Forensic Analytical™
Crime Lab

# AFFIDAVIT OF C. ALAN KEEL

I, C. Alan Keel, declare, under penalty of perjury, that the following is true and correct:

1. My name is C. Alan Keel. I am over the age of 18 and otherwise fully competent to give this statement.

2. I am the Forensic Biology/DNA Analysis Unit Supervisor and DNA Technical Lead Analyst for Forensic Analytical Crime Laboratory, Inc. (FACL) in Hayward, California. The FACL Forensic Biology/DNA Analysis Unit is fully accredited by ANAB (formerly Forensic Quality Services), the longest established provider of ISO/IEC 17025 accreditations to forensic testing agencies in the United States. FACL has provided DNA analysis and consulting services to law enforcement agencies, prosecutors, defense attorneys, and civil litigants since 1995. Approximately 40% of our current caseload is for law enforcement in the pre-trial investigation of criminal cases.

3. I earned my B.S from Texas A & M University. I am certified by the American Board of Criminalistics in Molecular Biology. I am also a member of the American Academy of Forensic Sciences and California Association of Criminalists. During my career I have over 36 years of experience in forensic serological and DNA analysis. I have been involved with and have conducted PCR-based DNA analysis casework since 1991. For almost 15 years of my career, I worked as a criminalist in state and police crime laboratories, including the North Louisiana Crime Laboratory in Shreveport, Louisiana, the Oakland, California Police Department Crime Laboratory, the Tulsa, Oklahoma Police Crime Laboratory, and the San Francisco, California Police Department Crime Laboratory. Since 1999, I have been in private practice as a criminalist at Forensic Science Associates (FSA), a private laboratory which merged with FACL in 2011, through the present in my current capacity at FACL. My resume is attached as Exhibit #1.

4. Over the course of my 36 years of experience, I have conducted DNA testing in hundreds of cases on thousands of samples from across the country on behalf of prosecutors and defendants in both pre-trial and post-conviction investigations from over 36 states including Arkansas, several military bases, and Canada. At FSA and FACL, we have conducted DNA testing in over 160 post-conviction investigations. In virtually every case the physical evidence was shipped from the local jurisdiction to my laboratory in California – without a single shipping mishap.

5. I submit this Affidavit to advise the Court of the current capabilities of post-conviction DNA testing, about which I have personal knowledge, to obtain new and relevant information from evidence gathered in the investigation of the February 9, 1993 murder and possible sexual assault of Debra Kay Reese and the subsequent prosecution, conviction, and execution of Ledell Lee. It is my understanding Lee was arrested within four hours of finding the victim and that there is little or no dispute Lee wore the same clothes all day that day. In preparing this

Affidavit I discussed the facts of the case with Jane Pucher of the Innocence Project and reviewed the following documents:

a. The February 9, 1993 Supplemental Reports of Jacksonville, AR Police Department (JPD) officers Joe McCollough and Richard Ward and various crime scene photographs;

b. The February 11, 1993 autopsy report of Dr. William Sturner of the Arkansas State Crime Lab at Little Rock (ASL);

c. An ASL Evidence Submission Form from JPD Detective J. Harper listing multiple items of physical evidence in this case;

d. The February 16, 1993 and March 21 and March 28, 1994 reports and some supporting bench notes of Serologist Kermit Channell, II of the ASL[1];

e. The March 19, 1993 report of ASL Criminalist Donald Smith;

f. The June 11, 1993 and September 3, 1994 reports and some supporting bench notes of Agent Harold Deadman of the Federal Bureau of Investigation (FBI) Washington D. C. lab;

g. The October 11, 1995 trial testimony of Mr. Smith;

h. The October 11, 1996 trial testimony of Mr. Channell.

## The Evolution of PCR-based DNA Testing And Current DNA Technology

6. During my 29 years of experience as a DNA analyst beginning in 1990, I have experienced the advances in DNA testing technology that have led to more detailed physical evidence examination procedures. These examination and technological advances allow the detection and collection of biological material and the development of highly discriminating DNA profiles from even minute quantities of biological evidence 1) that went overlooked or unconsidered by previous examiners, 2) was previously deemed insufficient using earlier methods, and 3) that previously generated "inconclusive" results using the methods available in 1996. Current DNA technology also typically enables the identification of a common DNA source across multiple items of crime scene evidence.

