

## **The History of Firearms Identification**

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### **THE HISTORY OF FIREARM AND TOOLMARK IDENTIFICATION**

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#### **ABSTRACT**

*The history of how the science of firearm and toolmark identification has evolved over the past 165 years is extremely interesting to many forensic scientists performing duties as firearm and toolmark examiners. It was thought that a study of this history would be of value for those examiners that have an interest in this history. Reference material and literature available to the authors, some of which was provided by other firearm and toolmark examiners over the past several years, was researched to provide the data for this article. We are keenly aware that a considerable amount of additional historical data, concerning the history of firearm and toolmark identification, exists in files assembled and maintained by other forensic scientists, especially in Asia, Europe, the Middle East, Central America, and South America. We would respectfully request that copies of any historical information that you have available to you be sent to the authors to allow for future revised information on this subject.*

One of the earliest references concerning the rifling of firearms is in a book authored by Harold Peterson wherein he discusses the rifling of firearms by Emperor Maximilian of Germany between 1493 and 1508. Although some firearms were rifled - helical grooves in the bore of a firearm barrel to impart rotary motion to a projectile - the recognition that this rifling was of value for identifying a fired projectile to the firearm didn't occur until late in the 19th century.

In the early part of this century (1900 — 1930), the science of firearm and toolmark identification was recognized by numerous judicial (law) systems in several countries around the world. Legal recognition was due, in part, to the efforts of several individuals from various countries around the world that had conducted research and experiments into the identification of fired projectiles and cartridges cases to the specific firearms. In researching

the exploits of many of these pioneer examiners, one is extremely thankful for their scientific curiosity as well as their contributions to our field of science.

In the middle part of this century (1930 - 1970), the science of firearm and toolmark identification continued to evolve. For example, in the United States, the Scientific Crime Detection Laboratory (SCDL) began operations at Northwestern University in late 1929 or early 1930, followed by formation of the Federal Bureau of Identification (FBI) Laboratory in 1932. Additionally, many other countries also recognized the requirement to provide this type of forensic analysis and established firearm and toolmark sections either in existing laboratories or as new laboratories. Over the next few years, several laboratories were established and commenced operations, especially in many of the larger cities in Canada, the United Kingdom, the United States and in Europe.

The effort of the individuals involved in firearm and toolmark identification during this time period should be recognized as they were the individuals instrumental in both continuing the development of the science as well as gaining public and legal acceptance of the science. The misuse of firearms in criminal cases, especially in the United States, greatly increased in the 1960's. In recognition of the need to exchange information and promote continuing scientific research in the field of firearm and toolmark identification, thirty-six individuals met in Chicago, Illinois in February 1969, and organized the Association of Firearm and Toolmark Examiners (AFTE).

In the last part of this century (1970 — 1999), the science of firearms and toolmark identification has continued to evolve with a greater number of forensic scientists being employed as firearm and tool-mark examiners around the world. Many of these examiners continue to conduct research and experimentation into the various aspects of our field and have published their findings in many of the leading forensic publications listed below. The science has greatly benefited from the numerous technological advances that have occurred during this time period. These advances include innovations in one of the primary tools of the firearm and toolmark examiner — the binocular comparison microscopes. Many of the current comparison microscopes have been equipped with photomicrography and closed circuit television (CCT) units, which allow for direct viewing or instant digital documentation. One of the authors (JEW) remembers that when he entered the field to begin training, the primary comparison microscopes available for his use was monocular, without the benefit of a movable centerline, and the bullet images reversed.

The most significant advances during this period include the tremendous growth, popularity, and relatively inexpensive cost of computers. The ability to fully utilize the vast potential of computers has allowed science overall, and forensic science more specifically, to take full advantage in development of several useful 'tools' for use within the laboratory. The ongoing development of computers has provided the firearms and toolmark examiner with such useful equipment as Drugfire and IBIS Systems. Using advanced computer technology, these two systems allow for the capturing of digital images of fired bullets and cartridge casings which are then analyzed to provide the examiner with a list of possible 'hits' for examination using a comparison microscope. This amazing technology, unheard of just a few years ago, provides the examiner with the opportunity to search for possible identifications on fired

evidence bullets and cartridge cases in the laboratory as well as at other laboratories who are connected on the system. A current study is underway, in the United States, to identify the possibility of interconnecting both Drugfire and IBIS into the National Integrated Ballistics Identification Network (NIBIN).

## **1835—1899**

The earliest event involving a firearms identification case that we have been able to locate occurred in 1835 in the City of London, England. A homeowner was shot and killed and the servant suspected of the crime. A Mr. Henry Goddard (no relation to Calvin Goddard of later firearms identification historical note), a Bow Street Runner (an early police force within the City of London), thoroughly investigated the case. Goddard was able to identify the mold mark — the mold is used to manufacture lead balls from molten lead — on the fired projectile (ball). He also examined the paper patch — the paper patch provides a seal between the ball and gunpowder in blackpowder firearms — and was able to identify it as having been torn from a newspaper that was found in the room of the servant. Goddard's careful observations and subsequent examination of the physical evidence from the crime scene were instrumental in bringing the guilty party to justice.

In 1852, a firearms related case examination occurred when the sheriff (title for county law enforcement official in the United States) in the State of Oregon (USA) was asked to determine whether the hole in a homicide victim's shirt was caused by either a bullet hole or tear. The sheriff, using the suspect firearm and victim's shirt, conducted experiments by test firing the weapon into the shirt. The sheriff, as a result of his experiments, testified in court that the hole in the shirt was from a gunshot and not a tear. The suspect was convicted and hanged for murder.

In Paris, France in 1857, a Monsieur Noilles published a thesis titled 'Les Plaies ParArmes a Feu Courtes'. His thesis dealt with the subject of wounds made by small firearms.

One of the earliest recorded cases involving a simple firearms identification occurred in 1863, during the United States Civil War, when Confederate General Stonewall Jackson was fatally wounded on the battlefield. When the fatal bullet was removed from his body, a simple identification of the bullet which involved examination of both the caliber and bullet shape, determined that the bullet could only have been fired by one of his own men. The projectile was identified as a .67 caliber ball projectile typical of those used by his own forces such as Hill's Division of the Confederate Army while it was also known that the Union forces used the .58 caliber minie ball projectile.

A year later, in 1864, Union General John Sedgwick, was killed in battle by a single projectile fired by a Confederate sniper from an estimated distance of 800 yards. When the fatal bullet was removed from his body, an identification of the fatal bullet was made based on both the caliber and hexagonal shape of the bullet. It was determined that this particular

caliber and shape of bullet was consistent with the Whitworth rifles that had been imported from England by the Confederate forces for sniping purposes.

In 1876, a Georgia State (USA) Court allowed a witness, who was experienced in the use of firearms, to provide expert testimony concerning the amount of time that had elapsed since a gun was last fired.

