

Photo Documentation of Toolmark Identifications – An Argument in Support

By: Bruce Moran, Sacramento County District Attorney Laboratory of Forensic Services

Key Words: photographs, photomicrography, photomacrography, scientific method, toolmark identification, comparison microscope, notes, documentation

ABSTRACT

This paper discusses the issue of the use of photo documentation in firearm and toolmark identification. It addresses: 1) historical perspectives, 2) the relationship of photographic documentation and the scientific method, 3) photography as the best means of documenting a visual process, 4) objections regarding photographing toolmark identifications, and 5) ASCLD-LAB considerations.

“When we have nothing but an ‘opinion’ to put forward, even though certain of its correctness, we much prefer to withdraw from a case altogether. We offer, in place of opinions, photographic evidence which tells its story mutely and dispassionately” – Major Calvin Goddard and Associates (1)

INTRODUCTION

A side issue that erupted out of the AFTE 2001 Toolmark Criteria for Identification Panel Discussion held on July 11, 2001 in Newport Beach, CA was, not surprisingly, on the subject of whether toolmark identifications should be photographed. There is obviously some dissention among AFTE members regarding this topic. I am a strong proponent for promoting the use of photo documentation of toolmark identifications. I submit my argument for peer review as follows:

To put the following comments in context I have been photographing my identifications in every case I have been assigned during my career under five different agencies since I began practicing in this discipline in 1978. I regard photographic documentation as a routine and logical approach to documentation of my observations and support for my conclusions. Good science requires documentation and I have always regarded our discipline as a science. The purpose of good documentation in my opinion is to : 1) provide a sufficient record of what I have done to refresh my recollection of my observations, to explain/illustrate what I examined in order to reach my conclusion(s), and provide sufficient support for those conclusions and; 2) provide sufficient records so that others may adequately peer review my work, whether it be a co-worker, supervisor, colleague, or defense examiner.

DEFINITIONS

For the purposes of this paper the following terms are defined as follows:

Photomacrography - a method of producing enlarged

images (greater than one to one) of a subject using a camera equipped with a bellows extension or a macro lens.

Photomicrography - a method of producing enlarged images by taking photographs through the objective lense of a microscope.

HISTORICAL PERSPECTIVE OF TOOLMARK PHOTOMICROGRAPHY AND THE VIEWS OF NOTABLE FIREARMS EXAMINERS PUBLISHED IN THE LITERATURE

Photographic documentation of toolmark identifications is not new to the forensic firearm and toolmark identification community. In fact, the technique has existed hand in hand with the very beginnings of our profession and marks an essential part of its underpinnings as a reliable science.

By the turn of the 19th century, photographic documentation in the criminal investigative field was notably recognized as a valuable tool in the hands of the investigator. Dr. Hans Gross, Professor of Criminology in the University of Prague, provided a summation of the prevailing attitude towards this form of documentation in the investigation of crime, both in the field and in the laboratory, in his text entitled *Criminal Investigation – A Practical Textbook* (2):

“Theoretically, the Judge trying the case, the Public Prosecutor, the expert, the counsel for the defense, and the jury or assessors, ought to see everything the Investigating Officer has seen. As this is generally impossible, the Investigating Officer has to supply the lack of the direct view by description. But how much clearer, more convincing, and more objective this description is when supplemented with photographs.” (3)

Gross’s recommendation for photo-documentation through the microscope was as follows:

“We suggest that the microscopist should sign no report without adding thereto a photograph of what he has observed under the instrument. Dr. Paul Jeserich was probably the first to draw attention to the necessity of such photographs. The idea came to him when, during the argument of a case, he heard the objection raised that what the experts had seen under the microscope and taken for blood was perhaps only mushroom mould or grains of starch. This objection could not be refuted, since the objects microscopically examined had long before decomposed and been destroyed, being thus incapable of further use in the case. This drawback is easily overcome by asking the microscopist to prepare and exhibit photographs of his experiments. Any mistake on the part of the expert may thus be excluded, for in his zeal he may perhaps see many things which are non-existent. He presents his photograph saying, as much for his own peace of mind as for that of others: “Look at the photograph and form your own opinion”. Proof of this kind may be given at any moment – even after many years, provided that the record of the case is still in existence; and is particularly easy to lay before the Judge and jury.” (4)

Gross further comments:

“Speaking generally it may be said that it [photography] should always be employed when it is desired to obtain absolutely objective, permanent, and easily controlled proofs capable of bringing about a conviction: the sensitized [photographic] plate is the new retina of the man of science; it may then be said that photography may be employed every time that there is room to suppose that the camera sees further than the eye, or, if it does not see further, each time that an object should be fixed for future reference.” (5)

Prior to the development of the comparison microscope, photographic enlargements of toolmarks were employed for comparison purposes. In 1912 Balthazard developed a photomacrographic method of comparing the markings on questioned bullets to bullets test fired from a suspect firearm by carefully taking a series of photographs of the rifled areas of each land and groove impression. The toolmarks appearing in the photographic enlargements of these images were then directly compared. Balthazard also used the same technique for the comparison of toolmarks produced on fired cartridge cases (6).

It was not until April of 1925 that the comparison microscope was introduced, and with it, photographic methods developed through this landmark instrument by those who introduced it (Waite, Goddard, Gravelle and

Fisher of the newly formed Bureau of Forensic Ballistics) (7). Goddard credited Philip O. Gravelle with: 1) the adoption of this instrument borrowed from the textile industry and; 2) his enlistment into the Bureau for the job of providing the needed photographic skills to go along with it, as he was an “*accomplished photographer and microscopist.*” (8)

Major Calvin Goddard, revered in the United States as the “*father of the science*” (firearm and toolmark identification) (9), considered graphic demonstration of toolmark identifications by use of photographs to be an essential ingredient to insuring the reliability and verifiability of his opinions as he so eloquently stated in the introductory quote to this paper. In his paper entitled “*The Identification of Projectiles in Criminal Cases*” published in *Military Surgeon* in 1926 (10) Goddard further expressed his support of the profession of firearms identification as a science in his tribute to Charles E. Waite:

“The value of a scientific method for solving these problems is readily apparent. Hitherto, the opinions of so-called experts have been all that could be relied upon when questions of this kind [identification of toolmarks in firearms cases] were to the fore, and such opinions, as we all know, can be perfect only insofar as their authors are omniscient and incorruptible an estate which, unfortunately, mortal man has yet to achieve. Entirely to eliminate “opinion” and to substitute therefore visual evidence of an easily understood character has, for the past tens years, been the ambition of a pioneer along these lines, Charles E. Waite, recently appointed vice director of the Bureau of Criminal Science”

This view was supported by descriptions of the development of the Bureau of Forensic Ballistics in 1925 in a Saturday Evening Post two part article entitled “*Forensic Ballistics*” by Wesley W. Stout. Stout comments in a section entitled “*Photography’s Aid Enlisted:*

“Up to now experts on firearms, whatever their expertness, never had been able to offer more than an opinion to the court or jury. If Waite’s method were to claim the title of a science, as he hoped, nothing less than a fact would do. The fact would be visualized for jury, judge, counsel, anyone, in enlarged low-power microscopic photographs of the bullets.” (11)

In Stouts article he further reports what the eye sees through the comparison microscope during examination of questioned versus test fired bullet and makes comment on the use of photo documentation and notes:

“what the eye sees, the sensitive film will record, given proper lighting and photographic equipment, and the marriage or divorces of two bullets can be shown a jury in a photograph enlarged as many times as is desirable. This is the silent witness which offers no opinions, expert or inexpert, but is a fact in itself.” (12)

In 1934 British firearms examiner Major Sir Gerald Burrard, an associate of Goddard, published his book entitled *“The Identification of Firearms and Forensic Ballistics”*. In this work Burrard expressed his opinion of the utility of the use of supporting photographs of bullet identifications stating *“but even if the investigator is satisfied in his own mind that he has married the “crime” bullet to the suspect weapon, more evidence is needed to satisfy a jury. Such evidence can only be provided by means of photographs taken through the microscope (13) and “any evidence unsupported by photographs cannot be regarded as being anything more than an expression of opinion. Photographs are, accordingly, essential; and such as are deemed necessary must be taken through the microscope.”* (14)

In 1935 Major Julian Hatcher in his *“Textbook of Firearms Investigation, Identification and Evidence”* praised the work of Goddard, commenting that:

“the work of Goddard and his associates has advanced the science of firearms identification to the point where such knowledge and equipment is available that the court can always assure itself of the services of an expert which is in a position to give the court and jury FACTS rather than OPINIONS.” (15)

Like his associates, Hatcher was a proponent of graphic demonstration of toolmark identifications and discussed its utility as follows:

“ This microscopic examination of fired cartridges and bullets, together with the recording and presentation by means of photography of what is revealed by the microscope, is called Advanced Firearms Identification. When it comes to work of this kind, it is relatively unimportant for the operator to be a gun-crank, though a knowledge of firearms and their construction and use, and a familiarity with the different kinds likely to be encountered is indispensable. However, if the operator is to become really good, he should know far, far more about photography than the

average gun-crank will ever know; and it is essential that he should have had training and experience in laboratory work, and especially in the use of the microscope.” (16) *“Moreover, the facts revealed by the microscope can be put into photographic form for future reference, and will thus be available for examination at any time should they come up for review, or should any other circumstance make such an examination of the evidence desirable. And these photographs will show the same thing for any expert who makes them. They cannot be made to testify for the side which can pay the largest fees. Of course, however, there is a difference in the ability of the various experts to use the microscope and camera, so that in the hands of a very skilled operator they may show the correspondence or lack of correspondence very clearly, while in the hands of a poor or mediocre operator, they may show the same thing faintly, or may even fail to show anything at all.”* (17) *“With the comparison microscope the investigator may or may not find that the fatal bullet matches the test bullet. If it does, he has visual proof of it, but this proof will no longer be available after he takes the bullet out from under the lens, unless he takes the precaution to photograph what he as seen through the microscope. This matter of photographing through a microscope is common laboratory practice, and is called Photomicrography.”* (18)

In 1935 – J. D. Gunther and C. O. Gunther published their contribution to the field entitled *The Identification of Firearms* (19). These well known pioneers expressed their opinion on the subject of photographic documentation as follows:

“In enabling the jury to reach a conclusion instead of accepting a ready-made conclusion from the witness, pictorial and demonstrative evidence must be effectively presented. Photomicrographs are invaluable because they afford to the jury a permanent record of the markings observed through the comparison microscope.” (20)

The authors further comment:

“the expert witnesses are now permitted to appeal to the intelligence of the juries by demonstrations and by pictorial evidence. By the same token, the juries are no longer forced to rely upon the mere assertions of the experts. They look primarily to the explanations of the data upon which the opinions are predicated for proof that the conclusions are warranted. By

means of these comprehensive explanations, the juries are equipped to consider more intelligently a single opinion on its own merits, and to evaluate more intelligently the merits of conflicting opinions. The disagreement between experts is becoming a disagreement as to the reasons for opinions rather than a mere conflict of opinions.” (21)

In 1942, *Photographic Evidence* (22), a voluminous work just short of 1000 pages dedicated to the subject of photography and the legal system, was published by Charles C. Scott. This treatise addressed almost every conceivable issue concerning photographic documentation of physical evidence including an extensive chapter on the subject of *Shells, Bullets and Firearms*. Scott recommended the following in regards to selecting a firearms identification expert:

“The attorney selecting a firearms identification expert to determine whether or not a bullet or shell was fired in a certain weapon should look for a man with these qualifications: First, the ability to make enlarged photographs that show definitely whether or not the markings on the bullet or shells were fired in the suspect weapon. Second, the ability to explain these photographs to the jury in such a way that every man in the box will understand how the expert reached the conclusion that the bullets or shells shown in the photographs were or were not fired from the same weapon. Concerning the first qualification it can be said that no matter how much he may know about firearms identification, an expert is of no use as a court witness unless he can make or superintend the making of photographs that will speak for themselves. Firearms identification testimony unsupported by photographs which tell clearly their own story is practically useless.” (23)

In 1957 Major General Julian S. Hatcher’s 1935 textbook *“Firearms Identification, Investigating and Evidence”* was revised and republished by Frank J. Jury, New Jersey State Police Crime Laboratory and Jack Weller, Firearms consultant from Princeton, New Jersey (24). In the preface of the revision Jury and Weller indicate to the reader that *“the book as it is now appearing is more than 90% new material.”* This new material included a significant change in the subject of photographically documenting toolmark identifications. Although quite a bit of text is devoted to describing the procedures of photographic documentation through the comparison microscope, the new authors add their own views in a section, entitled *“Decline in Use of Micro Comparison Photographs.”* (25) In this section the authors describe how *“photo micrographs are now rarely used”*

throughout the United States. They list the following reasons for this trend:

- 1) *“Undoubtedly, the most important of these is that Firearms Identification is now accepted in the courts far more readily than it was even a few years ago. Further, the findings of the Expert are accepted by the judge and jury without the visual proof required when Colonel Goddard and other were first presenting their cases.”;*
- 2) *“Perhaps the second most important reason for the decline in photography is the vast increase in the number of cases handled. If photographs were taken in one case, they would have to be taken in every case. The photographic expense – would, of course, be far too great, particularly since the luxury of such a presentation is not really necessary.”;*
- 3) *“Photographs are almost unsatisfactory to the Expert who has made a positive comparison through the comparison microscope. You photograph only what you can see at one single time. The camera cannot move along the surface of bullets to pick up identity after identity.”;*
- 4) *“these pictures were not understood by juries. A good deal of knowledge and experience are necessary to evaluate them.”;*
- 5) *Some men after years of working in Firearms Identification refuse to make a positive identification from pictures alone.”* and
- 6) *“Clever defense attorneys, by stressing lines in photographs that do not match, create a doubt in the minds of jurymen that would not have been there at all if the Expert had merely testified without producing any pictures.”* They concluded *“very few photographs have been presented in court recently. Actually, some departments have not taken pictures through their comparison microscopes in years.”*

In 1959, Leland V. Jones, Assistant Professor at Los Angeles State College and former Commander of the Scientific Investigation Division of the Los Angeles Police Department, authored *“Scientific Investigation and Physical Evidence.”* (26) Jones supported the use of “photomicrographs” in the following manner:

“The author has been asked many times by the defense if he arrived at his opinion through a study of the photomicrographs submitted. The answer, of course, is no. The expert arrives at an opinion after a thorough study of all the ramifications of the case, and it would often be a physical impossibility to photograph each and every detail that aided him in reaching his conclusion. For instance, he may study two bullets through the comparison microscope,

searching each land and groove and comparing all the characteristics of the entire circumstances of the bullets, yet to photograph all of these characteristics would be impractical, if not impossible. The best point or points of comparison would be selected and photographs made of these characteristics.”