7. In 1996 at the time of this trial, DNA-based evidence testing was just gaining a foothold in the forensic arena. RFLP-based DNA testing was well-established[2], but few government laboratories had the resources necessary to conduct RFLP testing and most biological

[1] Mr. Channell is the current Executive Director of the ASL.
[2] RFLP DNA analysis used by the FBI in 1994, although highly discriminating, required approximately 50 to 200 times as much DNA as PCR-based methods and is now obsolete.

physical evidence specimens were not amenable to RFLP testing. PCR-based DNA testing was limited to the immobilized probe six-gene DQA1/PM assay (released in 1994) and a single VNTR gene D1S80, but these tests were highly labor-intensive, and few laboratories had adopted them. All these tests are now obsolete. It was not until 1996 the first multiplexed Short Tandem Repeat (STR) gene kits became available; then, multiplex PCR-based DNA analysis coupled with automated capillary electrophoresis analysis in the late 1990s rapidly became the standard for the genetic discrimination of biological evidence in forensic crime labs. In 2000, the FBI replaced RFLP analysis with PCR-based STR analysis as the foundation for the Combined DNA Index System (CODIS), our national DNA-based identification system.

8. Today's STR DNA technology is more sensitive and discriminating than the conventional serology and early-generation DNA analysis methods available to the forensic community at the time of this trial, including the RFLP and PCR-based DNA tests available to the FBI in 1993-1994. The DNA quantification methods are more sensitive, the DNA amplification polymerase is more efficient and less susceptible to inhibition, more PCR cycles are employed during STR amplification, and the DNA typing instruments are more sensitive. FACL has extensive experience in developing DNA profiles from severely degraded, inhibited, and low-level DNA samples. We have successfully obtained highly discriminating to unique DNA profiles from challenging forensic evidence such as vaginal samples from cases where no ejaculation occurred and a very limited amount of male DNA was recovered, from body surface swabs and fingernail clippings/scrapings where a small amount of the male biology was present, and from the roots of single hairs recovered from crime scenes. We have also been successful in obtaining highly discriminating to unique DNA profiles from so-called "touch DNA" (low levels of biological material containing DNA that can be transferred from a person via brief handling or physical contact) recovered from clothing items or objects found at crime scenes.

9. Y-STR testing, not available at the time of the trial in this case, is particularly suited to casework in which the evidentiary items contain a mixture of female and male DNA. Y-STR technology is like other DNA testing methods with one major difference: the STR regions targeted for identification are all located on the Y-chromosome, which is exclusive to males. Y-STR testing is especially valuable where the evidence contains a small amount of male DNA commingled with female DNA. By targeting only male DNA and "avoiding" the often otherwise overwhelming amount of female DNA, Y-STR testing is highly useful for discriminating male DNA present in a mixed sample, such as a victim's fingernail evidence specimens, vaginal swabs with little or no semen, and victim clothing that was handled by a perpetrator.

10. Mini-STR testing, which first became available for forensic use in 2007, focuses on portions of the DNA that can break down over time and is particularly suitable for small or degraded samples collected in old cases. Mini-STR technology involves the same method of amplification but uses shorter and more strategically placed primers to resurrect longer DNA STR genes that may no longer be amplifiable in a given sample. Mini-STR testing can thus develop a DNA profile from a degraded sample even where previous STR DNA testing did not.

11. In 2017, the FBI expanded the CODIS to include twenty core STR genes. The commercial forensic industry responded to produce several STR profile kits ("MegaPlex" STR kits such as Qiagen's Investigator 24plex, Applied Biosystem's GlobalFiler, and Promega's PowerPlex Fusion) that include all twenty of these CODIS-core STR genes and more. At the same time, the FBI relaxed the requirements an evidentiary profile had to meet to become eligible for search against the CODIS database.[3] Together, these two very recent developments have created the potential to produce DNA profile investigative leads from almost any human biology that can be recovered from physical evidence. This technology has led to an explosion of investigative requests for DNA analysis of mere contact or "touch DNA" evidence specimens.

12. Even more recently, computer-assisted probabilistic genotyping, one of the most powerful DNA analysis tools at our disposal, has revolutionized the ability of the forensic community to make sense of complex DNA mixtures and either eliminate or assign a high probability of inclusion to a known person as a potential contributor to a complex mixture. The analysis of tools, firearms, and other potential weapons often used by multiple persons over the course of time and the mixtures of body fluids encountered on habitually-worn clothing – both of which generally produce mixed DNA results – have benefited greatly from the application of probabilistic genotyping to this problem.

