 21 and 139ff.

19 Sopinka, Lederman, Bryant, The Law of Evidence in Canada, *supra*, note 10, section 12.33.1, p. 97. See *R. v. Mohan*, *supra* at note 3, at p. 411.

20 *R. v. J. (J.-L.)*, [2000] 2 S.C.R. 600, at 623, per Binnie J., quoting with approval Paciocco and Stuesser, The Law of Evidence (1996) at p. 19.

21 McCormick on Evidence (5th), Volume 1, p. 641.

22 See *R. v. Corbett* (1988), 41 C.C.C. (3d) 385 (S.C.C.), at pp. 417-8 per LaForest J.; *R. v. Watson* (1996), 108 C.C.C. (3d) 310 (Ont. C.A.), at p. 323, per Doherty J.A.

23 *R. v. Arp* (1998), 129 C.C.C. (3d) 321 (S.C.C.), at p. 338, per Cory J.

24 *Ibid.*, at p. 338 per Cory J. and *R. v. Watson*, *supra*, at note 22, at p. 323, per Doherty J.A.

25 Justice David Watt, Watt's Manual of Criminal Evidence (2005), Section 3, p. 31ff.

26 *R. v. Mohan*, *supra*, note 3, at p. 411 (C.C.C.) per Sopinka J.

27 Sopinka, Lederman and Bryant, *supra*, note 10, section 12.34.1, p. 100 ff.

28 *R. v. Murrin*, *supra*, note 1, at para. 128.

29 The availability of samples for independent testing addresses both reliability concerns as well as potential prejudice associated with how a jury may view the evidence: see *R. v. Terceira, supra*, note 11, at para. 55.

30 (1998), 130 C.C.C. (3d) 353 (Ont. C.A.).

31 (1988), 41 C.C.C. (3d) 385 (S.C.C.) at 400-401.

32 *R. v. Terceira, supra*, note 11, para. 65.

33 *R. v. Murrin, supra*, note 1, para. 127.

34 Nor does it appear that this narrow question was been specifically litigated.

35 See, for example, the approach utilized by Dr. Terry Melton, as reported in *U.S.A. v. Coleman, supra*, note 14, at p. 7-8.

36 *R. v. Murrin, supra*, note 1, para. 133. As Ms. Rochman pointed out, as in this case, the only observation of the mtDNA profile in *Murrin* occurred within the Caucasian sub-group of the database.

37 As Crown Counsel observed, arguably there is some Ontario authority for this approach: *R. v. Terceira, supra*, note 11, at paras. 41-43. However, that case involved nuclear DNA where the statistical methodology is not premised upon the counting method as it is here. In addition, the issue was quite different. The question was whether there should be an absolute prohibition against the introduction of specific match figures in a nuclear DNA case and whether the probative value of the numbers reflecting the statistical rarity of a match in the general population was outweighed by its potential for prejudice. The Court of Appeal held there should not, in the nuclear DNA context, be an absolute prohibition against the introduction of specific match figures. As Finlayson, J.A. pointed out, only the Crown had called evidence on the *voir dire* relative to the DNA profile. Unlike the present case, there was at that stage no issue of differing approaches to statistics or any suggestion that one approach, not commonly used, might cause the jury to be misled. The Court's comments to the effect that the competing figures were properly to be assessed by the jury were made in the context of both sides having actually called experts before the jury where those experts differed significantly on statistics and the range of numeric frequency. Finally, the Court underscored the need to consider the admission of statistics on a case by case basis (at para. 43): "It was justifiable to admit the probability statistics in this case, and it might be in others. I would leave the matter to the discretion of the trial judge in the particular case." See also: *R. v. D.D.D.*, [2005] A.J. No. 1340 (Alta Q.B.).