A Minnesota State (USA) Court, in 1879, used the services of a qualified gunsmith to examine a fatal bullet in conjunction with two suspect revolvers. His examination of the two revolvers revealed that one of the revolvers had actual rifling marks while the other revolver only had false rifling marks at the muzzle. His examination of the two revolvers, and his careful examination of the marks on the fatal bullet, allowed him to testify that the bullet could not have been fired from the revolver with rifling marks but might have well been fired from the other revolver.

Another case involving testimony concerning the time elapsed since the gun was last fired occurred in a Texas State (USA) Court in 1883. The court allowed an individual to provide expert testimony on the elapsed time since the evidence firearm was last fired. His testimony was based on his examination of the fired wadding (paper patch), the percussion cap (a small metallic cup containing a primary explosive used to ignite the muzzle charge in muzzle loading firearms), and the barrel of the firearm.

In 1885, in Lyon, France, a study titled “Etudes Medico-Legales des Plaies Entrée Par Coups de Revolver” (Medico-Legal Study of Wounds of Entry Caused by Revolver Bullets) was published by the Poix. Travail du Laboratoire de Medecine Legale de Lyon. This is one of the first recorded studies that involved examination and reporting on wounds caused by revolver bullets and represented information of value to both the medical field and the forensic field of firearms identification.

In 1889, Mr. A. Lacassagne of Lyon, France, published a paper titled “La Deformation Des Balles de Revolver” (Deformation of Revolver Bullets) in Volume 5, Archives de l’Antropologie Criminelle et Des Sciences Penales.

One of the first recorded instances of someone being permitted to provide testimony to the effects of firing a pistol at human hair and a paper target occurred in a Kansas State (USA) Court in 1896. The court permitted the witness, experienced in the use of firearms, to conduct various experiments using the evidence pistol and similar cartridges in an attempt to determine the effect on firing at hair and targets at close distances. The witness, as a result of his experiments, was then allowed to provide testimony as to the results of his experiments.

In 1898, this type of analysis was further expanded when in Paris, France, a Mr. Corin published an article titled “La Determination de La Distance a’Laguelle un Coup de Feu a e’te’ Tire” (Determination of the distance at which a shot has been discharged from a firearm).

**1900—1930**

In 1900, in Buffalo, New York (USA), a very significant article titled "The Missile and the Weapon" was published in the June issue of the Buffalo Medical Journal. The article, written by Dr. Albert Llewellyn Hall, dealt with a variety of issues to include how measurement of land and groove markings (impressions on the bearing surface of the bullet caused by the rifling process) are made on bullets. He also discussed the examination of gunpowder residues in barrels of firearms and the changes that take place over time after the weapon is fired. Dr. Hall, while not following up on the research that he conducted for the article, did perform a valuable service as he alerted others to the potential for evaluating markings found on fired bullets.

Two years later, in 1902, a Massachusetts State (USA) Court allowed an individual to provide expert testimony on the effects of rifling and other markings in a gun barrel upon bullets fired through the barrel.

In 1903, in London, England, Mr. E. J. Churchill (uncle of Robert Churchill of later fame as a firearms examiner for the United Kingdom) provided testimony as to some experimentation that he had performed involving the distance at which a shot had been fired into a human skull. Mrs. Camille Holland was shot and killed in Essex, England in 1899. Her body was recovered and examined to determine cause of death. It was determined that she had been shot at a close range with a 32 calibre revolver. E. J. Churchill, using a similar revolver and the same type of ammunition, fired test shots into sheep's skulls at varying distances. He examined the skull of the victim in conjunction with the damage observed in the sheep's skulls and provided testimony in court that, in his opinion, the fatal shot was fired from a revolver at between 6 and 12 inches. The accused was convicted and hanged.

Three years later, in 1905, in Leipzig, Germany, a Mr. Kockel published an article titled "Zur Sachverständigen Beurteilung Von Geschossen" (The Expert Examination of Fired Bullets) in the *Kriminalfallen*, Leipzig.

In 1907, in Brownsville, Texas (USA), several soldiers from a nearby US Army Infantry Regiment were allegedly involved in a riot (later referred to in the popular press as the Affray at Brownsville) in the small Texas town of Brownsville. During the hours of darkness, and during a ten-minute period, the soldiers were alleged to have fired some 150 to 200 shots from their assigned rifles throughout the entire town. The facts surrounding the 'riot' are very much in question and although the case was supposedly investigated, it was never determined if any soldier actually participated in the riot. The importance of this event for the field of firearms identification is that it was the first time that a serious study was undertaken to attempt and identify fired cartridge cases to specific rifles and represents one of the first recorded examinations of fired cartridge cases. Following the alleged riot, some townspeople 'found' in a back alley of the town a grand total of 39 fired 30-caliber cartridge cases and some fired bullets. These items, and numerous rifles belonging to three infantry companies, were collected and sent to the staff of Frankfort Arsenal for their examination. The arsenal staff studied the submitted evidence and then devised a method of attempting to identify the fired cartridge casings to the submitted rifles. The arsenal staff, after spending a lengthy period of time test firing the rifles, was able to specifically identify 33 of the fired cartridge casings as having been fired from four of the submitted rifles. The remaining six cartridge

casings could not be associated with any of the submitted rifles and no conclusions were reached concerning any of the fired bullet evidence. A report titled "Study of the Fired Bullets and Shells in Brownsville, Texas, Riot" was published in 1907 by the US Government Printing Office, Washington, DC, as part of the Annual Report of the Chief of Ordnance, US Army. This exhaustive examination of evidence, and subsequent written report, is the first recorded instance of fired cartridge casings being evaluated as evidence and represents a milestone in firearms identification history.

A court case involving both expert testimony and experimentation as concerns the distance a firearm was from the target occurred in a Wisconsin State (USA) Court in 1908. The trial judge allowed an individual to provide expert testimony on his observation of the presence and/or absence of gunpowder at various distances.

Another very significant milestone in firearms identification history occurred when starting in 1912, in Paris, France, Professor V. Balthazard devised a series of procedures to identify fired bullets to the firearms from which they were fired. Professor Balthazard identified the bullets to the suspected firearm by taking an elaborate series of photographs of test fired bullets from the firearm as well as evidence bullets. The photographs included the rifled areas of each land and groove. The photographs were then carefully enlarged and the observed markings compared by Balthazard and his staff. Balthazard also applied these same specialized photographic techniques to the examination and identification of cartridge casings using firing pin, breech face, ejector and extractor marks. In 1909, Balthazard published a paper titled "Identification des Projectiles de Revolver en Plomb Nu" (Identification of Revolver Projectiles of Plain Lead) in Volume 148 of Comptes Rendus de l' Academie des Sciences.