13. FACL analysts are highly trained in evidence examination and modern DNA testing methodologies used to obtain a DNA profile, including megaplex STR DNA testing as well as Y-STR and Mini-STR testing. Our analysts are trained to recover and work with minute amounts of biological material that are generally invisible to the naked eye, degraded evidence, and evidence samples collected in decades-old "cold" cases. FACL has been using the computer-assisted probabilistic genotyping software STRmix to interpret complex DNA mixtures for almost two years.

## Applying Current DNA Technology to Previously Examined Evidence in this Case

14. In this case the Arkansas State Crime lab at Little Rock (ASL) examined and tested biological evidence in 1993 using only non-DNA-based genetic analysis (conventional serology)[4]; other evidence sent to the FBI in 1994 was tested only with RFLP DNA analysis. There is strong reason to believe that DNA analysis using today's PCR-based technology would be successful in this case 1) on evidence not previously considered and 2) on evidence previously tested but without success.

[3] Now, in order to qualify for CODIS upload, an evidence profile need contain alleles at only 8 of the original 13 core genes, and the searched profile (including alleles from the expanded genes) need meet a statistical rarity of only 1 in 10 million.

[4] For example, the 1993 report of Kermit Channell II describes the examination of multiple items of evidence for blood in an attempt to conduct conventional ABO blood group typing.

## Hairs from the Crime Scene (State Exhibit 81)

Hair from Vacuum Debris KB1
Hair from Club JH4

15. ASL Criminalist Donald Smith described in his March 19, 1993 report and testified in 1995 that many hairs from the crime scene "*are similar and may be considered of a common origin*." He also described in his report and testified in 1995 "*some Caucasian head hairs of undetermined source*" – meaning in his opinion they did not originate from the victim or Mr. Lee – were present in the vacuum debris KB1. He also testified that "*Negroid head hair fragments recovered from KB1 the vacuum debris and JH4 the wooden club could not be excluded from but not identified as coming from the suspect Ledell Lee*" and "*One intact*[5] *Negroid head hair was recovered from KB1 the vacuum debris, that could not be excluded from but not identified as coming from the suspect Ledell Lee*." [see TT 10-11-95, pg. 688] Each of these hairs is presumably resident on a microscope slide now contained within a box identified as State's Exhibit 81 [see TT 10-11-95, pgs. 691-693].

16. As has been well documented by the 2015 FBI/US DOJ Microscopic Hair Analysis Comparison Review[6], the comparison of the microscopic characteristics of hairs as the basis for assigning common origin is not reliable. This finding is exemplified in two cases from Montana. In separate 1987 trials Jimmy Bromgard and Paul Kordonowy were convicted of rape. Conventional genetic testing of the semen evidence was not informative. In both cases the Montana State Crime lab director identified Bromgard and Kordonowy as the source of hairs collected from each crime scene. In 2001 and 2003 I conducted post-conviction DNA testing of semen recovered from the victims and crime scenes in each case. Bromgard and Kordonowy were eliminated as the semen source and both were subsequently exonerated.

17. With DNA testing hair evidence has the potential to be highly probative – if not dispositive – as to the identity of the hair source. For example, on July 4, 1998 in Aberdeen, South Dakota a child was abducted from her home while the family slept. She was raped and required surgery to repair her vagina. No semen was found associated with the physical evidence, however a single pubic hair stuck in blood on the child's thigh was recovered. I was able to develop a unique nuclear male DNA profile from this pubic hair root that eliminated the initial suspect and the child's father as the source of the hair. Local authorities then collected reference specimens from every male who attended a neighboring Fourth of July party that day and the source of the hair was identified. Had this hair not possessed a root, it was more than adequate for mitochondrial DNA (mtDNA)[7] analysis.

18. All the evidentiary hairs from the vacuum debris or the wooden club can be categorized as to whether they contain a root. The cellular tissue in a hair root can be tested for nuclear STRs in an attempt to develop a profile for the hair source. Any STR profile developed can be compared to the victim and/or Mr. Lee to determine whether they are eliminated as a possible source of the

[5] An intact hair possesses a root, whereas hair fragments may or may not possess roots.
[6] See https://www.fbi.gov/news/pressrel/press-releases/fbi-testimony-on-microscopic-hair-analysis-contained-errors-in-at-least-90-percent-of-cases-in-ongoing-review
[7] Mitochondria are organelles containing DNA that are distributed in the tens to hundreds along the inside of a hair shaft. MtDNA testing can be successful with as little as 2 cm of hair shaft.

hair. Any sufficient/eligible foreign hair root profile can be uploaded to CODIS to possibly identify the hair source. Any hair that does not have a root can be subjected to mtDNA testing for comparison to the victim and Mr. Lee as a possible source. This investigative approach may also be applied to any other hair evidence in this case.