In 1962, Dr. J. H. Mathews, well known for providing the firearm and toolmark identification community with his three volume set of books titled “Firearms Identification”, provided a candid view in favor of photographic documentation of toolmark identifications. In a section entitled “*Use of photographs of matchings in court*” (27) he discusses the “*considerable difference of opinion among investigators regarding the use of photographs in court to illustrate the matching of rifling marks, breechblock marks, extractor marks, ejector marks etc.*” and lists many of the objections as described by Jury and Weller in the previous paragraph. He addresses these objections as follows:

“However, there is another side to be considered. How about the viewpoint of the intelligent and perhaps skeptical juror? Will he be satisfied with the unsupported word of the expert? And what is he to think when the experts do not agree? They may have honest differences of opinion. Some of them may be overzealous in their cause and in their opinions. And some are downright dishonest. In the past thirty years the author has met all of these types. As a juror he would want to be shown. And a good photograph accompanied by a full explanation of principles involved and a frank acknowledgement of such limitations as exist will have much better effect on the jury than an unsupported statement of an expert who, in the majority of cases, is unknown to members of the jury. Jurymen often may be uneducated, but few of them are dumb.” “In several cases in the author’s experience good photographs of matchings have been a decisive factor.” “Oftentimes, opposing counsel has asked questions concerning the photographs as they are being shown on the screen and this should be welcomed because it offers the expert additional opportunity to clear up matters for the Jury. If the photographs cannot be defended they should not have been shown in the first place. When a man’s life (or future liberty) is at stake he is entitled to a fair and complete trial and the members of the jury are entitled to the best possible presentation of evidence, both pro and con.”

In 1979, R. L. Tanton published the results of his

psychological research in the Journal of Forensic Science (28) on jury functions relative to extra-evidential factors affecting the juror’s evaluation of the forensic scientist and his or her testimony and what expectations jurors have regarding the forensic scientist in the courtroom. In this study, through a series of surveys, Tanton’s objectives were to: 1) determine jurors’ preformed expectations (preconceptions) of the forensic scientist in the courtroom; 2) determine if deviations from preconceived stereotype caused devaluation of the expert’s testimony; and 3) to generate data to confirm or refute the effects of personal appearance referred to in prior research. Tanton made some interesting observations in regards to juror feelings about the use of illustrations to supplement expert witness testimony. Tanton observed:

“while a majority of Survey A subjects expected the scientific expert to be sitting and talking, Survey B subjects preferred the standing and illustrating expert by a ratio of 5 to 1. With all other factors equal, it is probably safe to assume that the forensic scientist who stands and illustrates part of his testimony will appear more knowledgeable than the one who stays glued to the witness stand.”

A review of the AFTE Journal on this subject revealed a number of papers commenting on the subject of firearm and toolmark identification photo-documentation. In 1981 a reprint of a paper recommended by several AFTE members entitled “*An Overview of Firearms Identification Evidence for Attorneys – Parts I – IV*” by R. J. Joling, A.B., J.D. was published in the AFTE Journal (29). This paper provided an overview of the process of firearms identification. In this paper, Joling makes specific reference about the significance of photomicrographs to attorneys as follows:

“Photomicrographs are made so that the identification made under the comparison microscope can be documented and used for both notes of reference and for demonstrations. It should be mandatory that enlarged photographs be made to document the evidence to be presented before court and jury. Whenever this is not done, the trier of the case should be skeptical concerning the credibility of the identification allegedly made”.

In 1988 a synopsis of a presentation entitled “*Guarding Against Error*” (30) given by AFTE member and then Firearms-Toolmarks Unit Chief of the FBI Laboratory, Evan Hodge, at the 1987 Seattle Training Seminar, contained the following comments in regards to photographing toolmark identifications:

“I think this is the best way to guard against serious error and I recently instituted policy requiring confirmation of some identifications

within the FBI Firearms – Toolmarks Unit. This policy is stated as follows:

All identifications which are not suitable for representative photographic depiction will be confirmed by another examiner who will initial the case notes. The Unit chief or acting Unit Chief will review all notes and not sign out any report not in accord with the above. No examiner, including the Unit Chief or acting Unit Chief, will sign out his own report.

Obviously, this means that it is now our official policy to take photographs that are representative of our identifications. Why? First, it documents what we saw through the microscope. Where would Monty Lutz and John Ward have been in their confrontation with Robert Steindler if they hadn't taken photographs of the anvil marks identification to prove Steindler was totally wrong in testifying that the .22 caliber cartridge cases were not fired in the suspect weapon. Second, it provides a method of quality assurance, a check for the reviewing supervisor. Third, it reminds us of what we saw before we testify. And, lastly, it will provide us with a court exhibit if needed. We do not require court exhibits routinely. That is left to the discretion of the examiner and the requirements of the prosecutor."

In 1991 The California Department of Justice Firearms / Toolmark Identification – Training Syllabus entitled Professionalism (Module 7) was published in the AFTE journal (31). The authors of section 7B3 dealt specifically with the subject of photography by saying that:

"it should be the policy of the crime laboratory that photography be routinely used to supplement casework notes and sketches for the following purposes: A) So that the analyst will be able to recall, even years after the examinations, what was done with the case; B) so that the case may be adequately reviewed by a person technically familiar with the analyses performed, usually a supervisor, and C) so that appropriate court exhibits or other demonstrative evidence may be prepared when needed."

In Section 7F-2, entitled *Preparation and Marking Court Exhibits* (32), recommendations regarding the use of photographic evidence included:

"...some examples of exhibit preparation and presentation that are applicable to firearms and

toolmark examinations are: Photomicrographs of class and individual characteristics illustrating areas, demonstrating points of identification or elimination in toolmark comparisons. It is often advantageous to use both macro and micro photography to complement each other. This is particularly advantageous in the case of comparison photomicrographs of subjects such as bullet or cartridge case comparisons, or toolmark comparisons where it is difficult for a layperson to orient and visualize where the toolmarks are actually located on the items photographed. When possible, class characteristics or other easily recognized reference points should be included in the field of view of all photomicrographs which allow confirmation of class characteristics and orientation to readily recognize referenced points." The document further supports the use of photographs in court stating, "Most photographs help the trier of fact gain an appreciation for how you conducted your examination(s) and the basis for our conclusions. In a very small number of cases, the agreement in striae comparison cases where identifications are made is so slight that photographs would add little. By far the majority of these cases, however, can be illustrated photographically. One reason used to justify not using photographic displays is that one adversary will point out discrepancies in agreement and make a major issue of it. In the author's experience, this argument has little merit. Simply explain why you are using the photographic exhibits and that minor, non-relevant discrepancies are often present. In fact, this is a good thing to bring up when giving direct testimony about the photographic displays. Mentioning discrepancies during direct testimony helps prevent someone else from making an issue of them during cross-examination." (33)

In the following issue of the AFTE Journal Roberts strenuously objected to the California Department of Justice guidelines regarding the use of photographic evidence in demonstrating toolmark identifications in his commentary entitled *Photography of Identifications Professionalism or Personal Preference?* (34) Roberts objected to the use of photographs to document toolmark identifications because:

- 1) *"the actual identification is three-dimensional while a photograph is only two-dimensional and the depth of field is greatly limited";*
- 2) *"a photograph further limits the field of view and may have a major portion out*

of focus due to the curvature of the evidence. Many identifications use areas over a large part or formation of the evidence and a photograph is unable to pick up these series of identities. For these reasons photographs may not accurately depict what is seen through the microscope”; 3) “I find it time consuming and unnecessary to accurate analysis in the average case”; 4) “I simply do not perceive a value equal to the expense in time, equipment and film.”; 5) “The money spent on film might be better spent on equipment upgrades or training of the analyst.” and 6) “I would not, nor would any of my colleagues, make a firearms identification from a photograph. I do not know of an examiner that would.”