In 1915, in New York State (USA), the notorious 'Stielow' case occurred, which caused a gross miscarriage of justice. Stielow, an illiterate tenant farmer was accused of shooting and killing his employer and the employer's housekeeper. The woman, after being shot, had run from the employer's house and was found dead near the door of Stielow's house. The local authorities, unused to investigating homicides in their rural area, allowed the crime scene to be trampled by the curious crowd, which destroyed most of the evidence. The authorities hired an alleged firearms examiner to examine the evidence who promptly stated that a revolver found in Stielow's house had fired the fatal bullets. He based his opinion on nine abnormal scratches that he supposedly observed during his examination of the bullets. Stielow was sentenced to death for the murders and sent to the state prison to await execution. The Governor of the State, who was unsatisfied with the entire investigation, ordered a special investigation and engaged individuals to completely reinvestigate the case. Assigned to the case was Mr. Charles E. Waite, a special investigator for the New York Attorney General's Office. Waite, and a few other individuals, thoroughly investigated the case, which included examination of the firearms evidence and the fatal bullets. Waite, in conjunction with Dr. Max Poser, a microscopy expert with Bausch & Lomb, microscopically examined the fatal bullets in conjunction with bullets test fired from Stielow's revolver and determined that Stielow's revolver could not have been used to fire the fatal bullets. This evidence, in conjunction with other aspects of the investigation, provided sufficient evidence to allow the Governor to pardon Stielow and release him from prison.

In 1917, Dr. Sydney Smith (later Sir Sydney Smith) was offered the position as Principal Medico-Legal Expert in Cairo, Egypt, after the incumbent, Dr. Hamilton, passed away. Dr. Smith arrived in Egypt and immediately sought to have a series of laboratories attached exclusively to his operation to facilitate his duties. All of the analyses and other scientific activities were, until that time, provided either in the Government analytical laboratories or in the School of Medicine. Mr. Arthur Lucas at the Government Laboratory was also interested in the application of science to medico-legal problems that included the examination of firearms and related evidence. Smith was involved in a substantial number of murder investigations over the next several years — many involving the examination of fired bullets and cartridge casings. He began to slowly collect information relative to the firearms evidence recovered from various crime scenes with the hope that it might one day lead to the identification of the criminals through the weapons they used.

In 1920, two factory workers carrying the factory payroll were shot and killed in Dedham, Massachusetts (USA). The trial of the two accused murders, Nicola Sacco and Bartolomeo Vanzetti started in summer of 1921. The case received worldwide publicity due to the political activities of the accused. At the trial, four ‘experts’ presented firearms related evidence — two for the prosecution and two for the defense. The firearms identification experts for both prosecution and defense were at odds with each other throughout the trial. The two prosecution examiners provided testimony linking the firearms evidence to the suspects firearms while the defense experts stated that the bullets and cartridge casings were not fired by the suspects firearms. Based on the testimony of the firearms examiners, and other testimony presented to the court, the two suspects were convicted of murder and executed some seven years later. Many individuals objected to both the trial and the execution as they felt that Sacco and Vanzetti had been framed for their political views and that firearms evidence was unreliable.

In 1921, a court in the State of Oregon (USA) allowed a Sheriff to provide expert testimony involving the identification of a fired cartridge case to the evidence rifle. The Sheriff was able to explain and then demonstrate to the court how a small flaw in the breechblock of the rifle left an identifiable mark on the rim of the ejected cartridge case that had been fired in the rifle.

In 1921, in San Paulo, Brazil, two articles dealing with wounds were published. Mr. Jorge T. Filho published an article titled “Da Diagnose da Distancia nos Tiros de Projecteis Multiplos — Chumbo de Caca” (Estimation of distance from which a bullet was fired) while another thesis (author not identified) was titled “Orificio de Hntrada de Projecteis de Revolver — Estudo experimental das zonas de contorno nos tiros proximos” (Entrance wounds and Powder Markings). In the same year, in Washington, D.C., Mr. Louis B. Wilson published an article titled “Dispersion of Bullet Energy in Relation to Wound Effects” in *The Military Surgeon*, Washington, September 1921.

In 1922, several issues concerning firearms identification occurred:

A court in the State of Missouri (USA) permitted an individual to qualify and provide expert testimony concerning exactly how far a certain firearm would eject a fired cartridge case.

In Denver, Colorado (USA), Mr. C. Williams wrote an article titled "Fingerprints on Bullets" which appeared in *Outdoor Life* magazine, Volume 49, pages 329-331.

In Ithaca, New York (USA), Mr. Emile Monnin Chamot authored a 61 page monograph titled "The Microscopy of Small Arms Primers".

In Paris, France, Professor Balthazard wrote an article titled "Identification des Projectiles: Perfectionnement de la Technique" (Identification of Projectiles: Perfection of the Technique) which appeared in *Annales de Medicine Legale*, Volume 2, January 1922, pages 345-250. In the same issue, pages 30-32, Mr. Georgiades wrote an article titled "Une Nouvelle Methode pour Determiner l'Identite des Projectiles" (A new method for determination of the identity of projectiles).

In Tucson, Arizona, Paul V. Hadley was tried for attempted murder and murder. Hadley had accepted a ride with an elderly couple and while riding in their automobile, was alleged to have shot both, seriously wounding the man and killing the wife. He was subsequently arrested and found in possession of a 32 calibre Mauser pistol and several cartridges. A. J. Eddy was requested by the prosecuting attorney to determine if the fatal bullets could be identified as having been fired by the suspect's firearm. Eddy, a practicing attorney, had previously conducted research and experimentation into the area of bullet identification and he was fairly certain that a bullet fired from a gun carried distinctive markings. With the assistance of a local photographer, Eddy conducted numerous tests on the suspect murder weapon as well as several other 32 calibre firearms. The Mauser pistol was test fired, using ammunition seized from Hadley, and the test and fatal bullets were photographed by reversing the lens of the camera. Eddy conducted his experiments over a period of three months and was called to court to testify as to the results of his research. He provided extensive testimony concerning the elaborate tests that he had conducted and attempted to prove to the jury that each pistol left its own distinctive characteristics markings on bullets. The defense attorney's argued that Eddy wasn't an expert but the judge overruled their request taking the position that Eddy was merely showing the results of his exhaustive research and experimentation. The judge characterized Eddy's testimony as being that of a "semi-expert" and allowed him to testify. Hadley was convicted, in large part to Eddy's testimony, and the case was appealed to the Arizona Supreme Court. The court, after careful deliberation, rendered a historic and momentous decision. The court upheld the lower court, thus recognizing ballistics evidence as valid and admissible. This ruling appears to be the first time that a State Supreme Court in the United States had done so.

In 1923, the court cases and literature continued at a fast pace:

Among the court cases was an Oregon State (USA) case where the judge allowed a pistol expert to testify that the evidence bullets were fired in a Colt Army Special revolver similar to the firearm owned by the defendant.

In a Washington, DC (USA) court, the court decided that expert testimony that was provided concerning that the evidence bullet was fired from the defendant's pistol was competent.

In the literature, a Mr. R. E. Herrick published an article titled "Ballistics Jurisprudence" in *Arms and Man*, Volume 70, Number 17, May 1923.