## The Defendant's Shoes KWB12

19. The crime scene reports of Officers McCollough and Ward describe the apparent attack upon the victim by her assailant as a "*fight*" scene with a chair and potted plants knocked-over extending from the living room area into the bedroom where the victim was found. The medical examiner noted the cause of death as "*Craniocerebral, facial, and neck trauma*", and the various crime scene photographs document heavy loss of blood by the victim and blood spatter on the south wall, telephone, and night stand adjacent the bed and victim. My understanding is there is little to no dispute the victim was beaten about the head and face with the short baseball bat-like club found next to the victim on the bed. Based on this reconstruction, it is reasonable to expect significant amounts of blood from the victim to be on the assailant's clothing as a result of this violent attack. Clearly, the initial investigation focused on this expectation.

20. The victim was eliminated as the source of a blood stain on the defendant's jacket via RFLP testing by the FBI. Other than the jacket bloodstain (which was consumed by the FBI) the only other blood found associated with the defendant's clothing was two small droplets of blood found on the defendant's shoes by Mr. Channell during his initial examination in 1993. Mr. Channell describes these bloodstains in his 1996 trial testimony as a very small "*pinhead in size*" stain on the tongue of the left shoe and a "*very small spot*" on the right shoe. It is plausible this blood was deposited on the defendant shoes contemporaneously with that on his jacket. In his March 21, 1994 report (and in his 1996 trial testimony) Mr. Channell indicates these bloodstains were consumed in his 1993 testing. The shoes were then submitted to the FBI on March 28, 1994 for re-examination and possible DNA testing. The September 3, 1994 FBI report states "*Nothing of apparent significance was noted in an examination of* [the shoes]. Nonetheless, as described above, using today's DNA technology, it is likely that meaningful DNA results could be obtained from the minute amounts of blood that remain in the stain areas of each shoe – and/or other possible blood stains not previously noted or considered "sufficient" to pursue on the shoes.[8] One microliter (1 millionth of a liter, a droplet about the size of a pinhead) of blood contains on average 20 nanograms of DNA. One can expect meaningful DNA test results from less than 100 picograms of DNA, or less than 1/200$^{th}$ of the pinhead droplet of blood. Such minute amounts of blood may not be visible, or even grossly detected chemically.

[8] It is my understanding the soles of the defendant's shoes have been treated with ninhydrin in order to prepare pattern impressions. Ninhydrin is a common fingerprint-enhancement reagent. This treatment may diminish but should not interfere with finding and testing any blood/DNA remaining on the soles. See Fregeau, et al. Fingerprint Enhancement Revisited and the Effects of Blood Enhancement Chemicals … J For Sci 2000;45(2):354-380 https://projects.nfstc.org/workshops/resources/literature/Amplification/42_Fingerprint%20Enhancement%20Revisited%20and%20the.pdf. In fact, because of the destructive nature of DNA sample collection, most evidence processing flow-charts or decision trees recommend processing an item for fingerprints before DNA sampling.

21. For example, in *Mississippi v. Sherwood Brown* (2012-DR-00203-SCT) bloody shoeprints similar to Brown's shoes were found at the scene of the murder of three women in 1994. FBI Special Agent Joseph Errera examined Brown's shoes for blood and testified that a very small spot on one of the shoes indicated the possible presence of blood. However, a confirmatory test on the suspected blood was negative. As a result, Agent Errera could not conclusively say that there was any blood on either of Brown's shoes. Brown was convicted in 1995 of all three murders and sentenced to death plus two life sentences. In 2014 FACL re-examined Brown's shoes and produced unique profiles from two males from blood located on the soles of Brown shoes. Brown's conviction has since been vacated.