Roberts reports that the California Department of Justice adopted the California Association of Criminalists Code of Ethics which states, in part ... “a proper scientific method demands reliability and validity in the materials analyzed, conclusions will not be drawn from material which themselves appear unrepresentative...”. With regard to this passage and the photography of toolmarks, Roberts comments that:

1) *“photographic checks can not be considered a part of the analytical procedure”; 2) “such checks are, at best, a way to allow a supervisor the easy way out of doing a thorough job and may give a false sense of security as well. The supervisor’s microscope time would probably be less than that required of the analyst to take the photographs combined with the supervisor’s time to examine them” and; 3) “unless the nearly impossible task of photographing and checking all possible non-identifications is undertaken, how can a review of only identification photographs be adequate?” (35)*

The California Association of Criminalists Code of Ethics also states, in part “The true scientist will make adequate examination of his materials and apply those tests essential to prove. He will not, merely for the sake of bolstering his conclusion, utilize unwarranted and superfluous tests in an attempt to give greater apparent weight to his results”. With regard to this section Roberts comments that:

1) *“If an analyst uses a photograph to convince the jury that he has reached a correct conclusion, he is using the photograph “merely for the sake of bolstering his conclusions”; 2) “If the analyst uses the supervisory checks done by photograph to improve his image before the jury, he has again used the photograph “merely for the sake of bolstering his conclusions”.*

Roberts, however, makes a somewhat favorable comment about the use of photographs in general as follows: “I do believe that photographs can be an excellent note taking tool for those who wish to use it, but not necessarily the best method for everyone.” But he also states:

“I take notes about those things to which I will be testifying. If I cannot put the information into words at the time I view it through the microscope, I may not be helped by a photograph when trying to do so later. Nor do I see the advantage to going into great detail about what is seen, neither words nor photographs are likely to convince another examiner if the microscope does not.”

In 1994 Kriegle and Brooks, in full support of the use of photomicrographs in documenting toolmark identifications, published *Photography of Bullets Using the Comparison Microscope* in the AFTE Journal (36). The authors comment that with “our fast paced society today and a jury that is made up of people who are more educated and possess a show-me attitude, sooner or later you may have to photograph your own evidence for court.” The authors then provide the reader with a succinct but detailed step by step process of obtaining the best quality photographic images on Polaroid film and then compare Polaroid film to emulsion based negative film for purposes of producing court exhibits. This paper is accompanied with good photographic examples contrasting proper technique and poor technique to aide the photomicrographer in self-diagnosing his/her own work when taking photographs through the comparison microscope. This paper is slightly outdated in terms of film choices, but the same principles apply to present day considerations using emulsion based photography as well as modern day digital imaging. I would highly recommend this paper for a good review or evaluation of the readers’ own photographic skills.

1997 – Heard, in his book entitled *Handbook of Firearms and Ballistics* (37), commented:

“in general, the use of comparison photomicrographs in a court of law to illustrate stria comparisons should be discouraged. At best they are illustrative of a stria match and at worse they can be totally misleading to a layman jury. A video recording of the whole circumference of a bullet comparison or the various parts of the match on a cartridge could, however, be far more informative and remove some of the perceived “mysticism” behind striation comparisons”.

SCIENTIFIC METHOD, DOCUMENTATION AND THE PROCESS OF FIREARM AND TOOLMARK IDENTIFICATION

Scientific method is a process of problem solving that helps ensure a self-evolving, self-correcting body of knowledge built upon verification and validation. It is a systematic mechanism by which science develops knowledge with principles that are clearly articulated and applied. I firmly believe that firearm and toolmark identification fits neatly into this definition and I approach the discipline accordingly. Examiners in this field practice the scientific method both informally and formally.

The key element in the above definition that has relevance to this discussion is the reference to verification and validation. To verify is to confirm, substantiate, or to provide evidence that establishes accuracy or truth. The process of verification leads to soundness of method that is robust and sustainable in its application. In other words, for our work to be valid, it must be verifiable by other examiners. This means that other examiners must be able to repeat the work and come to the same conclusions. Therefore, the data that we gather should provide a well defined “roadmap” as to what experiments we performed to answer the question(s) posed, what data was gathered, and a clear demonstration of the evidence from which we supported our conclusion(s). This mechanism of communication among scientists through good documentation is a substantial part of the process of verification.

PHOTOGRAPHY AS THE MOST APPROPRIATE MEANS OF DOCUMENTING A VISUAL PROCESS

Appropriate recording of scientific data is determined by the method of study. In the case of firearm and toolmark identification, the process of gathering data is purely visual as we view markings on test toolmarks versus questioned toolmarks through the comparison microscope. This calls for the most appropriate form of documentation. With this in mind, let's now look at how we conduct examinations in toolmark identification. It is my opinion that toolmark examiners interpret evidence by employing their cognitive ability to recognize agreement between patterns that in their “minds eye” constitutes an identification or “match” between a questioned pattern or toolmark and toolmark patterns produced from known tools. When the examiner believes that an identification has been established, he or she is relying on scientific principles of toolmark identification theory developed by using the scientific method/empirical testing to support his/her opinion of identity. Because much of the examination process is cognitively based on the recognition of patterns, our judgments and/or decisions of identity vs. non-identity is based on what is seen. **I can think of no better way to represent what we see than to document those patterns photographically. This form of documentation is superior to all other forms of**

documentation in terms of demonstrating what we have seen that provides a basis for our conclusions because it replicates most closely what registers on the retinas of or eyes. Notes, sketches, written descriptions and diagrams of toolmark agreement are only secondary to photographs in that they can supplement what we are basing our opinion on by qualifying the photographic documentation, assisting the examiner in relocating the areas of significant agreement, associating the toolmark in question to the source of the mark on the tool surface, etc.

In relating the above comments on documentation to the scientific method, Lastrucci provides clear guidelines about the collection of visual data in his book entitled *The Scientific Approach – Basic Principles of the Scientific Method* (38) as follows:

“The proper recording of scientific data is influenced by the type of study: the quantity and quality of the material involved, the methods employed, and the interests and skills of the researcher” ... “the data should be arranged in such ways that they are clear and easily available. Competent researchers tend to develop neat and orderly systems of data arrangement, systematized in such ways that others would have no difficulty in studying the material if desired.” ... “Visual data may be interpreted verbally, of course, especially when they are of a simple and indisputable type (e.g., the number of persons crossing a street, the size of dresses most frequently sold, or the color of packages most often selected). But when the quality of the data or their arrangement or interpretation are pertinent to their employment in the hypothesis, then the data should be recorded by appropriate instruments (cameras, photomicrography, x-ray, etc.) ... the whole range of photographically recordable data should be exploited in a manner most pertinent to the needs of the study.”

