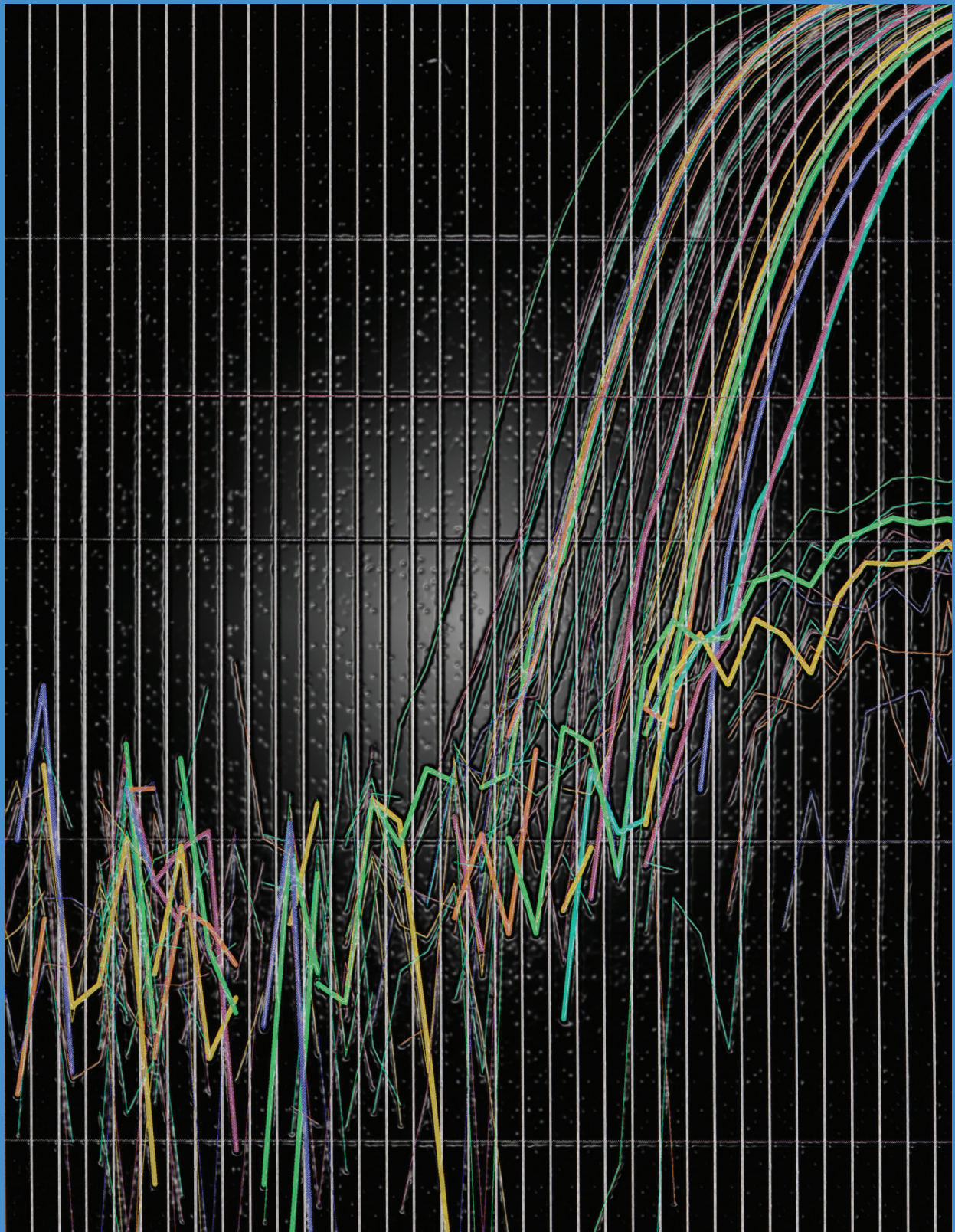


The CACNews

News of the California Association of Criminalists • Second Quarter 2006



The President's Desk

The manager sets the tone for the organization. If the manager doesn't care about his subordinates, that manager will be ineffective, period.

My year as President has gone quickly; by the time you read this I hope I will have completed the tasks I set out to do this year. The Board of Directors and I have worked hard at addressing many long-term issues and will present these to the membership. The questions on handling the semi-annual seminars will be addressed at the next business meeting. In addition, you will have received the by-laws updates, which have been amended to update them with the CAC today. Also, the Board has had to struggle with inconsistencies as its composition changes regarding what is required for advancements to full member. These requirements are now spelled out in the by-laws which will ensure consistency in advancement to full member, thereby letting every new member know what is expected in order to progress from provisional to full member.

The Board of Directors now has an insurance policy to help protect the CAC assets. Anyone who is a member of AFTE knows the importance of Director's Insurance. The other area that I hope to have finished is a space on the website listing the committees, their chairpersons, and the members of the committees along with a description of the job of that committee. The Board of Directors will also have a brief description of their job duties. All of this is to educate and encourage CAC members to be active members.

The CAC is a great organization. I believe a criminalist would be hard-pressed to find a better, ethically based forensic organization. Many of the other organizations are based in part on our code of ethics. There are detractors as to the worth of the CAC, but any member who takes the time to attend the study groups, dinner or luncheon meetings, and the semi-annual seminar will understand that meeting and getting to know the people of this organization is as important as the contents of the meeting. The last two semi-annual seminars met both requirements as Oakland PD and Los Angeles PD did a great job putting on quality programs that addressed the need for information and provided fun social events where our members could meet each other.

Lastly, I had promised to write about "Leadership"; however, due to space and time I will only superficially offer my two cents with respect to the job functions of a criminalist, the criminalist's supervisor, and the criminalist's manager. These are some of the things that I have seen succeed or things that have bothered me in my 30 years in the field.

The criminalist's responsibility is to do his/her job. You are paid to do the work; you are (or should be) well trained in your job function. You chose this field for the interesting work, so have fun with it. Do not worry about your co-worker's time or work production. You *should* worry about your work quality and it behooves you to be aware of your co-worker's work quality. It is essential that you bring misconduct to the attention of your supervisor or management staff. This is a profession; you need to be active in the field and keep learning, if necessary, on your own.

The supervisor has three critical jobs: support, guidance, and accountability. That means you have to help your workers get their jobs done and you need to support your boss in run-

ning the laboratory by keeping him/her informed accurately of your problems and your unit's successes. You need to work as an advocate to provide training, supplies, equipment, and most importantly backing, when your workers are in pressure situations. You also need to recognize good work. You need to hold poor workers accountable. A supervisor also needs to set a good example, supervisors who do not review reports in a timely manner but expect the workers to complete lots of casework are inconsistent. Supervisors who come in late and leave early or are doing personal business, but come down hard on employees for the same faults will garner no respect. It really helps when a supervisor can help with the casework either in offering guidance, second opinions, or taking care of easier analyses to keep your workers working on the more difficult cases. If you only have functional supervision over a unit, those workers just want to know you will support them and aid them where you can.

The manager sets the tone for the organization. If the manager doesn't care about his subordinates, that manager will be ineffective, period. I have been very critical of those managers who have forgotten what it is like to do the work. The manager must support the supervisors but at the same time be very aware of the supervisor's impact on his/her work area. It is important that a manager express the political realities of an organization to the workers; but at the same time it is nice when a manager goes to bat for the analysts and supervisors to stop unnecessary work requests even when faced with strong disagreements from the upper management or the prosecutor's office.

Maybe the most important function of a supervisor or manager is to convey ACCURATELY the feelings, needs, and wants of his/her subordinates. When a supervisor or manager accurately communicates problems or concerns of their subordinates (without commentary) up the chain of command, that supervisor or manager will be trusted by the workers. Workers who respect or trust their supervisor or manager will work harder and say positive things that will help the supervisor or manager look good.

I think the managers and supervisors of laboratories today may be surprised how much work will get done when the staff is happy. After all, isn't the mission of all crime laboratories to complete casework?