## Fingernail Evidence

Fingernail Swabs collected from Lee KWB2 through 11
Victim's Fingernail Clippings WS5 and WS6

22. Fingernail specimen evidence has long been recognized as often holding blood, saliva, and/or tissue from a victim or assailant deposited, usually on the undersurface of the nails, during close/violent contact during an assault. The forensic literature documents that 1) foreign biology is not generally resident on the fingernails of random persons, 2) intimate or vigorous contact is required for biology transfer to fingernails, and 3) the persistence of foreign biology on the fingernails of living persons is short.[9] Ten swabs [KWB2 through 11] identified as "swabs with residue from suspect fingernails" were submitted by JPD Detective Harper [emphasis added]. It is my understanding these swabs were collected from Lee within hours of the report of the crime. These swabs are listed individually in the March 19, 1993 report of Mr. Smith and are identified as specimens Q2 through Q11 in the February 16, 1993 report of Mr. Channell. Mr. Channell indicates "*no blood was found*" on any of the swabs. It is unclear from the Channell report whether the fingernail swabs were only visually examined or were chemically tested for blood. The Lee fingernail swabs were also examined by Mr. Smith. In his 1995 testimony, Mr. Smith describes his visual examination of the Lee fingernail swabs with a stereomicroscope as "*didn't show any significant foreign material*."

23. Right [WS5] and left [WS6] hand fingernail clippings from the victim were collected at autopsy. The Channell reports do not describe any examination of the victim's fingernails; the Smith report describes observing a Caucasian hair fragment among the right hand fingernails. No other examination of the Lee fingernail swabs or the victim's fingernail clippings was conducted; neither of these specimens was submitted to the FBI for DNA testing.

24. FACL analysts have examined fingernail evidence in over 63 cases, and I personally have examined fingernail clippings, scrapings, and swabs in over 50 cases. Based on my own work with scores of fingernail specimens and the scientific literature, fingernail evidence from suspects and victims in violent crimes often bears biological material capable of producing highly discriminating DNA profiles. To the extent the ASL examiners did not find blood or observe foreign material, transferred biological evidence associated with fingernails is rarely self-evident from a mere visual examination and often is not from blood.

[9] See Matte, et al, *Prevalence and persistence of foreign DNA beneath fingernails*. Forensic Science International: Genetics 6 (2012) 236–243.

For these reasons, the victim and defendant fingernail specimens should be revisited. Using today's Y-STR DNA technology it is not unusual to recover (male) DNA sufficient to produce a meaningful profile from one or several different fingernail specimens, even if that DNA is commingled with an abundance of female DNA.

25. As described in paragraph 19, the crime scene reveals the attack upon the victim extended from the living room area into the bedroom where the victim was found. The medical examiner noted "*Injuries to the hands include periungual hemorrhage and abrasions located around all ten fingernails as well as multiple small contusions located on the knuckles of the left and right hands injury to both of the victim's hands*". Clearly, the victim struggled mightily with her attacker in an effort to defend herself.

26. Based on the medical examiner's report and the crime scene reconstruction one would expect to find biological material from the assailant on the victim's fingernails, and conversely, one would expect there should be significant amounts of blood from the victim on her assailant's hands and clothes. Any foreign DNA profile from the victim's fingernail should be CODIS-eligible. Any DNA from the victim on the defendant's fingernail swabs, even if visually invisible, should reveal itself in testing. If foreign DNA is recovered it likely will be mixed with DNA from the source of the sample. Nevertheless, STRmix analysis should readily determine whether the victim, Mr. Lee, or any other known person's DNA is present in a mixture. Minimally, Y-STR DNA analysis should elucidate a male profile from even a trace level of male DNA from the victim's fingernail clippings. For these reasons, the victim's fingernail clippings and the defendant's fingernail swabs should be tested.

27. For example, LaBarron Miller was convicted of the 1981 rape and murder of a woman in Alabama and sentenced to life in prison without possibility of parole. Although some semen evidence was preserved, the sperm DNA was intractable to testing. In 2005 I tested the fingernail clippings of the victim and although most of the DNA was female, I was able to develop the same partial but very highly discriminating male DNA profile from several of the fingernails, using both autosomal and Y-STR analysis. Miller was, for all intents and purposes, identified as the source of the male biology from the victim's fingernail clippings.

28. Similarly, Nicholas Yarris was convicted in 1983 of the 1981 rape and murder of a New Jersey woman and sentenced to death. In 2003 sperm DNA evidence produced in my laboratory and a second private laboratory eliminated Yarris as the source of semen on the victim's vaginal swabs, however the relevance of the semen was unclear. Later in 2003 I examined the victim's fingernails clippings and a pair of gloves foreign to the victim recovered at the scene. The same male DNA profile from the semen evidence was produced from the fingernail clippings and the gloves. Yarris was exonerated after spending over 20 years on death row.