Lastrucci further develops the utility of this approach as follows:

“In determining which kinds and amounts of data should be included in a study, the scientist bears in mind the basic fact that scientific method demands exactness and clarity; and thus he includes in his presentation (i.e. casework notes) all those elements which a competent student of the subject might require in order to be able to understand and possibly criticize both the methods and the conclusions. Like any human being who might become emotionally involved in his field of interest, the scientist is at times apt to distort or exaggerate (by maximizing

or minimizing) his data in the direction of his predilections or prejudices. But the basic fact that scientific method is self-critical means that the possible distortions of an investigator can always be checked by the duplication or replication of a study by other investigators. For all practical purposes, then, no data or interpretations are acceptable as valid until corroborated by other investigators working independently. This means, in effect, that dishonesty cannot be practiced for any length of time; and therefore, that the presentation of a study always make clear exactly how the study was done.”

The point is that the most appropriate means of documentation should be applied to the method being used. In the case of firearm and toolmark identification, it is photography. It is an essential element of the scientific method applied to the process of firearm and toolmark identification that allows other examiners to observe what we visually base our opinion upon. This greatly aids the reviewing examiner in repeating the work and therefore verifying and validating the process. This is essential to demonstrating reliability of the method. In other words, being able to repeat the method and obtain the same results.

OVERCOMING TRADITIONAL OBJECTIONS TO PHOTOGRAPHING TOOLMARK IDENTIFICATIONS

The following objections to photographing toolmark identifications have been abstracted from Hatcher, Jury and Weller (39) and Roberts (40). I believe these concerns by Jury, Weller and Roberts to be outdated and are significantly outweighed by the advantages of photographic documentation of toolmark comparisons. I address these objections as follows:

“Undoubtedly, the most important of these is that Firearms Identification is now accepted in the courts far more readily than it was even a few years ago. Further, the findings of the Expert are accepted by the judge and jury without the visual proof required when Colonel Goddard and other were first presenting their cases.” – Jury and Weller

This statement may have been true when it was published in 1957; however, the “blind” acceptance of firearm and toolmark identification evidence is rapidly changing as we enter the 21st century. Jury and Court alike have increasingly demanded visual demonstration of our identifications. Today’s juries, whether we like it or not, are heavily influenced by television police and detective shows showcasing the latest technologies with plenty of visuals. Our present day juries have developed a “show

me” attitude and under the influence of modern day media are expecting increasingly sophisticated “visuals” supporting the opinion of the “expert witness”. As a result, verbal testimony describing agreement observed by the expert, unsupported by photographs, is becoming less and less effective in providing clear and convincing proof of our toolmark identifications.

The firearm and toolmark identification community is under increasing pressure to provide demonstrative evidence of our identifications by the Courts as well. This change in the attitude of the courts was most recently demonstrated in the Ramirez vs. State of Florida Supreme adverse court decision (41) ruling against the admission of toolmark identification evidence involving the identification of knife marks in human cartilage. Among a number of concerns expressed in the Ramirez decision, the supreme court emphasized the lack of photographs of the knife mark comparison as a major deficiency in convincing the court of the reliability of the experts opinion. The justices discuss their concern as follows:

“The States experts testified that the examining technician generally takes no photomicrographs of the casts because lay persons would be unable to understand the identification process. This testimony, however, is belied by the published articles in the present record. Each article ... contains photos of the matching striae, and the photos are instrumental in confirming – for the reader – the validity of the “match”” (42)

The justices further expressed concern that:

“...there are no photographs, nor comparisons of methodology to review, and the final deduction is in the eyes of the beholder” (43)

*“Photographs are almost unsatisfactory to the Expert who has made a positive comparison through the comparison microscope. You photograph only what you can see at one single time. The camera cannot move along the surface of bullets to pick up identity after identity.” – **Jury and Weller** “a photograph further limits the field of view and may have a major portion out of focus due to the curvature of the evidence. Many identifications use areas over a large part or formation of the evidence and a photograph is unable to pick up these series of identities. For these reasons photographs may not accurately depict what is seen through the microscope” – **Roberts***

I bring your attention to the words of Charles C. Scott who once stated, “anything that can be seen can be

photographed and the testimony of a firearms expert unsupported by photographs should be given very little weight” (44). In the twenty-three years that I have been photographing identifications, it has been an extremely rare occasion that what I have observed under the stereoscope or comparison microscope cannot be meaningfully photographed, particularly with emulsion based films. In the infrequent event that I am unable to demonstrate what I have observed photographically, I simply say so in the notes. I photograph what I can, and describe the limitations due to fine/subtle detail present. This is so infrequent that in my experience I cannot remember the last time it happened. It is in marginal cases where documentation is most important as striated toolmarks of this nature have the highest potential for misinterpretation. I would fully expect to have my work critically reviewed in these situations. So why not facilitate the most effective means to do so. If there is a disagreement in opinion then defend your position as you are entitled to do as an expert in our discipline. Clear photomicrographs will allow you to do this convincingly. To use this infrequent situation as a reason to abandon photographing all toolmark identifications does not, in my opinion, have merit.

Further, the argument that you can only photograph what you see in one field of view at a time is certainly true. However, to suggest that a camera cannot move along the surface of bullets to pick up a series of pattern agreement areas is not true. A series of photographs representing slightly overlapping fields of view will certainly accomplish this and I have done so in some cases. However, photographing the entire toolmark comparison is seldom necessary to provide sufficient documentation to support an opinion of toolmark identity. I often take representative photographs of the areas of agreement and qualify the photographs as such when providing testimony. I also take photographs at low magnification to orient the jury to the specific location(s) of the matching agreement.

“these pictures were not understood by juries. A good deal of knowledge and experience are necessary to evaluate them.” – Jury and Weller

I disagree with the basis of this argument. All humans have a natural cognitive ability to recognize pattern agreement whether they are trained experts or not. The average jury will, indeed, recognize demonstrative evidence in the form of a photograph illustrating pattern match agreement, whether striated or impressed. Therefore, recognizing the pattern agreement in the photographs being offered should not be an issue. What is important, however, is that the jury or court understands that they are not being asked or expected to interpret the agreement that is shown. This will be explained by the

expert.

It is the experts’ obligation to provide a thorough interpretation of the meaning of the agreement viewed by court and jury in the photograph(s) being offered, using the training and experience of the examiner. Pointing out areas of significant repetitive agreement supporting the identification and explaining the numerous reasons for expecting areas of disagreement in a match comparison should be routine for any well trained toolmark examiner. This is why we are the experts. A good photograph goes a long way to instilling jury confidence in the expert’s opinion.

The present day court and jury alike, especially in today’s world of sophisticated visual media advances, are expecting graphic demonstrations of the expert’s observations on an increasing basis. Anything less will result in significantly diminished weight to the experts’ opinion. Allowing the court and jury to see the pattern agreement for themselves supported by such explanations and/or qualifiers carries significantly more weight to the expert’s opinion than denying such a visual demonstration on the basis that they will not understand a photograph. Good defense attorneys, in my experience, work hard to keep photos from the juries view because they are so persuasive.

“Some men after years of working in Firearms Identification refuse to make a positive identification from pictures alone.” – Jury and Weller “I would not, nor would any of my colleagues, make a firearms identification from a photograph. I do not know of an examiner that would.” - Roberts

I would generally agree with these statements, as the purpose of photography is to document what is being viewed directly through the comparison microscope and is not intended as a primary means of effecting a toolmark identification. However, I would submit that the resolution of images produced from emulsion-based film is sufficient to record the detail that I observe directly through the comparison microscope. It is a rare event when I am unable to accomplish this. Further, a review of good photographs of pattern agreement properly supported with notes and other forms of documentation can and are used as a good means to convince others that a valid identification has been observed through the comparison microscope. The goal of my photographic documentation is to accomplish this. When I am administratively reviewing the work of others, the photographic documentation is the principle means by which I critically evaluate the validity of identifications made by others. If the agreement viewed in the photographs is not sufficient to support the opinion stated

in the conclusions section of the report under review, then I am certainly free to review the work directly through the comparison microscope.