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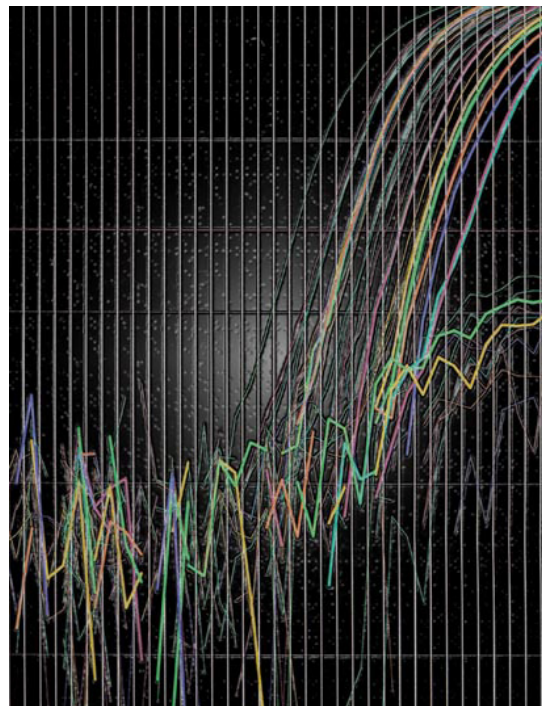
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Because of the computerized typesetting employed in *The CACNews*, submissions should be made in the form of MS-DOS compatible files on CD or by e-mail (ronald.nichols@atf.gov). Text files from word processors should be saved as ASCII files without formatting codes, e.g. bold, italic, etc. An accompanying hardcopy should be submitted along with the file. Graphics, sketches, photographs, etc. may also be placed into articles. Please contact the editorial secretary for details.

The deadlines for submissions are: December 1, March 1, June 1 and August 15.

Second Quarter 2006



On the cover...

A stylized PCR amplification curve is shown. Each vertical line represents a copying cycle, the graph becoming smoother as more and more DNA is manufactured.

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CAC Spring Seminar Announcement

The Contra Costa County Sheriff Criminalistics lab will be hosting the Spring CAC Seminar. This is a joint meeting with our sister organization, the Forensic Science Society from the UK. The Seminar will be held at the Hilton Concord in Concord, CA May 8-12 2006. For more information, contact Paul Holes, 925-335-1600, phole@so.cccounty.us. The CAC website has links to the announcement, a call for papers and an abstract submission form www.cacnews.org/upcoming.htm#seminars.

Southern Section Report

On December 15, 2005 the CAC Southern Section had a luncheon meeting at the Long Beach Police Department training center (*photo*). All eight of the study groups met during the day, including the first joint meeting between the DNA and CSI study groups!

The **DNA Study Group** held a round table discussion of different strategies for evidence sampling, purification, analysis procedures, and casework turnaround times from different laboratories. Additionally, a discussion of instrument platforms took place.

The **Crime Scene Investigation Study Group** had two presenters, Nand Hart-Nibbrig (Crim., LAPD) and Carolyn Gannett (Senior Crim., SDSO), who discussed bloodspatter interpretation and bloodstain analysis. The discussions centered on common sense methods that work at crime scenes.

The **Forensic Alcohol and Fire Debris Study Groups** had a meeting.

The **Trace Evidence Study Group** examined the concept in "The Sign of Three" by Umberto Eco that includes three models of logic (abduction, deduction, and induction) and Dr. Peter DeForest's viewpoint of the direction that criminalistics should be taking, including the reconstruction of crime scenes, but seems to be moving in the opposite direction. They also discussed the up coming SCANNING meeting in

Washington, DC in April and the CAC Spring Seminar in Contra Costa.

The **Toxicology Study Group** had DRE Troy Gielish speak on drug trends. His presentation included an excellent video on drug trends with several short segments on people under the influence of various drugs. One individual in the tape was stopped while driving and fell out of the car when he opened the door. When the person would try to sit up against the car from lying on the ground, he would face plant back into the ground.

The **Drug Study Group** had a guest speaker.

The **Quality Assurance Study Group** accomplished a seven-item agenda that included the upcoming ISO accreditation topics, GSR proficiency tests, future meetings and auditing of laboratories.

A survey was made and distributed over the CAC website and during the Study Group meetings.

The response to the survey was a success with a total of 75 people responding! Not every respondent answered all of the questions creating an unusual skew to the results and some questions permitted more than one answer.

Seventy-seven percent of the respondents admitted to being CAC members—not everyone answered the question. The average length of being employed in criminalistics was just over 11 years with 65 of the 75 respondents answering this question. The median time was 8 years.

The central lab area (OC, LA, Riverside, San Bernardino) represented about 61% of the laboratories with 11% from the north and 24% from the south. Forty-nine percent of the respondents to the question about rotating locations wanted rotating locations, which have been done historically while only 28% wanted one location. Several individuals simply wanted the meetings close to train stations.

Of the study group most wanted, Footwear/Tiretrack was the most asked for at 28%.

Respondents preferred 4 meetings per year with luncheon meetings being the most popular (73%). Thursday was



the chosen day 2:1 over Wednesday, the second most popular day. Somewhat close was whether the CSI and DNA or Trace Study Groups should meet on different days. Having the meetings on the same day at different times edged out having them meet on different days.

Some of the reasons for not attending CAC luncheon meetings included the following: not having topics of interest; notifications of meetings not timely; schedule and locations are not optimal; driving distance; location and child-care issues.

Only nine people indicated that their management or supervisor inhibited or made it hard to attend. Some were not permitted to attend a study group of interest because it wasn't in their current working assignment.

I want to thank all of the people who responded to the survey! Your input will determine the near future of the CAC luncheons.

—Wayne Moorehead
Southern Regional Director, CAC

LA County Coroner Plans Skeletal Workshop

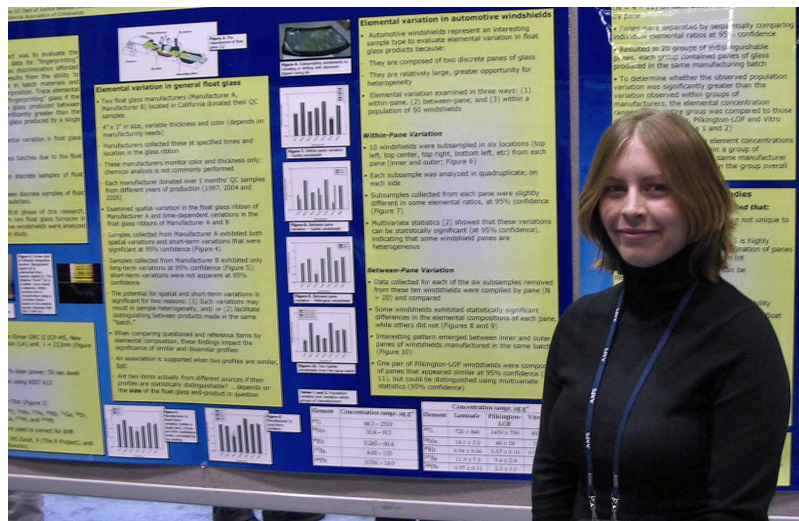
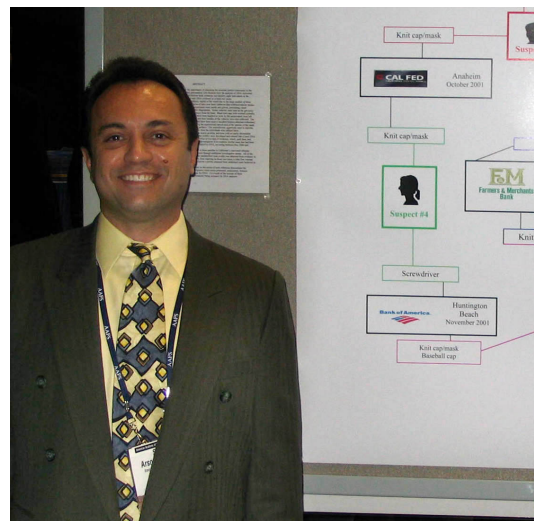
The LA County Coroner will be hosting a POST certified course in the proper techniques for excavation of graves, forensic anthropology, archeology, odontology, entomology, the use of cadaver dogs and proper evidence collection techniques. The course will be held in Los Angeles, May 1-5, 2006. For more information, contact Michelle Sandberg at msandberg@lacoroner.org or visit the CAC website: www.cacnews.org/wordfiles/Skeletal%20Recovery%20Workshop%2020122805.doc

NEAFS Meeting in NY

The 32nd Annual NEAFS Meeting will be held on November 1-4, 2006 at the Tarrytown DoubleTree Hotel in Westchester County, NY.

