blood splattering was also observed. Based on this, it is not unlikely that the person who committed the murder sustained an injury from which bleeding occurred.

As part of the further examination of evidence in this case, additional testing of two pieces of evidence (rope and plastic straw) taken from the scene of Daniel Croteau's death was undertaken. The rope and plastic straw were sent to Forensic Science Associates (FSA), 3053 Research Drive, Richmond, California for DNA typing to be conducted on the biological evidence using the PCR DNA amplification procedure in order to determine traits associated with the blood on the rope and straw. The rope and plastic straw were received from Trooper Michael Sullivan of the Massachusetts State Police (who at that time was assigned to the Hampden CPAC Unit attached to the Hampden County District Attorney's Office and was assigned as case officer to this investigation) at the FSA laboratory, via Federal Express mail, on March 13, 1992. The FSA laboratory was told that this evidence was collected pursuant to a homicide investigation about twenty years ago; but, it was not told the name of the victim or possible suspects in this case.

On January 8, 1993, a report of the examination of the rope and plastic straw sent to FSA for analysis was issued by the FSA laboratory personnel and subsequently sent to the Hampden County District Attorney's office. The testing of the rope and plastic straw was conducted by Edward T. Blake and Jennifer S. Mihalovich. (Refer to Addendum J).

Edward T. Blake holds a Doctor of Criminology in Forensic Science from the University of California at Berkley. He also received a Bachelor of Sceince in Criminalistics from the University of California at Berkley in 1968. Dr. Burke is a member of the California Association of Criminalists, Sigma Xi (Research Society of North America), American Society of Human Genetics, American Association for the Advancement of Sceience, New York Academy of Science, American Academy of Forensic Sciences, and the Northwest Association of Forensic Scientists. He has worked in the field of forensic science since 1969, and has been a consultant in forensic biology from 1975. Dr. Blake received Service Awards for his work from the California Association of Criminalists in 1976, 1977 and 1984. He received the Distinguished Member Award of the California Association of Criminalists in 1985. He has numerous published works in his field, including but not limited to, Clecila H. von Beroldingen, E.T. Blake, R. Higuchi, G.F. Sensabaugh, and Henry Erlich, "Applications of PCR to the Analysis of Biological Evidence," in PCR Technology: Principles and Applications for DNA Amplification, Henry A. Erlich, Ed., Stockton Press, 1989, 209-223; Henry A. Erlich, Russell Higuchi, Ceelcilia H. von Beroldingen, and Edward Blake, "The

Use of the Polymerase Chain Reaction for Genetic Typing in Forensic Samples," Proceedings of an International Symposium on the Forensic Aspects of DNA Analysis, June, 1989, Quantico, Va., 93-101, U.S. Government Printing Office, Washington, D.C.; E.T. Blake, S. Paabo, and M.D. Stolorow, "DNA Amplification and Typing from Aged Biological Evidence," Proceedings of an International Symposium on the Forensic Aspects of DNA Analysis, June 1989, Quantico, Va., 267-268, U. S. Government Printing Office, Washington, D.C.; S. Walsh, R. Higuchi, and E. Blake, "PCR Inhibition and Bloodstains, "Proceedings of an International Symposium on the Forensic Aspects of DNA Analysis, June 1989, Quantico, Va., 281-282, U. S. Government Printing Office, Washington, D.C.;Rhea Helmuth, Nicola Fildes, Edward Blake, M.C. Luce, J. Chimera, Roberta Madej, C. Gorodezky, Mark Stoneking, Norma Schmill, William Klitz, Russell Higuchi, and Henry A. Erlich, "HLA-DQ [alpha] Allelle and Genotype Frequencies in various Human Populations Determined by Using Enzymatic Amplification and Oligonucleotide Probes," Am. J. Hum. Genet., 47, 1990, 515-523; Rebecca Reynolds, George Sensabaugh, and Edward Blake, "Analysis of Genetic Markers in Forensic DNA Samples Using the Polymerase Chain Reaction," Anal. Chem., January, vol. 63, 1991, 2-15; Edward Blake, Jennifer Mihalovich, Russell Higuchi, P. Sean Walsh, and Henry Elrich, "PCR Amplification and HLA-DQ [alpha] Oligonucleotide Typing on Biological Evidence Samples: Casework Experience," J. Forens. Sc.,Vol. 37, No. 3, May 1992, 700-726. In addition, from 1971, Dr. Blake has made over seventy-five presentations at scientific meetings in his field with approximately eight presentations specifically involving DNA analysis and techniques in the last six years.