## The Victim Body Orifice Swabs collected at Autopsy

29. Vaginal [Q17], oral [Q18], and rectal [Q19] swabs and corresponding smear slides from each body orifice swab were collected from the victim at autopsy. ASL Serologist Channell indicates in his February 16, 1993 report "*No semen was found on Q17, Q18, or Q19*." No testimony was

elicited from Channell regarding the body orifice specimens. It is unclear how the victim body orifice specimens were tested. Over the course of my career and in particular among the over 160 post-conviction cases in which I have been involved, it is not unusual to find sperm/male DNA where none was found in prior examination by other analysts/laboratories. Any DNA profile from sperm foreign to a consensual partner should be CODIS-eligible. Even if semen is not present, sufficient DNA from other male body fluid/tissue may be present to produce meaningful Y chromosome results. On that basis, the victim body orifice specimens should be re-examined.

30. For example, Brian Kinder had been convicted and sentenced to death for raping and murdering a woman in St. Louis in 1990. Post-conviction DNA testing was conducted on the victim's rape kit by the Missouri State Police (MSP) lab in 2005 and 2006. The lab could not identify sperm on the vaginal swab smear slide, vaginal swabs, or anal samples. The lab was also unable to develop any autosomal STR profiles from these samples and was able to develop only a weak partial Y-STR profile from the vaginal swabs. In so doing the MSP lab consumed the absorbent vaginal swab tips. In 2007, the remaining evidence was sent to me for retesting on behalf of Mr. Kinder. From the denuded vaginal swab wooden sticks, I recovered numerous epithelial cells and spermatozoa which were more than adequate to develop unique STR profiles. From the biological material remaining on the vaginal swab sticks, the victim was identified as the source of the female biology and Kinder was identified as the semen source.

31. Similarly, Ricky McGinn had been convicted and sentenced to death in 1995 for the 1993 rape and murder of his step-daughter. Semen was detected associated with the child's vaginal specimens and underpants, but conventional genetic testing by the Texas Department of Public Safety lab in Austin in 1993 was not informative. This evidence was sent to the FBI in 1993 for DNA analysis. The FBI RFLP DNA testing was not fruitful and resulted in consumption of the vast majority of the evidence including the entirety of the four vaginal swab tips. The semen evidence was sent in 1994 to yet a third lab, CRB Laboratories in Boston, for PCR-based testing, which again, was not successful. In 2000 after a stay of execution was granted, the evidence was sent to me for examination. From the denuded vaginal swab sticks and from the child's underpants, I recovered sufficient sperm to produce a unique male DNA profile, identifying McGinn as the source of the semen from both specimens. McGinn was executed September 27, 2000.

32. In 2017 for the Hawaii County Police Department we investigated the sexual assault of a woman by two men in September 2016. No semen was identified in the victim's sexual assault kit in a previous examination by the Hawaii State Investigation Section lab in Honolulu. Our testing of the victim's vaginal swabs and pubic hair combings specimens also revealed no evidence of semen, however male DNA was recovered from both specimens. Y-STR DNA testing of the pubic hair specimen revealed a mixture profile compatible with both male suspects. From the sea of female DNA from the vaginal swabs we were able to develop major and minor Y-STR profiles compatible with each suspect.

## The Wooden Club E-4/JH4

33. A short baseball bat-like club was recovered from next to the victim on the bed at the crime scene. Given its location and the blunt force trauma to the victim, it is reasonable to assume this club is the murder weapon and there could be biology from the perpetrator on this weapon. The club was examined by Mr. Channell and Mr. Smith, and it was submitted to the FBI laboratory. Mr. Channell determined human blood was present on the club but did no further examination/testing of the club. Mr. Smith's examination of the club revealed hair fragment(s) compatible with the originating from the victim. The FBI's examination of the club (identified as Exhibit Q2) focused on swabbing "stains" in a 2 x 3 cm area at the top/barrel end of the club; however, insufficient DNA was recovered to attempt RFLP DNA typing.