In Paris, France, three articles appeared in the journal "Annales de Medicine Legale". The first article was by Mr. P. Chavigny and Mr. E. Gelma and titled "Les Fissures du Crane: Coups de Feu a Courte Distance — Revolver" (Fissures of the skull by revolver bullets at short range", Volume 3, pages 345-352. Another article in the same journal was by Professor Balthazard and was titled "Perfectionment a la Methode d'Identification des Projectiles" (Perfecting the method on the identification of projectiles), pages 6 18-620. A third article was by Mr. DeRechter and Mr. Mage and titled "Communication sur l' Identification des Douilles et des Projectiles tires" (Communication on the Identification of Fired Bullets and Shells).

Meanwhile, from Leipzig, Germany, a Mr. Hulst published an article titled "Bestimmung der Identitat und Herkunft einer Kugel" (Determining the identity and the origin of a bullet), *Archives fur Kriminologie*, page 300.

In London, England, Arthur Lucas published an article titled "The examination of Firearms and Projectiles in Forensic Cases" in "The Analyst". (Note: This is the same Arthur Lucas who worked in the Government Laboratory in Egypt and who collaborated with Dr. Sydney Smith)

In a Connecticut State (USA) Court, a case of some distinction (*State v. Harold Israel*) resulted in the prosecuting attorney recommending that the charge of murder be *nolle prosequi* (dismissed). His recommendation was due, in large part, to the opinion of six expert witnesses that testified that the fatal murder bullet could not have been fired from the pistol of the defendant. The court record reflects, in some detail, the principals of firearms identification as known at that time.

In Wisconsin, Dr. J. Howard Mathews, the Chairman of the Department of Chemistry at the University of Wisconsin, became involved in his first criminal case that involved the metallographic analysis of bomb parts used to kill an individual. Due to his involvement in this case, he was then requested to examine a rifle used in a homicide case. These two cases, followed by others, caused him to become quite involved in the examination and identification of firearms related evidence.

In November 1924, an event occurred in Cairo, Egypt that would lead to the climax of Dr. Sydney Smith's five years' work on forensic ballistics. Sir Lee Stack Pasha, the Sirdar (Commander-in-Chief) of the Egyptian Army and Governor-General of the Sudan was shot while being driven through the streets of Cairo. The Sirdar died the following day from his wounds. Smith relates that he examined the car, reconstructed the crime scene, and examined the firearms evidence which consisted of nine cartridge casings found at the scene and six fired bullets recovered from the victim's bodies (the driver and the aide-de-camp were also killed). All of the fired bullets were 32 calibre designed to be fired from a semi-automatic pistol. In five of the six bullets, including one used to kill the Sirdar, a cross-shaped cut had been made on the nose in an attempt to convert them into expanding bullets. Smith, after a

Careful examination of all of the firearms evidence, was able to report that if a suspect firearm were recovered, he would be able to identify it to the fired components found at the scene or from the bodies. Due to the severe nature of the crime, maximum investigative efforts were put forth to determine the identity of the assassins. Suspects were developed in fairly short order and various firearms and ammunition submitted to Dr. Smith for his evaluation and examination. His examination of the submitted evidence, in conjunction with the items from the crime scene and autopsies, allowed him to positively identify the firearms as having been used during the shooting. The eight suspects were charged with murder, or incitement to murder, and tried in court. The case relied on confessions from the suspects, a police informer, and scientific examination of the evidence by Dr. Smith. Obviously, the testimony by Dr. Smith concerning his examination of the firearms evidence played a very crucial role in the suspects being convicted of murder. Seven of the eight were executed while the remaining suspect was sentenced to life imprisonment. Dr. Smith wrote an article concerning the details of the investigation that appeared in the *British Medical Journal* in January 1926. He relates that he believes that scientific examination of firearms and projectiles in Great Britain had its beginning as a result of the publication of his report on the case. While this claim may be somewhat exaggerated, it is also recognized that Smith's efforts were instrumental in furthering the science of firearms identification.

In 1924, Captain Edward C. 'Ned' Crossman, a well-known shooter and sports writer, examined firearms evidence for the Los Angeles County Sheriff. In his writings on the subject, he further reports that he became associated with the Bureau of Forensic Ballistics in 1926 serving as a regional representative for the western portion of the United States. In a book authored by Crossman in 1932, he discusses having some 200 cases submitted to his laboratory for firearms identification work between the initial case in 1924 and 1932. He continued to provide these same services until his death. One of the authors (JEH) has a collection of many of the case notes, reports and invoices rendered by Crossman for his work on many of the cases he examined during his career. These files, along with a replica bullet used for demonstrations in court, were presented to the author by the late Colonel Edward B. 'Jim' Crossman (Ned's son) prior to his death. Colonel Crossman graduated from the California Institute of Technology with a Bachelor's degree in Science and worked with his father examining firearms related evidence from 1929 until his military unit was activated in 1941. Colonel Crossman served over 23 years in the US Army and retired as Chief of the Weapons Branch for Army Material Command. Jim Crossman was also a well-known shooter, sports writer for several publications, a product liability expert in the field of firearms and ammunition manufacturing, and firearms consultant.

In April 1925, in New York City, New York (USA), the Bureau of Forensic Ballistics was established by C. E. Waite, Major (later Colonel) Calvin H. Goddard, Philip O. Gravelle and John H. Fisher. The Bureau was formed to provide firearms identification services throughout the United States as few law enforcement agencies had the capability to provide this type of service. Major Goddard was very much a firearms identification pioneer who wrote and spoke extensively on the subject and was published in numerous publications. One significant event of particular note is that Gravelle adapted a comparison microscope for use in the identification of fired bullets and cartridge cases. This singular act is considered by many to be a hallmark event in the science of firearms identification. Adapting the

comparison microscope, for use in the examination of fired bullets and cartridge casings, allowed for a significant increase in the examiner's ability to identify matching striae.

In June 1925, the Saturday Evening Post (then a weekly American general news and articles magazine) published a two-part series of articles entitled "Finger-printing Bullets". The two articles discussed in great detail both the organization and operation of the Bureau of Forensic Ballistics as well as the science involved in performing firearms identification examinations. The articles also discussed in detail the famous Stielow case that Waite had investigated several years earlier in 1917. As the Post was a very widely circulated publication, read by a great number of people, these two articles were very instrumental in informing the general public about both the science of firearm identification as well as the availability of services offered by the Bureau.

On February 14, 1929, in Chicago, Illinois (USA), an event occurred that greatly furthered the acceptance of firearms identification techniques by authorities in the United States. This event, referred to as the St. Valentine's Day (an American holiday where one buys candy and flowers for their sweetheart) Massacre, involved the brutal slaying of seven gangsters by a rival gangster group in the City of Chicago. The incredible public outrage over these slayings, and the rumors that police officers were possibly involved, caused local officials to immediately impanel a grand jury (a judicial process) to investigate the killings. The grand jury foreman, Mr. B. A. Masee, promptly engaged the services of Calvin H. Goddard of the Bureau of Forensic Ballistics to examine and report on the firearms related evidence. Goddard's careful and concise examination of all the firearms related evidence; which included fired bullets, pellets, fired shotgun casings and fired cartridge cases was significant. Goddard was able to conclusively state that the killers had used one 12-gauge shotgun and two Thompson submachine guns to commit the killings. He noted that one of the Thompson's submachine guns was fired using a 50-round drum magazine while the other was fired using a 20-round magazine. Due to the rumors concerning suspected police involvement, all police Thompson submachine guns were submitted for Goddard to test fire for comparison against the crime scene evidence. He was able to state that none of the police weapons were used and subsequently identified weapons that were obtained during the search of a suspect's home.