Jennifer S. Mihalovich holds a Masters of Public Health in Forensic Science from the University of California at Berkley. She also received a Bachelor of Science in Microbiology at the University of Montana at Missoula in 1985. She has been emplyed as a Criminalist at FSA laboratory since 1986. Ms. Mihalovich is a member of the California Association of Criminalists, the Regional Director of Northern California for the California Association of Criminalists, Board of Directors, and a Provisional Member of the American Academy of Forensic Science. She received a Merit Award for the work she conducted on the DNA Quality Assurance Committee for the California Association of Criminalists. She has also been honored with the Paul Kirk Award from the Califonia Association of Criminalists in 1990, and was a Regional Award recipient for the American Academy of Forensic Sciences in 1991. Ms Mihalovich has published a number of technical papers, including but not limited to, Gima,L; Sims, G; Konzak, K; Blake, E and Super-Mihalovich, J. "The Recovery, Amplification and DQ [alpha] Typing of DNA from Partially Cremated Human Remains," presented at the Fall 1990 Semi-Annual Seminar of the California Association of Criminalists, Long Beach, California,

the Fall 1990 Seminar of the North Western Association of Criminalists, Seattle, Washington, and the 1991 Annual Seminar of the American Academy of Forensic Science, Anaheim, California; Super-Mihalovich, J. and Blake, E.T. "Detection of DQ[alpha] Genotypes in DNA Mixtures" presented at the Spring 1991 Semi-Annual Seminar of the California Association of Criminalists, San Francisco, California; Super-Mihalovich, J. and Blake, E.T. "DNA -PCR Blind Trial Results" presented at the Spring 1991 Semi-Annual Seminar of the California Association of Criminalists, San Francisco, California; and Kearney, J. J. et al., "Guidelines for a Quality Assurance Program for DNA Analysis," Crime Laboratory Digest, Vol. 18 No. 2, 1991, 44-75.

Dr. Blake and Ms. Mihalovich report that recent advances in molecular biology have revealed an enormous extent of genetic variation at the level of the primary genetic material, the DNA. These findings are, to a large extent, a by-product of the recombinant DNA industry that has revolutionized the medical approach to genetic disease diagnosis and treatment. Recently it has been recognized that genetic analysis at the DNA level has particular application in the forensic sciences [Jeffreys et al., Nature, 316, 1985, 76-79; Gill et al., Nature, 318, 1985, 577-579; Dodd, Nature 318, 1985, 506-507; Jeffreys et al., Nature, 322, 1986, 290-291; Lewin, Science, 233, 1986, 521-522; Tyler et al., Forens. Sci. Intern'l., 31, 1986, 267-272; Sensabaugh, J. For. Sci., 31(2), 1986, 393-396; Kantner et al., J. For. Sci., 31(2), 1986, 403-408; Guisti et al., J. For. Sci., 31(2), 1986, 409-417, Higuchi et al., Nature, 322, 1988, 543-546]. Furthermore, application of DNA technology by anthropologists to mummified tissues of now extinct species is witness to the robust nature of the DNA encapsulated within the nucleus of tissue cells [Higuchi et al, Nature, 312, 1984, 282-283; Paabo, Nature, 314, 1985, 644-645]. Similar recent anthropological studies have shown that the effect of profound DNA degradation is a failure to obtain any result rather than the production of a false or misleading finding [Hughes et al., Nature, 323, 1986, 208]. The trust of this work indicates that biological evidence is susceptible to successful analysis using DNA technology.

Dr. Blake and Ms. Mihalovich further report that the San Francisco Bay area is a center for recombinant DNA research; and one of the leaders in this field is Cetus Corp. The DNA analysis in this case has been conducted employing DNA technology developed by Dr. Henry Erlich and his colleagues within the human genetics laboratory of Cetus Corp. Dr. Erlich's laboratory has been a pioneer in the study of genetic variation in the DNA associated with the HLA region of the human genome [Erlich et al., Bio/Technology, 4, 1986, 875-981]; conventional serological HLA typing has been a routine tool for paternity testing for many years. In addition Dr. Erlich's laboratory has been involved in the development of DNA

technology that is capable of amplifying relatively small quantities [sub-nanogram range] of DNA for genetic analysis [Saiki et al., Science, 230, 1985, 1350-1354; Saiki et al., nature, 324, 1986, 163-166; Higuchi et al., Nature, 332, 1988, 543-546; Saiki et al., PNAS, 86, 1989, 6230-6234]. The amplification strategy employed here also has been used to develop a direct test for the AIDS virus in blood [Ou et al., Science, 239, 1988, 295-297].

The particular DNA region exploited in these studies is the DQ segment within the HLA Class II group: this region has the subclass designation DQ[alpha]. The DQ[alpha] DNA region can be considered a genetic marker system in its own right in a similar manner to the ABO genetic marker system. Within the DQ[alpha] marker system there are 6 alleles (or traits) designated 1.1, 1.2, 1.3, 2,3, and 4. Since each individual has two alleles, this genetic marker gives rise to 21 possible types as follows: [1.1, 1.1], [1.1, 1.2], [1.1, 1.3], etc. Each allele is associated with a specific and known DNA sequence. The DNA associated with the conventional HLA genetic markers (A, B, and C loci) is in the Class I group. All of these genetic markers are associated with the short arm of chromosome 6.