34. An examination/re-testing of the wooden club today would focus on the grip/handle end of the club in an attempt to recover biology from the person who wielded the club in the attack. With today's DNA technology, it has become usual and customary to attempt to recover DNA from the biology referred to as "touch DNA" deposited on virtually any object during handling – but particularly if that object is a tool with a handle normally gripped tenaciously during use. If the wooden club is the murder weapon, there should be sufficient cellular material from the assailant's hands along the handle of the club to expect meaningful – and potentially CODIS-eligible – DNA analysis results. Even if mixed with the victim's blood STRmix analysis should prove effective in determing whether Mr. Lee or any other known person's DNA (such as the victim's husband) was recovered from the club handle. For these reasons, the wooden club should be tested.

## Clothing and Bedding

Bloody pillowcase/sham from bed JH11
Victim's white bra WS14
Victim's blue slacks with stirrups WS15
Various items of bedding

35. A bloody twisted white pillowcase/sham, documented in crime scene photo LL009418, was collected at the scene from next to the wooden club on the bed. This bloody twisted white fabric may have been wrapped about the wooden club during the attack, or it may have been used by the killer to wipe his hands/clean up after the assault. If either is the case, this item could bear considerable biology from the assailant. As described in paragraph 32 above, even if the assailant biology is commingled in the victim's blood on the pillowcase, this item could potentially identify the perpetrator and should be tested. Similarly, the victim's bra and pants, and the top/outermost items on the bed/bedding could be examined for "touch DNA". Each item examined could also be screened for semen deposits at the same time.

36. For example, in 2013 a woman was raped in Ventura County, CA. No suspect was identified, and no semen evidence was recovered. However, the outside front area of the victim's shirt that contacted the assailant during the assault was swabbed and male DNA was recovered. The victim's husband was eliminated as the male DNA source; the deduced male DNA profile from the victim's shirt was searched in CODIS and identified in 2018. Ultimately, the vaginal

specimens – void of sperm – were re-visited in 2019 and a Y-STR profile compatible with the suspect was produced.

37. In 1994 SS was convicted of rape in Pennsylvania. No evidence of semen was found by the Philadelphia Police Department (PPD) crime lab in the 1994 examination of the victim's rape kit. In post-conviction testing in 2019 the PPD crime lab re-examined the victim's clothing and again, no evidence of semen was found on any of the victim's clothing. The evidence was then sent to FACL and semen was found on the victim's sweater. SS was eliminated, the source of the semen was identified via CODIS, and the investigation of the CODIS hit is pending.

38. For the reasons expressed above, it is my expert opinion that modern DNA testing can and should be conducted on the physical evidence remaining in this case. This testing should be able to detect biology from the perpetrator in the environment of the crime scene and victim, determine whether Mr. Lee is the source of the biology, and if not, potentially identify the source via CODIS. This testing should also be able to detect any biology from the victim in the environment of the defendant.

Further, affiant sayeth naught.

Dated: Oct 21, 2019

C. Alan Keel

State of California
County of Alameda

Sworn to before me this 21st day of October, 2019.

Notary Public

I. M. BHAKTA
Notary Public - California
Alameda County
Commission # 2291070
My Comm. Expires Jun 29, 2023

Exhibit 1

# Resume of C. Alan Keel

Forensic Analytical™ Crime Lab

**C. ALAN KEEL**
**FORENSIC BIOLOGY/DNA ANALYSIS UNIT SUPERVISOR**
**DNA TECHNICAL LEADER**
***Curriculum Vitae***

## PROFESSIONAL EXPERIENCE

Mr. Keel is responsible for consultative, analytical, and expert witness testimony services on a wide variety of cases involving biological material. He has been performing traditional serological and DNA investigations in forensic casework and providing expert testimony for over 35 years. He possesses extensive knowledge and experience in physical evidence examination, biological material isolation, and its subsequent DNA analysis and interpretation utilizing the polymerase chain reaction (PCR) amplification of short tandem repeat (STR) genes.

## PROFESSIONAL AFFILIATIONS

- American Academy of Forensic Sciences, current
- California Association of Criminalists, current
- The American Board of Criminalistics
    - Diplomate in General Criminalistics, 1991-2012; November 2015, current
    - Fellow in Molecular Biology, 1995-2012; November 2015, current
- DNA Technical Leader/Manager, current, pursuant to the 1994 Identification Act and DNA Advisory Board Standard 5.2.1.1, advanced degree waiver conferred December 1999
- Licensed by the Texas Forensic Science Commission in Forensic Biology/DNA, January 2019

## EDUCATION

- Bachelor of Science (Zoology), Texas A & M University, College Station, 1978
- Graduate Course Work, Texas A & M University, College Station, 1978-80 in Food Science and Technology/Human Physiology
- Graduate Course Work, University of California, Berkeley, 1993 in Nucleic Acid Biochemistry