At the Academy

CAC members were in evidence at the 2006 American Academy of Forensic Sciences meeting in Seattle this February. As an example, two poster sessions are shown below. (left) "A Series of Bank Robberies Linked by DNA From Handled and Worn Items," Sly Arsovski. (right) "Forensic Glass Analysis by LA-ICP-MS: Assessing the Feasibility of Correlating Windshield Composition and Supplier," Abbigayle J. Dodds (co-authored with Donald P. Land and Edward M. Pollock).



For more information please contact Elayne Schwartz at (914) 231-1810 or ess6@westchestergov.com.

58th Annual INTER/MICRO Conference

Talbot Hotel, Chicago, IL, 60611, July 10-14, 2006
CALL FOR PAPERS

The McCrone Research Institute www.mcri.org cordially invites you to participate in Inter/Micro 2006, an internationally recognized professional meeting dedicated to applied microscopy. Please visit the conference website, www.mcri.org/IM_info_page.html, for complete information regarding abstract submission, on-line registration, accommodations, workshops and future announcements.

Abstract Submission Deadline: April 1, 2006

Papers are being solicited in the following subjects:
2006 Sessions

- Photomicrography and Scientific Digital Imaging
- Microscopes (confocal, fluorescence, scanning tunneling, polarizing, etc.)
- White Powder and Bio Terrorism Threats
- Resources, Books, Atlases, Databases
- Historical Topics
- Criminalistics, Forensic Microscopy & Trace Evidence (fibers, explosives, paint, glass, drugs, inks, etc.)
- Pharmaceuticals
- Environmental and Hazardous Dusts, Aerobiology (asbestos, mold, fungal spores, indoor air quality)
- Geographical Sourcing
- Teaching Microscopy/Education
- Microscopy Tricks of the Trade
- Micro-Analytical Methods (SEM/EDS, TEM, FTIR, Raman)
- Other: Industrial Microscopy, Crystallography, Mineralogy

Abstract Guidelines: Please follow these four easy steps:

Abstracts should not exceed 200 words; Abstracts may be submitted by email to intermicro@mcri.org or by mail (zip, floppy and CD accepted); Abstracts should include: title, author name(s), company name, address, telephone, fax, and e-mail address; Accepted formats are Word, rich text formatted or unformatted text.

Authors will be notified if their abstract has been accepted or rejected.

Speaker Information: LCD projectors, overhead and 2x2 slide projectors will be available. Speakers should prepare for a 15 - 20 minute talk, plus 2-3 minutes for questions/comments. Speakers are invited to the hospitality suite for the breakfast or lunch prior to their presentation, in order to load files onto the Inter/Micro laptop or make other preparations for their talk.

Registration: If you cannot register on-line please email, fax or call McRI to request that we send you a registration form. Any other questions may also be directed to: intermicro@mcri.org, 312-842-7100 or 312-842-1078 (fax).

We look forward to seeing you in Chicago at the 58th Annual INTER/MICRO 2006 conference!

Time to Suggest Candidates for Awards

Please submit names for candidates for both the Paul Kirk/Presidents Award and the Longhetti Distinguished Member Award. Each award has a nomination period of April 1-July 1.

Distinguished Member Award criteria:

1. The candidate must be a member of the CAC (in any category).
2. The candidate must have contributed significantly to the Association in one or more of the following areas:
 - a. Long term service to the Association as a member of the Board of Directors or in committees.
 - b. Sustained production of papers or technical notes in newsletters or at seminars.
 - c. Organization of study groups or workshops, etc.
 - d. Significant research and dissemination of the information to the Forensic Science community (i.e. journal or newsletter publications, seminar papers, workshops, study groups, etc.)
 - e. Any other unusual or significant contributions to the improvement of the profession Criminalistics.

The CAC Paul Kirk Presidents Award was established to recognize outstanding new members to the profession of criminalistics. This is a joint award with our sister organization, the Forensic Science Society of the United Kingdom. Every other year the CAC selects one member to send to a meeting of the Society. The travel and meeting expenses are covered by the two organizations.

Self-nominations will not be accepted. Candidates must be members of the CAC in any status, and must be employed in the profession for fewer than six years. Employment in the field is defined as full-time employment and shall not include time in pre-professional positions, such as an intern or laboratory technician. During the six-year qualifying period, the

candidate should have demonstrated an interest in a professional organization, not limited to the CAC.

—Alicia Lomas Gross & Mey Tan

Windshield Corrections

I believe there are three errors in the article "Determination of Elemental Homogeneity in Automotive Windshields by LA-ICP-MS" in the [4th Quarter, 2005] issue of *The CACNews*. In the text of the paragraph Instrumentation, it states: "Spot ablations of 60 mm in diameter and 100 mm in depth were" I believe that should be 60 um and 100 um respectively. Also, if the size marker of 14 um in Figure 2 is correct, then the diameter of the ablation is closer to 150 um not 60 um in size.

—Linda French

California Association of Criminalists

2006 FALL SEMINAR

Pechanga Casino and Resort Temecula, California **October 9th - 13th**

**The Climate of Crime:
Hot Topics & Cold Hits**

Hosted by
**The California Department of Justice
Riverside Laboratory**

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The Editor's Desk

Remember when...

Remember when packed column gas chromatography was the method of choice for fire debris? A colleague looked at a chromatogram of a standard sample using capillary columns and his immediate reaction—"There's too much information!"

Remember when an explanation as to why certain work was not done was actually compelling to a prosecutor in pre-C.S.I. days?

Here's one of my favorites. I remember when a firearms examiner wanted to do some test firing of a hand gun. He stepped into the reception area of the laboratory, asked the administrative clerk to leave the room and then shut the door. We put on muffs, re-adjusted the cotton recovery box on top of the filing cabinets and then proceeded to test fire the gun – right there in the reception area. Looking back I still wonder what the cotton box backed up on!

Spring training is here...

Here is another "remember when?" Remember the last time the Giants won a World Series? I don't—as it has not occurred in my lifetime. In all honesty, I am having a hard time getting fired up about this year's edition. They have been touted as having the best line-up in the West, provided they can actually stay in the line-up and out of the trainer's room.

Terms are called terms for a reason...

The CAC has need for individuals interested in serving, especially in positions on the Board of Directors. A number of terms end each year and if this organization is to maintain its vitality, fresh faces and ideas are so important. Please contact your nominating committee if you have interest.

On a related note, my term as Editorial Secretary is set to expire in May of 2007 and given some very important future goals it appears I will not be able to fulfill another two-year term. Besides, who wants to read more ranting about the Giants and Dodgers anyway? That being said, if anyone has an interest in knowing more about the duties of the Editorial Secretary please let me know and I will do all I can to answer your questions and help guide you through the process.

The responsibility lies with...

I remember early on in my career when I would get quite perturbed at those who would question the work that is being performed. The challenges were incoherent because the intricacies of the discipline were not understood. Those leveling the charges could best be described as legal experts but little more. How dare they question something about which they have some information, though not enough? If only they would do the research, then they would understand. But, then

What remains is for examiners to put this wealth of background into practice through good, solid practice and then, just as importantly, learn how to communicate the intricacies of the discipline to a non-scientific audience.

I realized something as I was pointing a finger at them—three more were pointing right back at me.

If you read this issue's response to a recent criticism published in the law literature, you will see that there is a wealth of material to support the scientific background of the firearms and tool mark discipline available in the scientific literature. I am certain that such is the case with the variety of disciplines within forensic science. Given that, shouldn't that be enough? Quoting Captain Kirk from *Star Trek VI: The Undiscovered Country* we might want to proclaim, "Has it occurred to you that this crew is due to stand down in three months? We've done our bit for king and country!"

Well, actually I do not think it is enough. First, while it may be published, this material is rarely ever found in one place. In addition, little if any of the material is completely comprehensive, such that a single discipline is handled in an "A-to-Z" type format. What we have is bit parts of the puzzle, generated through decades of work, throughout an international community, published in some of the most unreachable places of our galaxy.