Although I do not use photographs as a primary means upon which to base identification, it does not mean that photographs cannot be used as the basis upon which to form an opinion of identification. There are situations, especially in marginal cases, where a series of good quality photographs recording isolated areas of agreement located over a large area have been of great assistance in supporting my opinion that there is sufficient agreement in total to support an identification. In these cases, each isolated area by itself may not be of sufficient quantity/quantity to support an identification. For example, this situation happens occasionally with isolated areas of repetitive agreement located only in the leading edges of fired bullets with very poor quality markings. A series of good photographs taken of these areas are reviewed at the conclusion of my examination in their totality to remind me of the cumulative agreement I observed that I might not otherwise be able to accurately recall in my mind. This is especially true if it has taken me several hours to conduct my examination and significant time has lapsed between my viewing of these isolated areas. The photographs act as a means of refreshing my recollection of this accumulation of agreement that I can then compare against my personal criteria for identification in making a final decision as to whether there is sufficient agreement to conclude an identification or some lesser associative conclusion. Having not taken photographs in these situations where limited quantity of information is available leaves me with a much more vague recollection of the agreement I observed. As a result, my confidence in “making a call” is reduced as I am merely basing my final conclusion on what I can remember I observed over a relatively long period of time in these marginal situations.

“Clever defense attorneys, by stressing lines in photographs that do not match, create a doubt in the minds of jurymen that would not have been there at all if the Expert had merely testified without producing any pictures.” – Jury and Weller

I have experienced this courtroom tactic on occasion. However, this is most commonly done in an “out of context” manner. The defense council picks out the worst photo you have taken and then purports to the jury that your opinion is based solely on the photo that he or she is holding. When ever I use photographic displays, I set myself up for success by explaining how I use photographs in casework and that, in most cases, they only represent a portion of the agreement and are taken in part to be able to explain in court how I did my

examination(s). I also describe the limitations of photographs as well. I bring to the counselors attention that the photographs were used to illustrate the minimum basis for the identification and does not necessarily record all the visual observations that I made under the comparison microscope. All toolmark examiners should be prepared to defend their work against routine courtroom antics such as this.

“the actual identification is three-dimensional while a photograph is only two-dimensional and the depth of field is greatly limited” – Roberts

Toolmark identifications made directly through the comparison microscope are **not** three-dimensional, but are in fact only two-dimensional. Viewing objects three dimensionally is only possible with stereoscopic viewing (such as a stereoscope where each eye is viewing the same object through separate objectives). This is certainly not the case with the comparison microscope as both eyes view both specimens through two objectives. Three-dimensional viewing is not possible through this optical system. We do, however, perceive the two-dimensional images through the comparison microscope as three-dimensional and are able to estimate depth and contour of the toolmarks we compare. Therefore, when viewing two-dimensional photographs of what is actually seen two-dimensionally through the comparison microscope, we are able to perceive three-dimensional contour as we do when viewing directly through the objectives.

As to the concern for limited depth of field, this is not a function of the photograph itself but results from the limits of the optical system in the comparison microscope. Depth of field is indeed reduced as magnification of the objective lens increases. However, I am often able to increase depth of field by adjusting the iris diaphragm and in many cases can produce a photograph in sharp focus across the entire field of view. In cases where I am unable to keep the entire area of pattern agreement in focus due to this problem, I simply take a series of photographs with segments of the toolmark that I can keep in focus. Depth of focus is then, really a non issue.

“Perhaps the second most important reason for the decline in photography is the vast increase in the number of cases handled. If photographs were taken in one case, they would have to be taken in every case. The photographic expense – would, of course, be far too great, particularly since the luxury of such a presentation is not really necessary.” – Jury and Weller “I find it time consuming and unnecessary to accurate analysis in the average case” – Roberts “I simply do not perceive a value equal to the expense in time, equipment and film.”- Roberts “The money spent

on film might be better spent on equipment upgrades or training of the analyst.” - Roberts

I agree that in the average toolmark case, whether or not a well-trained examiner has photographically documented his or her work, should make little difference in his/her ability to reach a reliable conclusion. However, I firmly believe that communicating the basis for their conclusions is as important as reaching the conclusions themselves. I regard photographic documentation as a routine and logical approach to recording the results of the visual process during which I make my observations that support my conclusions. Therefore, the loss of time taken to photographically record the basis for my opinion is grossly outweighed by their value and I take photographs in every case.

A majority of our respected forefathers, previously discussed, stressed the importance of photographic documentation, despite the time it took using the techniques available to them. Having used emulsion based film (usually tri-X or plus-X) during the first few years of my career, I certainly don't relish memories of having to first hand load the film, properly expose the film using good photographic technique through the comparison microscope, and then process the film in the darkroom to make sure I had a good quality image on the negative to produce a usable photograph. Relative to the total time I spent on my cases, the amount of time was significant but in my opinion worth it.

However, with the development of numerous excellent quality Polaroid films (Types 52, 53, 55, 57, 59, and 400 for example) the amount of additional time to photograph a comparison under the microscope has been reduced to a matter of a few minutes at the most. This additional time, relative to the total time to complete the overall examination, has become insignificant.

In the late 90's I began to take advantage of digital imaging as a means of documenting my work. Today, my documentation of toolmark comparison is almost exclusively via digital imaging. This method offers a number of advantages over the use of traditional emulsion based and Polaroid films as follows:

- Good black and white as well as color images of what is viewed under the comparison microscope can be captured in a matter of seconds using the same photographic techniques as emulsion based and Polaroid films.
- Immediate evaluation of the captured image allows the examiner to make exposure, formatting, and depth of field adjustments to acquire the best image possible.
- The cost of capturing and storing digital images is significantly less than the cost of a comparable number of Polaroid photographs. Digital images captured and stored are on the order of a few cents as opposed to two to three dollars per sheet of Polaroid film. For example, in our laboratory, the savings in film costs over the first six months of using digital capture paid for the cost of the camera and the computer purchase cost.
- Digital images can be easily imported into worksheets, notes and reports. I use digital images for these purposes on a regular basis in my casework. Anyone reviewing my work will be in a much better position to repeat the work that I have done, especially in relocating areas of agreement that I have based my opinion on.
- Digital images also provide an easy means of producing good quality court exhibits in a matter of a few minutes.

Although most of my work involves digital imaging, I still maintain a supply of Polaroid emulsion based film available if it becomes necessary that I achieve the

resolution capable with emulsion based film to supplement my digital images. With the advent of modern day technology in producing good quality images, in my opinion, the objections that photography is too time consuming and too expensive are no longer valid.

There are many who still use Polaroid film to record the areas that support the basis for an identification and no internegative is needed. Polaroid photos can be enlarged using a good quality photocopier or can be scanned digitally to produce enlarged court exhibits. Polaroid photos can also be projected directly onto a large screen using video visualizer projection equipment that is now available in some courtrooms. Excellent quality color photocopies of black and white Polaroid photos can also be made for distribution with case notes during discovery as well as for projection in court using Elmo type projection equipment. These photographs can also be distributed as court exhibits to jury members and used directly without being projected at all. Scanned Polaroid images can also be projected on screens for viewing in the courtroom using digital equipment. I have used these techniques and have found them to work well.