### **1930 - 1970**

In 1930, as a result of Goddard's excellent work on the St. Valentine's Day Massacre case and the continuing indignation of the public concerning the killings, the foreman of the grand jury requested that he establish a crime detection laboratory to serve the citizens of the Chicago, Illinois (USA) area. The jury foreman, Mr. Masee, who along with other public spirited citizens stated that they would provide the necessary funds to staff and equip the facility as no public funds were available. Goddard accepted the opportunity and became the Director of the Scientific Crime Detection Laboratory (SCDL) which was affiliated with the Northwestern University School of Law near Chicago. Goddard remained Director of the SCDL until leaving in 1934 to form a private firm. Prior to his departure, Goddard provided scientific training, to include the areas of firearms and toolmark identification, to numerous individuals who went on to work in other laboratories around the United States.

In 1932, the Federal Bureau of Investigation (FBI) — the premier federal law enforcement organization in the United States — established and organized their laboratory at the direction of then Director J. Edgar Hoover. The laboratory initially started with one person on staff and has subsequently grown in size until today it is the largest forensic laboratory in the United States with a very well deserved reputation within the law enforcement, judicial, and forensic communities. It is of note that the person who staffed the FBI Laboratory had received training from Calvin Goddard at the SCDL.

In 1934, Major Sir Gerald Burrard wrote a book titled “The Identification of Firearms and Forensic Ballistics” which was published in London, England. The book was later published in the United States in 1962. In his book, Burrard discusses many of the early cases that occurred throughout the British Empire to include those of another pioneer English firearms examiner (unnamed in the book but known to be Robert Churchill) who Burrard frequently met in court — for the opposite side. Burrard acknowledges that he believes a Colonel H. W. Todhunter, C.M.G., a former Chief Inspector of Small Arms for the British Army, as ‘the pioneer of firearms identification in this country’. He further acknowledges his friendship with Colonel Calvin Goddard and Mr. Arthur Lucas.

In 1935, two books on firearms identification were written and published. One of these books was titled “Textbook of Firearms Investigation, Identification and Evidence” together with the “Textbook of Pistols and Revolvers” and was written by Major (later Major General) Julian S. Hatcher. Major Hatcher was a very experienced US Army ordnance officer who had spent nearly twenty years as a pistol and rifle shooter of some distinction. He had also served in a variety of assignments that involved the design, manufacturing and testing of ammunition and firearms. Hatcher’s book received excellent reviews and was quickly adopted by many firearms examiners throughout the United States. As an aside, one of the authors has a letter in his files, dated October 26, 1934, addressed to Captain Ned Crossman from J. S. Hatcher, thanking him for the fine pictures that he had sent him. These photographs, supplied by Crossman, appeared in Hatcher’s book.

The second book was titled “The Identification of Firearms” and written by Jack D. Gunther and Professor Charles O. Gunther. Jack Gunther was an attorney and member of the New York State Bar while Charles Gunther was a Professor of Mathematics and a reserve Lieutenant Colonel in the US Army Ordnance Department. Their book provided additional information about the principles of firearms identification with approximately one-half of the book discussing in great detail the Sacco-Vanzetti case to include reprinting large portions of the actual court transcript. The Gunther’s discussed the need for the science of firearms identification to utilize scientific methodology.

In 1935, an announcement was made concerning the formation of the Missouri Scientific Crime Detection Laboratory to be directed by a Mr. Thomas N. Lewis. The announcement further states that Lewis was for many years the research officer for the Sr. Louis Police Department.

In 1938, the Scientific Crime Detection Laboratory (SCDL), at Northwestern University, was bought by the City of Chicago. The equipment was transferred from the University to the

Chicago Police Department and existing laboratory personnel were offered positions in the new laboratory.

In 1940, the Indianapolis Police Department established a fully equipped crime laboratory under the direction of a trained scientist. The IPD crime laboratory ceased operation on December 31, 1985 and became part of the Indianapolis-Marion County Forensic Services Agency.

In 1944, John E. Davis joined the Police Department in Oakland, California establishing its first criminology laboratory.

In 1947, the State of Wisconsin established a State Crime Laboratory with Charles M. Wilson as the Superintendent. Wilson had been associated with Goddard at the SCDL at Northwestern and was later Director of the Chicago Police Department Crime Lab.

In 1948, a meeting titled 'The First American Medicolegal Congress' was held in St. Louis, Missouri. This meeting, a subsequent meeting later in the same year, and several committee meetings during 1949, was the genesis for the American Academy of Forensic Sciences to be organized and named in 1950. Interestingly, two of the papers presented at the initial meeting concerned firearms identification. One was titled "Firearms Evidence — Fact and Fiction" and presented by George W. Keenan, Department of Public Safety, Rochester, New York. The other paper was titled "The Recovery, Custody, Marking, and Preservation of Physical Evidence and Standards of Comparison Including Firearms Exhibits" and presented by Charles M. Wilson, Wisconsin State Crime Lab, Madison, Wisconsin. Over a period of several years meeting participants, especially firearms examiner practitioners and those interested in the field, would meet in the evenings and discuss their cases with one another. In the author's opinion, these informal meetings became the genesis for the Association of Firearm and Toolmark Examiners (AFTE) to be organized 21 years after the initial AAFS meeting in 1948. Credit and recognition should be given those individuals who presided at the birth of AFTE.

In 1955, Calvin Goddard presented an address before the American Academy of Forensic Sciences meeting in Los Angeles, California. The title of his talk was "The Unexpected in Firearms Identification". Two days after his presentation, Goddard passed away. Many firearms examiners, especially in the United States, are well aware of the significant contributions that Goddard made to the field of firearm and toolmark identification. He is considered by many examiners in the US to be the 'father' of the science.

In 1957, a complete revision of Major General Julian S. Hatcher's textbook "Firearms Identification, Investigation & Evidence" was published. The revised book was under the direction of Frank J. Jury, New Jersey State Police Crime Laboratory and Jac Weller, a Firearms Consultant from Princeton, New Jersey. The revised book contained substantial new material and updated much of the original material from the original text.