Although Massachusetts presently rejects the use of DNA evidence derived from RFLP (Restriction Fragment Length Polymorphism) analysis at the trial of a criminal case, see Commonwealth v. Lanigan, 413 Mass. 154 (1992), the PCR DNA analysis used on the rope and plastic straw in this case is reported not to have significant genotype deviations from the observed to the expected distribution based on Hardy-Weinberg equilbrium assumptions that some RFLP markers have been documented to have and which caused concern to the Supreme Judicial Court in Lanigan. In addition, the power of discrimination -- that two persons chosen at random from a population will have different genotypes -- for the DQ[alpha] marker is not as discriminating as a combination of RFLP markers so as to avoid yet another concern of the SJC in Lanigan concerning excessively large frequency estimates. For DQ[alpha], the agreement of observed and expected genotype frequencies does not necessarily imply that all the assumptions of the Hardy-Weinberg equilibium (random mating, no selection, and so forth) obtain but does show that there is no fundamental, systematic error with the typing method. The PCR based DQ[alpha] oligonucleotide typing method has been used to analyze biological evidence in over 250 cases thus far. It is possible to do PCR analysis on samples that are years old. As of September 1991, the DQ[alpha] test has been introduced as courtroom evidence in 44 cases and has been evaluated in 25 admissibility hearing in 20 different states. In 23 hearings, it has been admitted and in the case of Virgina v. Spencer, this ruling was upheld by the Virgina Supreme Court. Edward

Blake, Jennifer Mihalovich, Russell Higuchi, P. Sean Walsh, and Henry Elrich, "PCR Amplification and HLA-DQ [alpha] Oligonucleotide Typing on Biological Evidence Samples: Casework Experience," J. Forens. Sc.,Vol. 37, No. 3, May 1992. 700-726.

Dr. Blake and Ms. Mihalovich initially examined the rope and plastic straw, and reported that:

> The blood stained rope was examined for the presence of blood using a sensitive presumptive test [otolidine and hydrogen peroxide]. Blood traces were detected along the entire length of the rope. Four area from [A,B,C and D] were removed and the DNA extracted...The straw possesses a blunt end and a torn end. In addition the straw has been spilt down the length of the straw barrel. Presumptive tests for blood indicate a thin film of blood is present on the straw surface down its length; and much of this thin smear is visible to the eye. Two pieces of the straw [Areas A and B] were remove from near the torn end [see figure 2B] for DNA extraction....

Genetic analysis of the specimens in this case involved the following essential steps:

1. Digestion of blood with SDS and proteinase K.

2. Extraction of DNA from sample digests with chloroform/phenol and concentration of DNA using Centricon molecular filters.

3. Amplification of DQ[alpha DNA gene using the Polymerase Chain Reaction [PCR] employing 12.5 U Taq polmerase.

4. Hybridization probe analysis of the amplified sample DNA with Allele Specific Oligonucleotides (ASO's) for the sic DQ[alpha] alleles [1.1, 1.2, 1.3, 2, 3, 4] using a Dot Blot assay.

These findings revealed the following observed facts:

1. A low level of the DQ[alpha] gene was amplified from the straw [Item 1-2] in Area A. The DQ[alpha] type of this DNA was determined to be type 1.1, 4. This DQ[alpha] type occurs in approximately 8% of the Caucasian population and approximately 9% of the Black population.

2. The DQ[alpha] gene could not be amplified or typed from the straw in Area B due to the small amount of material and inhibition by the sample of the enzyme [Taq] responsible for the amplification process.

3. The DQ[alpha] gene could not be amplified or typed from any

of the specimens obtained from the rope [Item 1-1] despite repeated attempts to overcome PCR inhibition.

Through my conversations with Ms. Mihalovich I have been informed that if blood from a subject was sent to the FSA Laboratory, that sample could be tested pursuant to the PCR DQ[alpha] DNA testing as previously outlined in this affidavit and could be compared to the results of the testing previously performed by herself and Dr. Blake upon the plastic straw to identify by either including or excluding the subject as the depositor of the genetic material analyzed on the straw found at the scene of Daniel Croteau's death.

Based upon the probable cause established in this affidavit, I respectfully request that the court issue a warrant to search, seize, and test a blood sample of the suspect Father Richard R. Lavigne for evidence in the investigation of the murder of Daniel Croteau. Said blood sample to be drawn by trained medical personnel at a medical facility.

Signed under the pains and penalties of perjury, this ~~sixth day of August, 1993~~. Second day of September, 1993.

Thomas J. Daly

Thomas J. Daly, #861
Trooper, Massachusetts State Police