Getting back to a "remember when", I remember when I was assigned a bunch of reading material for my training as an expert in

Please turn to page 30



Ron Nichols
CAC Editorial Secretary

The Scientific Foundations of Firearms and Tool Mark Identification— A Response to Recent Challenges

by Ronald Nichols

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MASSACHUSETTS

UNITED STATES OF AMERICA,)
)
v.) CRIMINAL. NO. 02-10301-NG
)
DARRYL GREEN, et al.,)
Defendants)
GERTNER, D.J.:

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Recently, an article was published in *The Columbia Science and Technology Law Review* entitled "A Systemic Challenge to the Reliability and Admissibility of Firearms and Toolmark Identification."¹ The author, Dr. Adina Schwartz, is an Associate Professor with the John Jay College of Criminal Justice and the Graduate Center, City University of New York. Dr. Schwartz uses the framework of an *amicus* brief written on behalf of the defense in the case *United States v. Kain*² to expound on her arguments as to why "all firearms and tool mark identifications should be excluded until the development of firm statistical empirical foundations for identification and a rigorous regime of blind proficiency testing."³

Outlining her treatise, Schwartz first discusses the scientific issues related to firearms and tool mark identification. These scientific issues include:

The types of tool marks: *Class, Subclass and Individual.*

Three major sources of misidentification:

- *Individual characteristics are comprised of non-unique marks;*
- *Subclass characteristics may be confused with individual characteristics;*
- *Individual marks of a particular tool change over time.*

A call for statistical treatment using DNA as an analogy; The lack of adequate proficiency testing; Fundamental problems not cured by development of "computerized firearms database."

Subsequent to her discussion of the scientific issues, Schwartz discusses some of the case law related to firearms and tool mark identification. She does this to illustrate, in her opinion, that, "no state or federal court – either before or after *Daubert*—has understood the scientific problems with firearms and toolmark identification."⁴

The purpose of this article is to review and assess the arguments made by Schwartz and to evaluate the basis of support cited to support those arguments. It will be demonstrated throughout this article that the challenge offered by Schwartz is not as substantiated as an uncritical review of her article would suggest. There are numerous instances in which studies and articles are inappropriately quoted or inaccurately paraphrased. During the discussion of some of the scientific issues, there is an apparent lack of understanding of the relative significance as applied to the science of firearm and tool mark identification. While the author was apparently aware of the large number of articles available that can be used to address many of these issues, there was no mention of them made in her argument.⁵ Furthermore, there were instances in

1 Schwartz, Dr. Adina. "A Systemic Challenge to the Reliability and Admissibility of Firearms and Toolmark Identification." *The Columbia Science and Technology Law Review*, Volume VI, 1-42.

2 *United States v. Kain*, Crim. No. 03-573-1 (E.D. Pa. 2004). Subsequently published as "A Challenge to the Admissibility of Firearm and Toolmark Identifications: *Amicus* Brief prepared on Behalf of the Defendant in *United States v. Kain*, Crim. No. 03-573-1 (E.D. Pa. 2004)." *The Journal of Philosophy, Science, & Law*, Vol. 4, December 7, 2004.

3 *Supra* note 1, at 42.

4 *Supra* note 1, at 3.

5 Personal communication with Bruce Moran, Criminalist with the Sacramento County District Attorney's Forensic Science Laboratory via e-mail on April 16, 2005. Moran provided Dr. Schwartz with personal notes citing in excess of 100 different citations dealing with

which research into some of these primary resources, rather than reliance on some secondary resources, would have been much more enlightening.

It would also appear that when the case law is examined in a fuller context than that offered through the brief quotes and paraphrases by Schwartz, there is evidence that shows the courts are more aware of the relevant scientific issues than she gives them credit for. In addition, the lack of context for some of the quotes and paraphrases used in the article does a significant disservice to the reader of Dr. Schwartz's work.

I. Firearms and Tool Mark Identification is Rooted in Sound Scientific Foundations

A careful and thorough review of the literature will demonstrate that the discipline of firearms and tool mark identification is firmly rooted in the application of the scientific method, culminating in the definition of a theory of identification by the relevant scientific community associated with the discipline. The great majority of the study in this discipline follows the premise of the scientific method. This process defines a problem, formulates a hypothesis or tentative explanation, designs and executes an experiment to test the hypothesis, making observations, and interpreting the results to determine the reasonableness of the tentative explanation. At this point it would be appropriate to test the hypothesis further, adjusting some newly defined variables or, form a new hypothesis all together and perform more experiments. This cycle is repeated as many times as is necessary. A hypothesis that has successfully stood the test of many experiments with different variables can be established as a theory.

The scientific basis of this discipline is criticized in Part II of Schwartz's article. Yet, she does this without once either referring to or citing the AFTE Theory of Identification. The Theory of Identification is the work of the relevant scientific community, a careful reading of which would help answer some of the claims made by Schwartz. It reads:

[a] The theory of identification as it pertains to the comparison of tool marks enables opinions of common origin to be made when the unique surface contours of two tool marks are in "sufficient agreement."

[b] This "sufficient agreement" is related to the significant duplication of random tool marks as evidenced by the correspondence of a pattern or combination of patterns of surface contours. Significance is determined by the comparative examination of two or more sets of surface contour patterns comprised of individual peaks, ridges and furrows. Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours. Agreement is significant when it exceeds the best agreement demonstrated between tool marks known to have been produced by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool. The statement that "sufficient agreement" exists between two tool marks means that the agreement is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.

[c] Currently the interpretation of individualization/ firearm and tool mark identification.

identification is subjective in nature, founded on scientific principles and based on the examiner's training and experience.⁶

Schwartz identifies three central concerns dealing with the issue of firearms and tool mark identification, characterizing them as "central pitfalls."⁷ Rather than "pitfalls" it will be shown that they would be better addressed as critical issues of which conscientious examiners are aware.

A. Critical Identification Issues Do Not Undermine Its Evidentiary Value in Court

The literature has identified three central identification issues that do not undermine the evidentiary value of firearms and tool marks identification evidence in court because it has been demonstrated that they can be readily identified and addressed in the regular course of a conscientious evidence examination. These issues are the establishment of a criterion for identification, the potential for subclass characteristics, and the change a tool surface undergoes over time.

1. The Criterion for Identification Is Defined In the AFTE Theory of Identification

The AFTE Theory of Identification coupled with the comparative analysis and examination method upon which it is based, along with extensive studies in the literature and the individual training, experience, and expertise of examiners adequately addresses the primary question of the court – was this tool mark produced by this tool? This can routinely be accomplished despite the recognized and established fact that tool marks produced by different tools may display some level of similarity.

Schwartz cites this fact as a pitfall to the issue of identifying two tool marks as produced by the same tool. In doing so, she cites several references but does so in an incomplete manner such that the reader is left with the impression that it is an issue that the discipline has either ignored or produced little answer for. Considering that the criterion for identification is an issue of central concern for the discipline, she would do well to discuss it in its fuller and more complete context.

Schwartz says,

As a result of the overlapping individual characteristics of toolmarks made by different tools, examiners who assume that a certain amount of resemblance proves that the same tool produced both test and evidence toolmarks may be wrong because the same amount of resemblance may exist in toolmarks produced by different tools of that type.⁸

When making this statement she ignores that this represents only a part of the criterion for identification as specified in the AFTE Theory of Identification. Prior to rendering a call of same source, the examiner must also observe agreement that "is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool."⁹

That trained examiners can distinguish between tool

marks made by different tools has been established through controlled studies pursuant to the tenants of the scientific method. These have been summarized elsewhere.^{10,11} What the reader should note is that many of these studies were performed using consecutively manufactured tools which by their very nature are expected to contain more similarity than tools manufactured otherwise. These studies do demonstrate that the Theory of Identification is sound and has a scientific basis.