In 1958, John E. Davis, an eminent criminalist and Director of the Oakland Police Department (CA) Criminalistics Section (Crime Lab) wrote a book titled An Introduction to

Tool Marks, Firearms and the Striagraph". In his book, Davis provided excellent information about the examination and identification of firearms and toolmark evidence. He also discussed, in great length, his development of a specialized instrument that he named the 'Striagraph'. He described the instrument as follows: "the Striagraph is primarily a measuring, tracing and recording device suited to the analysis of micro surface-contours, that is, to the detection of microscopic irregularities in surface smoothness". Although the instrument never proved to be successful past the research stage, it was the forerunner of later technology for scanning the surface of a bullet using advanced laser and digital imaging techniques.

In 1961, Frances Russell, a Boston author who was convinced of the innocence of Nicola Sacco and Bartolomeo Vanzetti, arranged to have the firearms evidence reexamined. He arranged for the services of two men well known in the firearms community. The two, Frank Jury - formerly a Lieutenant Colonel in charge of the New Jersey State Police Laboratory, and Jac Weller of the West Point Museum in New York, had revised Hatcher's textbook which was published in 1957. Reexamination of the evidence included test firing the evidence firearms and comparing the test bullets to the bullet that had killed the payroll guard. The evidence and test bullets were identified as having been fired from the same firearm - that belonging to Sacco.

In 1962, Dr. J. H. Mathews, who had retired from the University of Wisconsin in 1952, after nearly a 40-year career, published a two-volume set of books titled "Firearms Identification". These two books were well received and sold well throughout the forensic community as they contained extensive reference materials that had been collected by Dr. Mathews both during the course of his nearly 40 years in the field of firearms identification and his subsequent years in retirement. Volume I contained information concerning the laboratory identification of a firearm, measurements of rifling data on a wide variety of handguns, and a series of appendices which include photographs of the firing pin impressions on rim fire cartridges. Volume II contained several hundred photographs of handguns to assist in their identification, illustrations of other handguns, and photographs of trade marks and other identification marks. Of the hundreds of photographs of firearms that Mathews photographed during his research, many were from his own collection while others were borrowed from various sources such as from weapons reference collections of numerous forensic (crime) laboratories as well as private weapons collections. In 1973, a third volume of the book was published posthumously as Dr. Mathews had passed away in April 1970. The final preparation of the manuscript was carried out by the family of Dr. Mathews' with the assistance and counsel of Senior Firearms Examiner Alan Wilimovsky, then of the Wisconsin State Crime Laboratory in Madison, (now deceased). Volume III contained additional data on rifling characteristics, notes on less well-known American revolvers and pistols, several hundred original photographs and illustrations of firearms, and other reference material.

In 1962, the Office of the Surgeon General, Department of The United States Army, Washington, DC, published a book titled "Wound Ballistics". The book, edited by Major James C. Beyer, MC (Medical Corps) contained some 833 pages and is an excellent reference source as it contains an exhaustive study of all types of wounds. Among the chapters, there are discussions on ballistic characteristics of wounding agents, the mechanism of wounding,

and wound ballistics and body armor. The book contains a significant amount of tabulated data gleaned from the research into wound ballistics.

In November 1963, the President of the United States, John Fitzgerald Kennedy, was assassinated by being shot to death during a visit to the City of Dallas, Texas. Shortly after the assassination of Kennedy, the suspected assassin, Lee Harvey Oswald, is alleged to have shot and killed Officer J. D. Tippit who was attempting to arrest him. Subsequent to Oswald's arrest, and while being transported to a judicial hearing, he was shot and killed by Jack Ruby in the basement of police headquarters. Analysis of the firearms evidence in these tragic incidents, excepting the evidence of Ruby shooting Oswald, figured prominently in the conclusions of the Warren Commission (a legal commission formed by direction of the United States

Congress to investigate the assassination). The FBI Laboratory's Firearms Unit was responsible for conducting the analysis and examination of the firearms related evidence as assassination of the president is a federal crime. Three senior firearms examiners from the FBI Laboratory; Robert A. Frazier, Cortlandt Cunningham and Charles Killion, examined the evidence and provided testimony, along with that of Joseph D. Nicol, (now retired) then Superintendent of the Illinois State Bureau of Criminal Identification before the Warren Commission. At the conclusion of the Warren Commission's lengthy proceedings, a 26 volume report titled "Report of the Warren Commission on the Assassination of President Kennedy" was published by the United States Government Printing Office, and made available to interested parties. Although the commission's report contained a massive amount of data, a number of individuals and groups then, and even today, regard the report as nothing more than a 'whitewash' which was intended to cover up what they believe to be a conspiracy to assassinate the president. Since the assassination, several authors have written books espousing various theories about who actually killed Kennedy. Many of the authors of these books have benefited financially from their writings on this subject.

In 1963, the science of firearm and toolmark identification suffered a great loss when Major General Julian S. Hatcher died at his home at age 75. Hatcher was a very prolific writer and well known in our field for both his Textbook of Firearms Identification, Investigation & Evidence (1935) as well as Hatcher's Notebook (1947).

In April 1968, Dr. Martin Luther King, Jr., an active civil rights proponent in the United States, was assassinated during a visit to Memphis, Tennessee. King was shot and killed while standing on the second floor of a motel (lodging). Subsequent to the assassination, a high power rifle was found. Partial latent fingerprints were developed on the rifle by the FBI's Latent Print Unit which, after an exhaustive period of some three months of searching their print card file, were identified to a suspect - James Earl Ray. The firearms evidence was examined by Robert A. Frazier, a senior member of the FBI Laboratory's Firearms Unit, and a report issued. The report concluded that the recovered evidence cartridge casing "was fired in and extracted from" the evidence rifle but that "it was not possible to determine whether or not this bullet was fired from this rifle". Ray was arrested some months after the assassination and confessed to having shot Dr. King. Ray was tried in court and sentenced to life in prison. He later recanted his confession and explained that the killing was done by

various shadowy factions. As occurred after President Kennedy was assassinated, numerous individuals wrote and spoke extensively on their thoughts as to what they thought had occurred in Memphis.

In June 1968, Senator Robert Kennedy, the brother of President Kennedy, who while campaigning for the office of President of the United States was shot and killed as he was leaving a Los Angeles hotel. During the assassination of Kennedy, others nearby were wounded by the gunfire. The gunman, Sirhan B. Sirhan, was captured at the scene of the shooting, tried in court, and given a life sentence in prison. Examination of the firearms evidence was performed by Officer DeWayne A. Wolfer (now retired) of the LAPD Crime Laboratory. As occurred after the assassinations of President Kennedy and Doctor King, and the murders of Officer Tippit and suspect Lee Harvey Oswald, a number of individuals, including several 'experts' publicly contended that Sirhan had not acted alone and that a second firearm was involved.