“Photographic checks cannot be considered a part of the analytical procedure” – Roberts *“Such checks are, at best, a way to allow a supervisor the easy way out of doing a thorough job and may give a false sense of security as well. The supervisor’s microscope time would probably be less than that required of the analyst to take the photographs combined with the supervisor’s time to examine them” – Roberts*

There is no doubt that toolmark identifications can be made without a single written note or photograph taken. However, if good science is to be practiced, the examiner must make every attempt to document his or her work in a manner that allows other experts to repeat it if necessary, and to critically evaluate the conclusions made. Photographic documentation of the visual process of viewing pattern match through a comparison microscope, supplemented by good hand written notes, is the most appropriate means to allow other interested parties to do this. Photographs simply act as an effective means for the reviewer to see the best representation of what was viewed by the examiner.

Roberts suggestion that supervisorial review using photographs only allows the supervisor the “easy way out of doing a thorough job” in verifying another examiners work is misguided. Good photographs, supplemented with thorough notes may properly be used by a subject matter expert/supervisor to critically review most toolmark identifications. In some cases where the peer

review must be made using the microscope, photomicrographs will certainly make it easier for the reviewer to relocate the critical areas supporting a toolmark identification when reviewing another’s work through the comparison microscope. In these cases, photographs, direct a reviewer to the critical areas supporting the examiners conclusions.

With today’s ability to either: 1) digitally image pattern agreement in a matter of a few seconds and print the image in a matter of a minute or two; or 2) take a few Polaroid photos, record the photo data, and tape them to photo data pages for inclusion in case notes takes an insignificant amount of extra time considering the totality of time spent in the comparison process to locate the areas of pattern agreement and to bring them into their best resolution for critical evaluation. For these reasons I would argue that taking photographs speeds the process of accomplishing a thorough review and facilitates good scientific practice as well.

“unless the nearly impossible task of photographing and checking all possible non-identifications is undertaken, how can a review of only identification photographs be adequate?” – Roberts

We expect to observe areas of disagreement in toolmarks known to have been produced by the same tool. This is why we carefully inter compare test marks or test fired bullets to become familiar with the signature of the tool. This signature is recognized in those locations where repetitive agreement is observed where subclass influence is not present. It is these areas that provide significance in being able to associate toolmarks to a specific tool. When recording an identification, my goal is to photograph these areas of agreement to a point that there is sufficient documentation to convince any other equally qualified examiner that a valid identification has been established. I do not photograph “non-matching” areas because I expect to observe them and I know that they are not significant in what constitutes an identification. In other words, in striated toolmark identifications, I photograph agreement, not disagreement.

“If an analyst uses a photograph to convince the jury that he has reached a correct conclusion, he is using the photograph “merely for the sake of bolstering his conclusions” – Roberts *“If the analyst uses the supervisory checks done by photographs to improve his image before the jury, he has again used the photograph merely for the sake of bolstering his conclusions” – Roberts*

To suggest that using photographs is some sort of crutch or image building tool to create an unneeded representation of my findings for a supervisor or jury is

false. I view photographs of toolmark identification as needed, obviously Roberts does not. To bolster is to add to, support, or uphold (45). I use photographs to substantiate, confirm and provide demonstrative evidence of the visual data I gather to make my conclusions. Photographs provide the clearest form of communication among scientists who base conclusions upon the visual process of data gathering in toolmark identification.

ASCLD-LAB “Raising the Bar”

Recent controversy over the use of photographing toolmark identifications has been brought about through ASCLD inspection challenges to laboratory photo documentation policy. The purpose of ASCLD-LAB is to promote uniform minimum standards. To not record our cognitively based identifications “visually” by the best means available is bad science, especially when it is so easy, with a bit of training and the right equipment, to take appropriate pictures. It also takes very little time, is cheap in light of all other costs associated with an investigation, once the right equipment and training is in place. If we as a profession hold to recording the basis for our comparison results with photos as a standard, labs would be forced to purchase the right equipment and provide the right training. Especially since doing so would help labs meet ASCLD-LAB accreditation standards. In this spirit I suggest that instead of fighting against the standard, embrace it, and use it as an opportunity to further our profession. Good science requires documentation, and it should be visual when our opinions are based on what is seen.

The Sacramento County District Attorney, Laboratory of Forensic Services ASCLD-LAB approved procedures manual entitled “Examination of Bullets and/or Projectiles - Photography” states:

“Generally, photographs may be taken as deemed appropriate by the examiner as a component of documentation. Photographs are especially useful in documenting pattern comparisons and examinations. Some examinations may have specific photographic requirements. The examiner is alerted to this in the *Documentation* section for that procedure.

It is recognized that photographs:

- Are for the purpose of note taking (documentation)
- Are inherently limited in their ability to record all detail observed by the examiner
- Only document selected portions of the evidence.

At least one photograph illustrating an identification match that is significant to the case must be taken. This photograph may document a

match of:

- Evidence to test
- Evidence to evidence from two different sources

It is not necessary to photograph every identification match in a case.”

In reality, even though only one photo is required, examiners in our laboratory often take multiple photographs of agreement to the extent that other examiners who will be assigned to peer review the work will have a reasonable expectation of seeing what the opinion was based upon. We meet the Essential ASCLD-LAB criterion by following this minimum requirement. Further, we meet the requirement with photos demonstrating the specific areas we are basing our identification upon, supplemented by sketches.

Those reviewing my work are able to more easily see the agreement that I have tabulated using clear transparent overlays over the photos. I make notations of consecutive matching striae with marking pens on the overlays. The importance of photographic documentation is even more amplified at this additional level of critical evaluation of striated toolmarks. Someone reviewing my work will know exactly what I was observing. If the reviewer is not satisfied with the agreement, then he or she has the option of looking at the original evidence. In this case the photos serve as an excellent means of relocating the area (s) in question.

I believe that photographic documentation should be a requirement for all toolmark examiners. The use of photographs has advantages in that:

- Photo images most closely represent what the examiner sees visually under the microscope
- A reviewer can evaluate the conditions in which the identification was made to determine such variables as:
 1. verification that the correct evidence items were actually compared and not inadvertently mixed up.
 2. were the shoulders of rifling impressions in question properly aligned when the agreement was observed.
 3. were the toolmarks being viewed in the same plane (indexed properly) or were they miss-aligned.
 4. were the lighting conditions similar between the exhibits being compared.
- The basis for a positive identification can be easily communicated between examiners and

therefore more readily peer reviewed

- The use of photographs increase the scientific reliability of the method (and our discipline) when properly qualified in the courtroom

As AFTE members we would serve our discipline well to “raise the bar” by requiring photographic documentation of our identifications and thereby more closely define ourselves as a scientific discipline that is peer reviewable and therefore more reliable. By doing so we raise the bar against error. Hodge addressed this issue in 1988 in his paper Guarding Against Error (47) as an essential element to achieving this end. I am in agreement with his arguments in favor of photographic documentation.