## OTHER PROFESSIONAL EXPERIENCE

- Criminalist/Consultant in Forensic Science, Forensic Science Associates, Richmond, California, 1999 – 2011
- Criminalist, San Francisco Police Department, San Francisco, California, 1996 – 1999
- Criminalist, Tulsa Police Department, Tulsa, Oklahoma, 1996
- Consultant in Forensic Science, Shreveport, Louisiana
- Death Investigator, Caddo Parish Coroner's Office, Shreveport, Louisiana, 1994 – 1996
- Criminalist III, Oakland Police Department, Oakland, CA, 1984 - 1993
- Criminalist, North Louisiana Crime Lab, Shreveport, Louisiana, 1982 - 1984

## SPECIALIZED TRAINING

- Recombinant DNA Technology, University of California Extension, Berkeley, CA 1986
- Forensic DNA Analysis, University of California Extension, Berkeley, 1989
- The Application of DNA Technology to Forensics, University of California Extension, Riverside, 1990
- PCR/DQA1 Typing Methods, CETUS/California Department of Justice, Berkeley, 1991
- Bloodstain Pattern Interpretation, California Criminalistics Institute, Sacramento, California, 1991
- Advanced PCR Analysis Methods: PM, D1S80, and Quantiblot, Roche Molecular Systems, Alameda, California, 1993
- Instrumental STR Analysis, Perkin-Elmer/Applied Biosystems, Foster City, CA 1996
- Advanced Crime Scene Reconstruction, California Criminalistics Institute, Sacramento, CA 1996
- FBI Quality Assurance Standards Auditor Training, June 2012

**PUBLICATIONS & PRESENTATIONS**

- *A Collaborative Study of DQA1 Typing by PCR* presented to the California Association of Criminalists, 1991 Spring Seminar, Berkeley

- *A Collaborative Study of DQA1 Typing by PCR* presented to the American Academy of Forensic Sciences, 1992 Annual Seminar, New Orleans

- *Penile Swab Evidence in the Investigation of Rape* presented at the 1993 International Forensic DNA Analysis Symposium, Quantico, Virginia

- *Sampling Approach and DNA Analysis of Fingernail Evidence Specimens* presented at the Third Joint International Seminar of the Forensic Science Society [United Kingdom] and the California Association of Criminalists, May 2000, Napa, California

- *Finding the Roscetti Stone: a review of the Lori Roscetti homicide investigation and trial transcripts* presented to the California Association of Criminalists, 2005 Spring Seminar, Oakland

- Freedom and Justice Award, presented by the Northeast Council of the Wrongfully-Convicted, Innocence Network Conference, Santa Clara University School of Law, March 2008

- *The Essential Elements of a Forensic DNA Analysis Laboratory Report*; *The Essential Elements of Expert Peer Review of a Forensic Laboratory DNA Investigation*; *The Utility of and Access to CODIS*; and *Some Potential Adverse Consequences of Regulation and Accreditation on Applied Forensic DNA Analysis* presented to the California Public Defender's Association, May 2014, Hayward

- *Adverse Effects of Blanket Quality Assurance Criteria on Sample-to-Sample and Lab-to-Lab Variable Genetic Data*, presented to the Joint California Association of Criminalists/Northwest Association of Forensic Scientists Seminar, October 2014, Rohnert Park, CA.

- *Demystifying "Touch DNA,"* presented to the 2015 National Innocence Network Conference, May 2, 2015, Orlando, FL.

- *The Difference between Low-Level DNA Analysis and Low-Copy Number (LCN) DNA Analysis and Why It Matters to You,* presented to the 2015 National Innocence Network Conference, May 2, 2015, Orlando, FL.

- *The Fundamentals of Forensic DNA Analysis*, presented as training to the Federal Habeas Corpus Resource Center, September 2015, San Francisco, CA

- *A Benchmark for Meaningful Forensic DNA Analysis: Field (Beta) Testing of the Qiagen Investigator Quantiplex Pro qPCR Assay*, presented at the 6th Annual Qiagen Investigator Forum, Prague, Czech Republic, April 5, 2017.

- *The Twenty-six Year Investigation of the Kidnapping, Rape, and Murder of Dana Ireland*, presented at the California Association of Criminalists Seminar, May 2017, San Francisco, CA.