In 1969, in recognition of the potential requirement for an association dealing specifically with the identification of firearms and toolmarks, thirty-five police and civilian specialists from throughout the United States and Canada gathered at the Chicago Police Department Crime Laboratory to discuss formation of an association. Many of these original participants had informally gathered for years during annual meetings of the American Academy of Forensic Sciences (AAFS) and felt the need for an association to address the requirements of firearms and toolmark examiners. The purpose of the conference was described by a statement from the program that read "this meeting is being held to determine the advisability of forming an organization of Firearms and Tool Mark Examiners. It is hoped that the organization will consider future meetings that could be devoted to the presentation of scientific and technical papers, descriptions of new techniques and procedures, review of instrumentation and the solution of common problems encountered in these scientific fields". The formation meeting was a success and the participants decided to form an association to be named the Association of Firearm and Tool Mark Examiners (AFTE). The officers elected to lead the association were: President Walter J. Howe, Wilton, CT (now retired); Secretary John C. Stauffer, Chicago Police Department Crime Laboratory, Chicago, IL (now deceased); and Charles M. Wilson, Wisconsin State Crime Laboratory, Madison, WI (now deceased). The first official publication of the association was AFTE Newsletter Number 1, published on May 15, 1969 (the name of the newsletter was subsequently changed to the AFTE Journal in 1972). From the original thirty-five participants, the number of members continued to grow as information concerning the newly created association reached other firearm and toolmark examiners. Specific credit should be given to two individuals who were very instrumental in the formation of AFTE: Burton D. Munhall, H.P. White Laboratory, Maryland (now deceased) and Walter J. Howe, Wilton, CT.

## **1970 - 1999**

In 1970, and each subsequent year to date, the Association of Firearm and Toolmark Examiners (AFTE) has hosted an Annual Training Seminar at a location throughout the

United States and Canada. The meeting site is based on both having members volunteer to host the meeting as well as the needs of the members of the association as determined by the Board of Directors. One primary purpose of the annual seminars is to provide for the interchange of information as it relates to all aspects of the science of firearms and toolmark identification.

In 1974, the Association of Firearm and Toolmark Examiners (AFTE) hosted its 5th Anniversary Annual Training Seminar in Washington, DC. Some 87 individuals, representing three countries, attended the seminar.

In 1975, due to continuing controversy surrounding the killing of Senator Kennedy, a petition by Paul Schrade (one of the shooting victims) and CBS, Inc., (a nation-wide television broadcaster) was made to the Superior Court of California, County of Los Angeles, requesting that the firearms evidence be reexamined. The court granted the petition and ordered that a panel be formed to conduct the reexamination. The American Academy of Forensic Sciences (AAFS) and the Association of Firearm and Toolmark Examiners (AFTE) were contacted and requested to submit names of firearms examiners to the Attorney General (senior law enforcement official) of the State of California. All interested parties were allowed to participate in the selection of members for the panel and the then Presiding Judge ordered that the following members serve on the panel. The seven member panel included the following individuals: Cortlandt Cunningham, FBI Laboratory Firearms Unit — Washington, DC (now retired); Stanton O. Berg, Independent Firearms Examiner — Minneapolis, MN; Alfred A. Biasotti, California DOJ Crime Laboratory — Sacramento (deceased); Lowell W. Bradford, Santa Clara County Crime Laboratory - San Jose, CA (now retired); Professor Ralph Turner, Michigan State University - Lansing, MI (deceased); Charles V. Morton, Private Crime Laboratory - Oakland, CA; and Patrick V. Garland, Commonwealth of Virginia Crime Laboratory — Norfolk, VA (now retired). After a thorough examination of the firearms evidence by each panel member individually, they collectively reported to the court that their examination of the evidence revealed that ‘there is not evidence to indicate that more than one gun was used to fire the items examined’.

In late 1977, and during a major portion of 1978, a distinguished panel of firearms experts reexamined firearms related evidence pertaining to the following previous investigations:

1. The assassination of President John F. Kennedy,
2. The murder of Police Officer J. D. Tippit,
3. The murder of Lee Harvey Oswald, and
4. The assassination of Doctor Martin Luther King, Jr.

The reexaminations of the firearms related evidence was due to increasing public pressure for additional answers into the events cited. In response to public demands, the United States House of Representatives assembled the Select Committee on Assassinations for the purpose of conducting analysis of the firearms related evidence. After their reexamination of the evidence, the panel presented testimony before the Select Committee investigating the assassinations of President Kennedy and Doctor King, and the murders of Officer Tippit and Mr. Oswald. The panel consisted of several distinguished members of the Association of

Firearm and Toolmark Examiners (AFTE). The panel included the following members: Monty C. Lutz, Wisconsin State Crime Laboratory — Milwaukee; Donald E. Champagne, Florida State Crime Laboratory — Tallahassee (now retired); John S. Bates, New York State Police Laboratory — Albany (now retired); Andy M. Newquist, Iowa State Crime Laboratory — Des Moines (now retired); Russell M. Wilhelm, Maryland State Police Laboratory — Pikesville (now retired); and George R. Wilson, Metropolitan DC Police Department Firearms Unit (now retired). The panel members (except Wilhelm) testified before the Select Committee in September 1978 concerning their examination of the Kennedy, Tippit and Oswald evidence. Their written and verbal testimony essentially verified the findings of the original firearms examiners. The entire panel, including Wilhelm, testified before the Select Committee in November 1978 concerning their examination of the King evidence. Again, their testimony essentially verified the findings of the original firearm examiners.

In 1979, the Association of Firearm and Toolmark Examiners (AFTE) hosted its 10<sup>th</sup> Anniversary Annual Training Seminar in Milwaukee, WI. 149 individuals, representing seven countries, attended the annual training seminar.

In the fall of 1980, after a two year pilot project with 44 forensic laboratories participating, the FBI started providing to the entire forensic community the General Rifling Characteristic (GRC) file via the National Criminal Information Center (NCIC). The GRC file, at the time of inception, provided over 18,000 rifling characteristic measurements. The measurements — number of lands and grooves, direction of twist, and measurement of land impressions — were provided by the FBI Laboratory and those laboratories that provided test fired components for entry into the system. One of the authors knows a firearms examiner who has provided in excess of 200 samples, from various recovered firearms, for entry into the GRC file. The GRC file has been found to be a very useful tool in the majority of crime laboratories.

In 1980, AFTE published the AFTE Glossary. The glossary consisted of 219 pages of definitions and illustrations related to the field of firearm and tool-mark identification, commonly used abbreviations, various formulas for determining bullet energy and rate of spin, and useful chemical formulas. The glossary was the product of the five member AFTE Standardization Committee, assisted by at least 57 other individuals. Subsequent to publication of the glossary in 1980, a second more comprehensive edition was published in 1982. A third edition of the glossary was published in 1994. This edition featured material from the first two editions with additional definitions and illustrations; new appendices which included definitions for computer terminology, fingernails examination (a toolmark in a biological matrix), knives, machining terms, gunshot wound terminology, and shooting scene reconstruction terminology.

In 1982, AFTE published an official training manual to be used as a modular guide for the training of firearm and toolmark examiners. It was the intention of the AFTE Training Committee to develop and provide a modular education program that could then be tailored to meet the needs of individuals and their agencies. The training committee, consisting of six experienced examiners, and aided by numerous other members of the association, produced a

400 -page manual that has provided an excellent source of material for assisting in training numerous firearm and toolmark examiners.