Further, I do not believe toolmark identifications can be supported by solely narrative descriptions of the agreement observed. For example, a narrative statement such as “the positive identification was made using striated toolmarks in a land impression and several groove impressions. The identification was made using detail in several land impressions., etc” is an ambiguous statement. We all observe detail in land and groove impressions when we are conducting a toolmark comparison. What is it about the pattern agreement observed in those locations that caused you to come to a conclusion? If I were reviewing the work of another examiner I would have no way of evaluating what was observed to make his or her conclusion. Narratives are useful in articulating the scientific basis for making an identification such as “the agreement I observed exceeds the best known non-match I have seen in my experience, in the literature, or demonstrated by my colleagues and therefore it is my opinion that this bullet was fired from this gun to the exclusion of all other guns”. But a narrative description cannot adequately describe what you have seen under the comparison microscope. Only a photograph can accomplish this.

CONCLUSION

I believe as AFTE members we have an opportunity to bring our discipline more rapidly forward as a science. The courts are looking more and more towards the forensic sciences for reliability. The comparative disciplines involving fingerprints, shoeprints, tire tracks; toolmarks and firearms are under increasing scrutiny by judge and jury alike. We are now being pressed to demonstrate our identifications instead of just talking about them. I can think of no better way to accomplish this than with the use of photographic documentation. Perhaps the significance of this was put into perspective most clearly by Michigan State Supreme Court Justice, Patricia J. Boyle, who addressed our association at the AFTE Banquet during the training seminar at Lansing, MI, on June 20, 1985 (48):

“Judges like juries, are not experts and their attitude toward expert testimony is directly related to their ability to understand it and to their intuitive sense of the integrity of the proposed witness. The ability of a layman to see the striation marks on a bullet, or the comparison points of fingerprints, accomplished more in the way of admissibility of their testimony than all the arguments of all the experts combined and the carefully measured new technique and professionalism of it’s proponents”

I wish to emphasize, however, that I advocate photo documentation of toolmark identification first because it simply is the right thing to do, and secondly because the courts/juries are coming to expect it more and more. I respectfully offer the above comments in the spirit of encouraging further discussion and peer review concerning this topic and look forward to any such dialogue.

REFERENCES

1. Scientific Firearm Identification in Civil and Criminal Cases, A pamphlet advertising Major Calvin Goddard and Associates (Successors to “Bureau of Forensic Ballistics, 4 East 28th Street, New York), circa 1927.
2. Criminal Investigation – A Practical Textbook for Magistrates, Police Officers and Lawyers of Dr. Hans Gross, Edited by John Adam, Crown and Public Defender, Madras and J. Collyer Adam, Public Prosecutor, Madras, Third Edition, London: Sweet and Maxwell, Limited, 2 & 3 Chancery Lane, W.C.2., 1934.
3. Supra #2, p. 172.
4. Supra #2, p. 176.
5. Supra #2, p. 171.
6. The History of Firearm and Toolmark Identification, Hamby and Thorpe, AFTE, Vol. 31, No. 3, 1999, p. 270.
7. Supra #6, p. 274.
8. The History of Firearms Identification to 1930, Colonel Calvin H. Goddard, AFTE, Vol. 3, No. 3, 1999, p. 231.
9. Supra #8, p. 276.
10. The Identification of Projectiles in Criminal Cases, Major Calvin H. Goddard, Military Surgeon, 58(12), p. 142.
11. Fingerprinting Bullets – The Expert Witness, Wesley W. Stout, The Saturday Evening Post during the weeks of June 13 & 20, 1925. Retyped by James Hamby and reprinted by Permission of The Saturday Evening Post, AFTE, Vol. 31, No. 3, 1999, p. 260.
12. Supra #11, p. 261.
13. The Identification of Firearms and Forensic Ballistics, Major Sir Gerald Burrard, New York: A. S. Barnes and Co. 1962, p. 154.
14. Supra #13, p. 175.
15. Textbook of Firearms Investigation, Identification and

Evidence, Major Julian S. Hatcher, Small-Arms Technical Publishing Company, Plantersville, South Carolina, 1935, p. 18.

16. Supra #15, p. 17.

17. Supra #15 p. 19.

18. Supra #15 p. 182.

19. The Identification of Firearms, J. D. Gunther and C. O. Gunther, John Wiley and Sons Inc., 1935.

20. Supra #19, p. 318.

21. Supra #19, p. 315.

22. Photographic Evidence – Preparation and Presentation, C. C. Scott, Kansas City, Mo. Vernon Law Book Company, 1942.

23. Supra #22, p. 293.

24. Firearms Investigation, Identification and Evidence, Major Julian S. Hatcher, Frank J. Jury and Jack Weller, 1957, pp. 225 – 227.

25. Supra #24.

26. Scientific Investigation and Physical Evidence – A Handbook For Investigators, Leland V. Jones, Thomas Books Publisher, Springfield, IL, USA, 1959, p. 91 - 92.

27. Firearms Identification, J. Howard Mathews, The University of Wisconsin Press, Madison, 1962, pp. 46 – 50.

28. Jury Preconceptions and Their Effect on Expert Scientific Testimony, R. L. Tanton, JFS, Vol. 24, #3, p. 681 – 691.

29. An Overview of Firearms Identification Evidence for Attorneys, Parts I – IV, R. J. Joling, AFTE, Vol. 13, No. 4, October 1981, pp. 128 – 148 (originally printed in JFSCA, Vol. 26, No. 1, Jan 1981, pp. 153- 175).

30. Guarding Against Error, E. E. Hodge, AFTE, Vol. 20, No. 3, July 1988, pp. 290 – 293.

31. California Department of Justice Firearms / Toolmark Identification Training Syllabus: Module 7 – Professionalism, A. Biasotti, AFTE Vol. 23, No. 1, January 1991, Section 7B3, p. 576.

32. California Department of Justice Firearms / Toolmark Identification Training Syllabus: Module 7 – Professionalism, A. Biasotti, AFTE Vol. 23, No. 2, January 1991, Section 7F2, p. 729.

33. Supra #32, p. 730.

34. Photography of Identifications Professionalism or Personal Preference?, J. L. Roberts, AFTE, Vol. 23, No. 2, April 1991, p. 694 – 697.

35. Supra #34, p. 695.

36. Photography of Bullets using the Comparison Microscope, C. R. Kriegel and M. Brooks, AFTE, Vol. 26, No. 1, January 1994, pp. 11-17.

37. Handbook of Firearms and Ballistics – Examining and Interpreting Forensic Evidence, B. J. Heard, John Wiley and Sons, 1997.

38. The Scientific Approach – Basic Principles of the Scientific Method, Carlos L. Lastrucci, Schenkman Publishing Company, Inc., Cambridge Massachusetts,

1967.

39. Supra #24 p. 225 – 227.

40. Supra #34 p. 694.

41. Ramirez v. State of Florida, Supreme Court of Florida, #SC92975, Dec 20, 2001 and AFTE Journal, Vol. 34, No. 2, 2002, pp. 215 - 226.

42. supra #41.

43. supra #41.

44. Photographic Evidence, Charles C. Scott, West Publishing, St. Paul, Minn. 1969, Vol. II p186).

45. Websters New Universal Unabridged Dictionary, Barnes and Noble Books, New York, 1992.

46. Comparative Evidence Procedures Manual, Office of the District Attorney, Laboratory of Forensic Services, 4800 Broadway, Sacramento, CA, pp. 2-4.

47. Supra #30.

48. The Role of the Expert Witness, Patricia J. Boyle, Michigan State Supreme Court, speech given at AFTE Banquet during the training seminar in Lansing MI., on June 20, 1985, published in AFTE Vol. 21, No 4, 1989, pp. 639 - 642.