Schwartz highlights several articles to demonstrate the severity of the issue. In doing so, she takes many out of context and relies on secondary resources instead of going to the original. When addressing that there are some identifications that may be missed due to a small sample size, such as a fragment, Schwartz cites a list of questions developed by Murdock as a source. Specifically, she writes,

See e.g., John E. Murdock...(stating that a "considerable amount of agreement" among striated toolmarks made by different tools is especially likely to be found "if the width of the mark being compared is quite small [say, two millimeters or less]")...¹²

The implication here is clear. If the tool marks are small, on the order of 2mm or less, then one can expect considerable agreement likely leading to false identifications. However, Murdock was a secondary source with regard to this issue of 2mm, not the primary source that he cited as a reference. The primary source of Butcher and Pugh simply set this 2mm size as a standard point for the study that was to be undertaken. At no point did they suggest that there would be a higher likelihood of considerable agreement in marks less than 2mm wide.¹³

Schwartz continues to emphasize the "significance of these problems" by citing statistics from some well-known studies in the discipline. She writes,

The significance of these problems is illustrated by findings that up to 25% of the striae in toolmarks made by different screwdrivers of the same brand matched, while the percentage increased to 28% when comparing toolmarks made by different bolt cutters of the same brand. Similarly, in a classic, statistical empirical study in 1955, Alfred A. Biasotti found that 15 to 20% of the striae on bullets fired from different .38 Special Smith & Wesson revolvers matched.¹⁴

The review of the primary sources produces a different perspective than that offered by Schwartz. The 25% corre-

6 AFTE Criteria for Identification Committee. "Theory of Identification, Range of Striae Comparison Reports and Modified Glossary Definitions – an AFTE Criteria for Identification Committee Report." AFTE Journal, Vol. 24, No. 2, April 1992, 336-340.

7 *Supra* note 1, at 5.

8 *Supra* note 1, at 6.

9 *Supra* note 6.

10 Nichols, R. "Firearm and Toolmark Identification Criteria: A Review of the Literature." Journal of Forensic Sciences. Vol. 42, No. 3, May, 1997, 466-474.

11 Nichols, R. "Firearm and Toolmark Identification Criteria: A Review of the Literature – Part 2." Journal of Forensic Sciences. Vol. 48, No. 2, March, 2003, 318-327.

12 *Supra* note 1, at 6-7, n. 13.

13 See, e.g., Butcher, S. and Pugh, D., "A Study of Marks Made By Bolt Cutters," Journal of the Forensic Science Society, Vol. 15, No. 2, April, 1975, 120 (stating "We set a minimum of 2mm as the extent of the matching area. This limit was chosen mainly as a result of experience. In case work it is occasionally necessary to examine marks less than 2mm wide, but such marks can introduce special problems associated with the number of lines in the pattern. In our experience a mark 2mm wide will normally contain sufficient lines to allow for an accurate assessment of whether test and suspect mark correspond.).

14 *Supra* note 1, at 7.

spondence was in a single KNM comparison¹⁵, the 28% was the highest of 880 KNM comparisons in which only three approached the figure of 28%¹⁶, and Biasotti found that the percentage of matching lines should not be used as an indicator of same source¹⁷. If not already aware, the reader should know that because of these issues with the potential for an unusually high percentage of matching lines in a known, non-match situation, the straight percentage of matching lines is not the commonly accepted practice in the relevant scientific field.

Schwartz concludes her argument by citing a “study”¹⁸ by Joseph Masson¹⁹, who happened to be the tool mark expert involved in the aforementioned *United States. v. Kain*. In this discussion the author displays a lack of fuller understanding of the purpose of the IBIS system and how it works. She also highlights the Masson “study” making it look like a treatise on the subject when it is nothing more than a one-page technical note, once two photographs and the abstract are removed. In no way is there an attempt to belittle the offering made by Mr. Masson to the scientific community, but to characterize his contribution as a “study,” offers it far more credibility than it deserves.

If one were to read Masson’s article, one will quickly observe that the entire point of the article was to encourage firearms examiners to use IBIS as a tool to gain even more familiarity with known non-match comparisons. As already stressed, such comparisons are vital because it is through these comparisons that firearm and tool mark examiners establish their baseline for their own criterion for identification.

Schwartz mischaracterizes what little was offered. She writes,

15 See, e.g., Burd, D. and Kirk, P., “Tool Marks: Factors Involved in Their Comparison and Use as Evidence,” *Journal of Police Science*, Vol. 32, No. 6, 1942, 465 (stating “Figure 4 illustrates how greatly two seemingly smooth edges on two tools of standardized manufacture will differ with respect to the marks they produce. Although in a comparison of two marks made by the same edge more than 80% of the lines matched, in *this case* [emphasis added] the percentage of matches is from 20-25%. It becomes immediately obvious that the number of matching lines in itself has no significance since in marks made with different tools one can find a considerable number of chance matches if the total number of lines is high. (A concept extensively detailed in a mathematically modeled study performed by Brackett. See, e.g., Brackett, J. “A Study of Idealized Striated Marks and Their Comparison Using Models.” *Journal of the Forensic Science Society*, Vol. 10, No. 1, Jan. 1970, pp. 27-56. Schwartz does not cite this study, which is vital to a comprehensive understanding of identification criteria.) The proportion of matching lines, on the other hand, will never be high unless the contour is very similar which in turn will not happen except when the same tool has been used.”)

16 *Supra* note 13.

17 See, e.g., Biasotti, A., “A Statistical Study of the Individual Characteristics of Fired Bullets.” *Journal of Forensic Science*, Vol. 4, No. 1, Jan. 1959, 37-39 (stating “it will be seen that the average percent match for bullets fired from the same gun ranged from 36 to 38% for lead bullets and from 21 to 24% for metal-cased bullets. For bullets fired from different guns (not tabulated) 15 to 20% matching lines per land or groove mark was frequently found. Relatively speaking this data indicates that even under such ideal conditions the average percent match for bullets from the same gun is low and the percent match for bullets from different guns is high, which should illustrate the limited value of percent matching lines without regard to consecutiveness.”).

18 *Supra* note 1, at 7.

19 Masson, J. “Confidence Level Variations in Firearms Identifications Through Computerized Technology.” *AFTE Journal*, Vol. 29, No. 1, Winter 1997, 42-44.

...finding that as the IBIS database grew for guns of a particular caliber, increasing similarities were discovered in the individual characteristics of tool marks on ammunition components known to have been fired by different guns of that caliber. The similarities between known non-matching tool marks were sometimes *so great* [emphasis added] that even under a comparison microscope, it *was difficult to tell the tool marks apart and not erroneously attribute them to the same gun* [emphasis added].²⁰

This statement has great implications. However, it would have been much more accurate to quote Masson in lieu of offering an inaccurate paraphrase. Here is what Masson offered.

As the database grew within a particular caliber, 9mm for instance, there were a number of known non-matched test fires from different firearms that were coming up near the top of the candidate list. When retrieving these known non-matches on the comparison screen, there were numerous two dimensional similarities. When using a comparison microscope, these similarities are still present and it is difficult to eliminate comparisons even though we know they are from different firearms.²¹

The use of the words, “*so great*” is not supported by Masson’s statement. In addition, the author’s characterization of Masson’s conclusion is not quite what the author said.

As a final statement with regard to this particular issue of IBIS, the system has never been offered as a means of “computerized firearms identification”²² or as implied by Masson in the title of his article. IBIS is a tool, similar to the AFIS system, used by the fingerprint community. This tool is designed to search a database of information and offer the examiner an opportunity to compare two items that may share a common source.

The author uses this opportunity to open a discussion about the databases that do and do not exist. She writes that,

Masson’s study implies that, due to the absence of non-firearms toolmark databases and the incomplete databases for firearms toolmarks, misidentifications *are likely to* [emphasis added] result because examiners underestimate the possible similarities between the individual characteristics of toolmarks made by different tools.²³

A full read of the article will quickly show that Masson never implied any of this. Furthermore, the last part of the statement can be considered true only by removing “are likely to” and replacing it with “can.” This paraphrase is the opinion of the author, and is not supported to any extent by Masson’s study. Furthermore, if there is a study showing a direct link between the absence, or incompleteness, of databases and the likelihood of an examiner to underestimate the possible similarities between tools, I have yet to see one.

The issue of identification criteria is a central one for any identification discipline including firearms and tool mark identification. It is expected that tool marks having differing origins will have coincident similarities. A multitude of studies in combination with training, education, and experience demonstrates that this is not an insurmountable obstacle. Furthermore, the relevant scientific community has developed a

20 *Supra* note 1, at 7-8.