In 1983, another reexamination of the Sacco-Vanzetti firearms evidence occurred. In the latest reexamination, a distinguished panel of 4 individuals was assembled to examine the evidence. The panel consisted of: Dr. Henry C.- Lee, Anthony L. Paul, Marshall K. Robinson, and George R. Wilson - the last three all distinguished of the Association of Firearm and Toolmark Examiners (AFTE). Reexamination of the evidence, and the subsequent report, was undertaken at the request of Westinghouse Broadcast and Cable, Inc. (a television company located in Boston, Massachusetts). The committee's report validated the original firearms identification examinations of some 62 years earlier.

In 1984, the Association of Firearm and Toolmark Examiners (AFTE) hosted its 15th Anniversary Annual Training Seminar in Metairie, Louisiana. Some 126 individuals, representing seven countries, attended the seminar.

In 1986, the FBI's Forensic Science Research & Training Center (FSRTC), at Quantico, VA (the FSRTC is part of the FBI Laboratory Division) announced the creation of a training course for firearms examiners. The course, titled "Specialized Techniques in Firearms Identification", was designed for court qualified examiners and covers a variety of subject matter designed to enhance the level of proficiency for examiners.

In 1989, the Association of Firearm and Tool-mark Examiners (AFTE) hosted its 20th Anniversary Annual Training Seminar in Virginia Beach, VA. Some 210 individuals, representing 12 countries, attended the seminar.

In late 1989, in the FBI Law Enforcement Bulletin, the FBI Laboratory Division announced the implementation of a new program — DRUGFIRE. The FBI's DRUGFIRE is an electronic data base and computer network that was designed to digitally capture photographs of fired bullets and cartridge casings for collation both within the laboratory and those laboratories that also have the equipment. Today, many forensic laboratories operate DRUGFIRE equipment with the result that numerous unknown suspect cases have been linked.

In 1990, the International Wound Ballistics Association (IWBA) was organized in California (USA). The formation documents stated the following "It (IWBA) is comprised of scientists, physicians, criminalist, law enforcement members, engineers, researchers, and others engaged or interested in the study of wound ballistics". Many AFTE members belong to IWBA and the official publication of the association — 'Wound Ballistics Review' — allows for the timely dissemination of a wide variety of wound ballistics information.

In 1992, the Integrated Ballistics Identification System (IBIS) was introduced as another method of utilizing digital imaging and computer programming to allow firearms examiners to 'capture' images from fired bullets and cartridge cases for comparison with other images.

In 1993, the United States Supreme Court changed a legal standard for those that provide scientific testimony (including expert testimony for firearms and toolmark identification) in US Federal Courts as well as some state courts. The new standard, referred to in the United States as the 'Daubert' ruling, required trial judges to be the 'gatekeepers' of expert evidence. The 'Daubert' court set four criteria (not all inclusive) by which scientific testimony must be evaluated before it can be admitted. The criteria are: 1- testability of scientific principle, 2 - known or potential error rate, 3 - peer review and publication, and 4 - general acceptance in a particular scientific community. This ruling has generated an appreciable amount of discussion within the firearms examiner community as it essentially requires that examiners be able to scientifically explain how they reached their conclusions. One method of meeting elements of the criteria are to conduct scientific research and then publish the findings in a peer reviewed journal such as the AFTE Journal.

In 1994, the Association of Firearm and Tool-mark Examiners (AFTE) hosted its 25th Anniversary Annual Training Seminar in Indianapolis, Indiana. Some 300 individuals, representing 21 countries, attended the seminar.

In 1994, a study titled "Benchmark Evaluation Studies of the Bulletproof and Drugfire Ballistic Imaging Systems" was released by the Office of National Drug Control Policy (ONDCP), Washington, DC. The study consisted of a technical evaluation by various individuals, including members of AFTE, and included recommendations for various actions as outlined by the contractor performing the study for ONDCP.

In 1996, the National Institute of Standards (NIST), Gaithersburg, Maryland, was directed to provide technical assistance to assist with 'ballistic imaging interoperability' between the Drugfire and IBIS technologies.

In 1996, Tom A. Warlow published a text on firearms identification titled "Firearms, the Law and Forensic Ballistics". Warlow, a senior firearms examiner, then assigned to the Forensic Science Service (FSS) Laboratory in Huntingdon, Cambridgeshire, England, is now located at the FSS Laboratory in London, England. (previously the Metropolitan Police Laboratory of the New Scotland Yard until it was absorbed by the Forensic Science Services in 1997 in an effort by the government to curtail costs). Warlow has written a useful text that contains excellent information for firearm and toolmark examiners.

In 1997, Brian J. Heard published a text on firearms identification titled "Handbook of Firearms and Ballistics — Examining and Interpreting Forensic Evidence". Heard, a senior firearms examiner is Officer in Charge of the Forensic Firearms Identification Bureau (FFIB) for the Hong Kong Police Force. (The current name is now the Hong Kong Police Force as in June 1997, Hong Kong was handed over by the British Government to the People's Republic of China where it is now a Special Administrative Region (SAR) of China). Heard has written a useful text that also contains excellent information for firearm and toolmark examiners.

In 1997, the assassination of Dr. King again entered the news. Attorneys working to exonerate James Earl Ray (now deceased), petitioned the court to reopen the case. They

claimed that ‘new ground-breaking technology’ now exists which wasn’t available during previous examinations in 1968 and 1977. As stated previously in this article, previous examinations were conducted in 1968 by firearms examiners of the FBI Laboratory Firearms Unit and in 1977 by a panel of firearms examiners who testified before the Select Committee of the House of Representatives. Ray’s attorneys touted the ‘new’ technology — Scanning Electron Microscopy (SEM) and fiber optic lighting — as not being available to the previous examiners. A search of literature reveals the use of SEM in firearms identification research prior to 1972 while a list of equipment used by the King panel members in 1977 lists fiber optics lighting as being part of one of the comparison microscopes used for the reexamination. The petition to reopen the case was denied.

In 1998, in the AFTE Journal (Volume 30, Number 1), articles were published that were the result of some excellent research concerning both criteria for identification studies and striae reproducibility on a firearms barrel. These articles and one concerning meeting the Daubert challenge (a judicial notice for many of the forensic sciences in the United States) are part of an ongoing process by members of AFTE to fully articulate the science behind their field of firearm and toolmark identification.

In 1999, in late March and early April, several members of the Association of Firearm and Toolmark Examiners (AFTE) participated as members of the ‘Angoff Committee. This committee was formed to provide validation of the testing methodology to be used as part of an ongoing certification study process.

In 1999, the Association of Firearms and Tool-marks Examiners (AFTE) celebrates its 30th Anniversary as an association. AFTE is conducting the Annual Training Seminar which is being held in Williamsburg, Virginia. The current membership of AFTE numbers approximately 850 members, technical advisors and subscribers that represent over 40 countries from around the world.

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