21 *Supra* note 19, at 42.

22 *Supra* note 1, at 1.

23 *Supra* note 1, at 8.

theory of identification that deals with this issue in a concise and tested format.

2. The Potential for Subclass Characteristics is Discernible

Knowledge and study of manufacturing processes of tools, in combination with the many studies addressing the issue of subclass characteristics, assist a trained and qualified examiner in easily discerning their potential for interference in comparative casework. Schwartz sums up the potential difficulty very well in the very first sentence in her discussion with regard to the issue of subclass characteristics. She writes, "A tool may also be wrongly identified as the source of a toolmark it did not produce if an examiner confuses subclass characteristics shared by more than one tool with individual characteristics unique to one and only one tool."²⁴ She continues with an analogy of fingerprints and DNA. However, since neither deals with subclass characteristics in a manner even approaching that of tool mark identification, their inclusion is irrelevant and only muddies the waters.

In her discussion, Schwartz acknowledges that, "...wear and tear on some tools may cause the subclass characteristics on their toolmarks to be completely replaced by individual characteristics..." while warning that "...subclass characteristics may persist alongside individual characteristics."²⁵ In support of this statement Miller's article²⁶ is referenced with Schwartz paraphrasing, "...finding both subclass and individual characteristics on the striated toolmarks on both land and groove impressions of bullets fired by used guns."²⁷ Not offered was Miller's contention that a correct identification of the bullets would not be affected by the presence of subclass characteristics and that it was difficult to find areas where subclass characteristics were even an issue.²⁸

Schwartz then goes on to criticize firearm and tool mark examiners, for seemingly ignoring this very evident problem.

Despite their knowledge of this variation, firearms and toolmark examiners have not formulated any generalizations or statistics about which types of tools can be expected to produce toolmarks with subclass or individual characteristics when they are newly manufactured. Nor have they developed statistics or generalizations about the rate(s) at which subclass characteristics on toolmarks produced by various types of tools can be expected to be replaced and/or joined by individual characteristics.

Firearms and toolmark examiners have also failed to develop any rules for distinguishing between subclass and

individual characteristics. To avoid confusing subclass characteristics shared by more than one tool with individual characteristics unique to one and only one tool, examiners can only rely on their personal familiarity with types of forming and finishing processes and their reflections in toolmarks.²⁹

Four charges are leveled against the discipline in the above passage. The first is that no generalizations exist with regard to which types of tools might produce subclass characteristics when newly manufactured. The second is that no statistics or generalizations have been made regarding when subclass characteristics might be replaced or joined by individual characteristics. The third is that rules for distinguishing between subclass and individual characteristics do not exist. The fourth is that a limitation does exist because examiners can only rely on their personal familiarity with finishing processes and how they impact the tool surface. These will be handled in turn.

a. Generalizations do exist with regard to the potential for subclass characteristics on newly manufactured tools

Beginning as early as 1949, there has been recognition of potential subclass issues when comparing tool marks produced by different tools, which has resulted in well-defined generalizations and applications in comparative casework. Schwartz makes the assertion that we have not, "formulated any generalizations [emphasis added] or statistics about which types of tools can be expected to produce toolmarks with subclass or individual characteristics when they are newly manufactured."³⁰ Miller's article previously cited by Schwartz contradicts that very statement.³¹

Miller's is not the only article in which subclass issues were identified and connected with the tool working process from which they emanated. In a recent study published in 2004, 19 different references were cited that were of import to the definition, recognition, and interpretation of subclass characteristics.³²

In 1949, Churchman observed subclass characteristics on bullets that had been fired from consecutively made, broach-cut rifled, rifle barrels.³³ In 1975, Skolrood made similar observations when examining three similar barrels, although these barrels are now being manufactured by a different company than at the time of the Churchman study.³⁴ Although not designated as subclass characteristics, Lomoro observed "family characteristics" on bullets fired from different guns. This carryover was only on the groove impressions and was attributed to a worn or very poor rifling tool used to cut the grooves.³⁵

29 *Supra* note 1, at 9.

30 *Ibid.*

31 *See, e.g.,* Miller, J., n. 26, 126 (stating, "Many articles and reported studies have shown that subclass characteristics will occur on the groove impressions rather than the land impressions. This is due to the manufacturing process, type of rifling method used, and the steps followed within the manufacturing process after rifling.).

32 Nichols, R. "Firearm and Tool Mark Identification: The Scientific Reliability and Validity of the AFTE Theory of Identification Discussed Within the Framework of a Study of Ten Consecutively Manufactured Extractors." *AFTE J.*, Vol. 36, No. 1, Wint. 2004, 67-88.

33 Churchman, J. "The Reproduction of Characteristics in Signatures of Cooley Rifles." *R.C.M.P. Gazette*, Vol. 11, No. 5, May 1949, 133-140.

34 Skolrood, R. "Comparison of Bullets Fired From Consecutively Rifled Cooley .22 Caliber Barrels." *Canadian Society of Forensic Science Journal*, Vol. 8, No. 2, 1975, 49-52.

35 Lomoro, V. "Class Characteristics of 32 SWL, F.I.E. Titanic

24 *Ibid.*

25 *Supra* note 1, at 9.

26 Miller, J. "An Examination of the Application of the Conservative Criteria for Identification of Striated Tool Marks Using Bullets Fired From Ten Consecutively Rifled Barrels." *AFTE Journal*, Vol. 33, No. 2, Spring 2001, 125-132. Schwartz is inaccurate in her reference with regards to volume number for this particular article.

27 *Supra* note 1, at 9, n. 24.

28 *See, e.g.,* Miller, J., n. 26, 128 (stating "Although some striae present in the land and groove impressions of the bullets fired from consecutively rifled barrels could be the result of subclass influence, none of these features affected the correct identification of the bullets. None of the areas examined between different bullets were of sufficient quality to lead to a misidentification. In fact, it was difficult to find areas that could be considered as having been produced by a subclass source.").

These three studies alone, demonstrate how one can move from generalizations to specific application. These three studies linked subclass characteristics on groove impressions with broach or otherwise cut rifling. In cut rifling, the metal of the barrel (grooves only) is cut away by a sharp bladed tool. If the surface of this tool responsible for the cutting has an imperfection, it can be transferred to the cut surface. This imperfection can be transferred to the surface of the next barrel in sequence to be cut if the imperfection is durable and does not change. If one were to examine a cast of the bore of a firearm, such characteristics would have to exist for the entire length of the cut surface. If a certain characteristic appeared after the cut surface had already started, then it would be an imperfection caused by the current process. If it disappeared before the end of the cut surface, then it is gone and by definition, its absence cannot be passed onto the next cut surface. Therefore, the only characteristics capable of being defined as subclass would be those that persist for the entire length of the cut surface. In this case we have moved from a generalization to a specific application and understanding of distinguishing between subclass and individual characteristics.³⁶

Murdock recognized a significant issue in that some barrels were not formed with a cutting process but a swaging process.³⁷ In such a process, the barrel is drilled (leaving tool marks perpendicular to the axis of bullet travel) and a button is passed down the barrel. Having a negative impression of the rifling, the button actually pushes metal out of the way, forming the rifling instead of cutting it. Such a process is significantly different than the cutting approach because in a swaging method no metal is removed.

Qualified and trained examiners consider the process. When a button is passed down a barrel, it does so under a tremendous amount of pressure. As such, it tends to polish tool marks that are already present (from the drilling process) and not impart any other markings except those that appear as imperfections on the portion of the button that comes into actual contact with the bore. This particular issue was observed to be taking place when Matty examined bullets from barrels produced from a single button-rifled blank (one long button rifled barrel sectioned into three smaller barrels).³⁸

Biasotti addresses both of these general types of rifling methods (cut and swage). He offers reasoning as to why subclass characteristics are not necessarily common and offers some appropriate words of caution to an examiner.³⁹ In

a study of the same broach-cut rifled barrels used by Biasotti in his CMS study⁴⁰, Tulleners and Hamiel examined both lead and jacketed bullets specifically for subclass characteristics and found them present on only some barrels and none on land impressions.⁴¹

In addition to barrels, those parts of the firearm that can come into contact with the cartridge case have also been studied and can be used to aid in our discussion of subclass characteristics. One of the first was a study performed on consecutively manufactured Smith & Wesson firing pins.⁴² It was observed that the circumferential tool marks on the surface of the firing pins, caused by their being turned in a lathe, displayed remarkable similarity among the firing pins. As a result, firearm and tool mark examiners are aware that such marks are not wholly reliable for identification to a specific firearm.

Breech face marks can be cut, milled or stamped. In each instance, subclass characteristics may be produced.^{43,44,45,46} As a result of such studies, firearm and tool mark examiners are alerted to the generalization that such processes can result in subclass characteristics. Marks, apart from those produced by the manufacturer, are commonly used for identifications for this very reason. In addition, when suspicion of subclass is high and cannot be resolved, examiners will routinely look to other marks, such as chamber marks, that are not as susceptible to subclass influence.

Advances in technology have included the use of computer numerical controlled (CNC) machining for more efficient tooling of various tools, including parts of firearms.⁴⁷

(forge)]. The first is the random nature and rapidity with which the toolmarks produced by "cut" type rifling methods change within a single barrel, or consecutively rifled barrels. Secondly, the toolmarks remaining in "swage" type rifling are predominately perpendicular to the axis of bullet travel. A possible exception to this generalization is the rare case where barrel blanks, are cut into multiple barrels; or where a swage or broach rifling tool with gross defects is capable of producing axial toolmarks that can be seen to extend the entire length of the bore. This latter case should present a problem to the examiner only where the questioned barrel is not available for examination. In those cases where the barrel is not available for examination, the examiner should use the toolmarks made by the lands or forcing cone to confirm an identification." This article is accompanied by photographic documentation of various tool marks to be found in rifled barrels.

40 *Supra* note 17.

41 Tulleners, F. and Hamiel, J. "Sub Class Characteristics of Sequentially Rifled .38 Special S&W Revolver Barrels." *AFTE Journal*, Vol. 31, No. 2, Spring 1999, 117 (stating "These subclass characteristics were present on some, but not all of the ten sequential barrels and in some but not all of the groove impressions... These subclass characteristics were not found on the land impressions of the fired lead bullets or on the land or groove impressions of the copper-jacketed bullets.").

42 Matty, W. and Johnson, T. "A Comparison of Manufacturing Marks on Smith & Wesson Firing Pins." *AFTE Journal*, Vol. 16, No. 3, July 1984, 51-56.

43 Lardizabal, P. "Cartridge Case Study of the Heckler and Koch USP." *AFTE Journal*, Vol. 27, No. 1, Jan. 1995, 49-51.

44 Thompson, E. "False Breech Face Id's." *AFTE Journal*, Vol. 28, No. 2, Apr. 1996, 95-96.

45 Matty, W. "Lorcin L9MM and L380 Pistol Breechface Tool Mark Patterns." *AFTE Journal*, Vol. 31, No. 2, Spring 1999, 134-137.

46 Lopez, L. and Grew, S. "Consecutively Machined Ruger Bolt Faces." *AFTE Journal*, Vol. 32, No. 1, Winter 2000, 19-24.

47 *Supra* note 32, at 74 (stating, [Such machining has] allowed many different tooling operations that might be performed on a single

Revolvers." *AFTE Journal*, Vol. 6, No. 2, April 1974, 18-21.

36 This is in direct contradiction to the charge made in the third charge to be discussed. In addition, such reasoning extends to all surfaces cut by tools. Whether it is a breech face that was cut with a broach, rifling that was cut with a broach, or the teeth of pliers that were cut by a broach, the principles of metal cutting extend to many different types of tools.

37 Murdock, J. "A General Discussion of Gun Barrel Individuality and an Empirical Assessment of the Individuality of Consecutively Button Rifled .22 Caliber Rifle Barrels." *AFTE Journal*, Vol. 13, No. 3, July 1981, 84-111.

38 Matty, W. "A Comparison of Three Individual Barrels Produced From One Button Rifled Barrel Blank." *AFTE Journal*, Vol. 17, No. 3, July 1985, 64-69.

39 See, e.g., Biasotti, A. "Rifling Methods - A Review and Assessment of the Individual Characteristics Produced." *AFTE Journal*, Vol. 13, No. 3, July 1981, 34-61 (stating, "Two factors virtually assure that a unique set of individual characteristics will be reproduced in barrels rifled consecutively by the current rifling methods evaluated [hook cutter, scrape cutter, broach cutter, button swage, and hammer swage

Despite observing subclass characteristics on bolt faces that were broach cut through the use of CNC machining, each of the bolt faces was unique enough to permit individualization.⁴⁸ In a similar study involving anvil marks on .22 caliber cartridge case rims, the author observed significant subclass characteristics to exist on the breech end (not the bore but the actual rear face of the barrel) on consecutively machined barrels.⁴⁹

Ten consecutively made extractors were recently studied for their potential for subclass characteristics.⁵⁰ In this study, it was observed that there was significant persistence of subclass characteristics on two of the machined surfaces of the extractor. Detailed with photographs, the study demonstrated the importance of not only the presence of subclass characteristics but also, the importance of understanding how tools and surfaces interact to determine if the subclass characteristics, while present, are even relevant. Specifically,

Two of the extractor surfaces exhibited significant subclass carryover among all ten extractors. One of the surfaces was on the beveled surface on the forward edge of the extractor hook.... The other surface was on the underside of the hook, limited to the area adjacent to the beveled surface at the base of the channel of the extractor hook.... Yet, results demonstrate that the presence of such subclass characteristics did not have any impact on the ability to distinguish between marks produced by each of the ten extractors. One likely reason is the ridge that is formed on the corners to which these surfaces are adjacent.... they [ridges] protrude away from the flat and beveled surfaces of the hook and are the common result of tooling different surfaces that share a common corner. It is apparent that these ridges are having a significant impact on the tool marks produced by the extractor, *so much so that the issue of significant subclass characteristics is negated* [emphasis added].⁵¹

Tools other than firearms have also been studied. In 1968, Burd and Kirk demonstrated that if the tips of screwdrivers are not subsequently finished, such as by grinding, then the stamping or die process used to manufacture them could be a source of subclass characteristics.⁵² While subclass characteristics were not observed on the teeth of consecutively broach cut pliers, Cassidy observes that in the normal use of the tool at present concern, they would not have been relevant anyway.⁵³

In some instances, molds are used to produce items of

comparative value. In such instances, it is important to understand the molding process and how such marks may persist across many items from a single mold⁵⁴ or across several molds produced from a single master mold.⁵⁵

It cannot be stressed enough that it is important to not only understand the potential of a tool surface to have subclass characteristics, but also, the action of the tool on an object. Such sentiments were evident in studies performed by Thompson when dealing with stamped and painted breech faces of Lorcin pistols⁵⁶ and Moran when dealing with lips on an ammunition magazine.⁵⁷ In this latter article there is detail concerning manufacture, potential for subclass, and potential for transference of such marks to a cartridge case.

In summary, nineteen studies have been offered detailing issues of subclass characteristics from which well-trained and competent firearm and tool mark examiners may draw generalizations regarding the potential for subclass influence on the specific evidence with which he or she is concerned. None of these found reference in Schwartz's article.⁵⁸

b. Rate of Change Regarding When Subclass Characteristics might be Replaced or Joined by Individual Characteristics is Not Relevant in Practice

Statistics or generalizations about the rate of change regarding when subclass characteristics might be replaced or joined by individual characteristics have not been offered because in conscientious practice, it is not relevant. It has already been demonstrated that there is sufficient literature upon which an examiner can base generalizations about tool working surfaces for their potential for subclass. Then, the potential for transference is assessed based on tool action. If the individual examiner finds that there is potential for the presence and transference of subclass characteristics such features simply should not be exclusively used for individualization to a particular tool. A conscientious examiner should concede the point made by Schwartz, being as conservative as possible, and not consider the possibility that subclass characteristics may have changed. Instead, individualizations to a particular tool will be made on other features that the examiner is confident do not include subclass characteristics.

c. Rules for Distinguishing Between Subclass and Individual Characteristics Do Exist

54 Kreiser, J. "Identification of Cast Bullets and Their Molds." AFTE Journal, Vol. 17, No. 3, July 1985, 88-90.

55 Miller, J. "An Introduction to the Forensic Examination of Tool Marks." AFTE Journal, Vol. 33, No. 3, Summer 2001, 233-248. See also Nichols, R. *supra* note 32, at 74 (characterizing this article by Miller as, "...one of the best general articles written in this regard, Miller discusses metallurgy, various tool manufacturing processes, basic tool types and their specific means of manufacture, and the tool marks typical of such tools. With respect to subclass characteristics, Miller emphasizes that they can exist over generations of tools. He suggests that a mold with an imperfection that is reproduced on multiple tools could have been the result of an imperfection on a master mold that was reproduced on multiple molds.").

56 Thompson, E. "Individual Characteristics Criteria." AFTE Journal, Vol. 30, No. 2, April 1998, 276-279.

57 Moran, B. "The Application of Numerical Criteria for Identification in Casework Involving Magazine Marks and Land Impressions." AFTE Journal, Vol. 33, No. 1, Winter 2001, 41-46.

58 That she was aware of at least some is evident. *Supra* note 5. Also, many of the primary sources were identified in the various secondary resources upon which Schwartz relied for the defense of her thesis.

piece by multiple operators to be performed by a single machine equipped with a wide range of various tools operated by a single individual. The concepts of the tooling are the same with the added variable of more precise tool placement from object to object.").

48 Coffman, B. "Computer Numerical Control (CNC) Production Tooling and Repeatable Characteristics on Ten Remington Model 870 Production Run Breech Bolts." Presented at the 33rd AFTE Annual Training Seminar, San Antonio, TX, May 2002. Also published in AFTE Journal, Vol. 35, No. 1, Winter 2003, 49-54.

49 Nies, R. "Anvil Marks of the Ruger MKII Target Pistol – An Example of Subclass Characteristics." Presented at the California Association of Criminalists Northern Section Firearm Examiners' Study Group Meeting, Sacramento, CA, Oct. 2001. Also published in AFTE Journal, Vol. 35, No. 1, Winter 2003, 75-78.

50 *Supra* note 32.

51 *Supra* note 32, at 74-75.

52 *Supra* note 15.

53 Cassidy, F. "Examination of Tool Marks from Sequentially Manufactured Tongue and Groove Pliers." Journal of Forensic Science, Vol. 25, No. 4, Oct. 1980, 796-809.

There exists a tremendous amount of background and literature upon which examiners routinely rely to assess surfaces for the purpose of distinguishing between subclass and individual characteristics. One need only examine many of the aforementioned articles detailing the issue of subclass characteristics to discover this. Therefore, the third charge leveled at the discipline, "Firearms and toolmark examiners have also failed to develop any rules for distinguishing between subclass and class characteristics"⁵⁹ is simply not true.

Most specifically, Tulleners and Hamiel provided such direction in their article, citing a letter from Biasotti who wrote,

That the occurrence of subclass characteristics in rifled firearm barrels is a rare event that can be easily determined by direct inspection of the rifling or a barrel cast; and where the barrel or barrel cast is not available, by applying a more conservative criteria in determining common origin.⁶⁰

d. Examiners must be Knowledgeable with Tool Finishing Processes and Their Effects

Examiners must be knowledgeable with regard to tool finishing processes and their effects on the resultant tool surfaces and the wealth of published information and studies helps to fulfill this requirement. Therefore, the fourth charge that "examiners can only rely on their personal familiarity with types of forming and finishing processes and their reflections in toolmarks"⁶¹ is only partially true. As has just been demonstrated through the extensive reliance on resources and other references in the literature, there is much for the examiner to reply upon.

Furthermore, there is not one conscientious firearms and tool mark examiner who would suggest that personal familiarity with tool finishing processes and their effects on tool surfaces is anything but vital to the proper understanding of subclass characteristics. Without such knowledge and appreciation of manufacturing techniques, examiners would have no way of ascertaining if subclass characteristics could exist. With such knowledge, examiners can articulate that they do (if they do), how they are formed, and the relevance of them for this particular case at hand.

A review of the remainder of Schwartz's argument with regard to subclass characteristics finds references that were inaccurately paraphrased. This includes discussion of why the AFTE formed the Criteria for Identification Committee⁶²,

⁵⁹ *Supra* note 1, at 9.

⁶⁰ *Supra* note 41, at 121.

⁶¹ *Supra* note 1, at 9.

⁶² Citing Bruce Moran's work in footnote 29 on page 10 (Moran, B. "A Report on the AFTE Theory of Identification and Range of Conclusions for Tool Mark Identification and Resulting Approaches to Casework." *AFTE Journal* Vol. 34, No. 2, pp. 227-235.) Schwartz writes, "The danger is that misidentifications will result from confusing subclass with individual characteristics is real, not theoretical. In the 1980's this type of confusion was discovered to have produced misidentifications of striated toolmarks. In response, members of the Association of Firearms and Toolmark Examiners ("AFTE") formed the Criteria for Identification Committee." (*Supra* note 2, at 10.) A review of Moran's work demonstrates that the paraphrase was inaccurate. Reading Moran's review of the history, the reason for the formation of the committee was given as well as

proficiency testing results published by Collaborative Testing Services (CTS)⁶³, and a review article by Eckerman⁶⁴. Schwartz also cites Biasotti and Murdock in which they discuss that the goals and concerns of tool manufacturers are not necessarily always in line with our desire to see individual marks.⁶⁵ Not offered was the cautionary conclusion that Biasotti and Murdock

the recognition that misidentifications were the reason. Whether those misidentifications were due to subclass is not known based on Moran's work. Specifically, Moran writes, "In the 1980's some striated toolmark mis-identifications resulting from a poor understanding of toolmark criteria for identification were experienced. An increasing need to address problems of applying subjective criteria became apparent. As a result of this need, a group of AFTE members formed the Criteria for Identification Committee (CFID Committee) in 1985 to investigate the problems and find solutions" (Moran, at 227).

⁶³ *Supra* note 1, at 10. Specifically, "Invoking laboratory policy that identifications cannot be reached unless the suspect firearm is examined to eliminate the possibility of subclass characteristics, test takers have refused to make identifications in the absence of a gun." Reviewing the tests cited by Schwartz (CTS Test Reports for Test Numbers 03-526 and 03-527), nowhere in the additional comments does it state that an individual invoked laboratory policy. The closest to this is when CTS made this assumption in their own summary of conclusions, "Many of the latter responses [concluding inconclusive results when the actual evidence was fired in different weapons] may be due to laboratory policy requiring the actual firearm and some history before reporting an elimination." (CTS, Inc. "Firearms Examination Test No. 03-526 Summary Report," 3 at www.collaborativetesting.com/reports/2326_web.pdf last visited June 21, 2005). Again, this was an assumption by CTS. Not only that, it dealt with the issue of eliminations, not subclass characteristics. In a review of the published comments made by laboratories in that specific test, the issue of subclass characteristics was mentioned. Comments included, "A cast of the firearm's breech face would have been taken to rule out any sub-class characteristics from the similar ammunition used for tests in this comparison." In addition, another reported "I would want to examine the tool working surfaces of the firearms in order to eliminate the possibility of subclass carryover." Comments made in the second of the tests offered by Schwartz included this mention of subclass characteristics, "Subclass characteristics in the GEA's are ruled out." (CTS, Inc. "Firearms Examination Test No. 03-527 Summary Report," 35 at www.collaborativetesting.com/reports/2327_web.pdf last visited June 21, 2005). The final results of these proficiency tests might also be of interest to the reader. In CTS Test 03-526 there were no misidentifications out of a total of 246 responses that associated a cartridge case as having been fired from a firearm from which it was not fired. In CTS Test 03-527 there were 4 misidentifications, wrongly identifying a bullet as having been fired from a particular firearm when in fact it was not. This was from a response base of 116 where the general feedback regarding the test as being very difficult and that the actual firearm was strongly desired.

⁶⁴ *Supra* note 1, at 11. Schwartz writes, "Changes in manufacturing processes are likely [emphasis added] to increase the risk of misidentifications resulting from the confusion of subclass with individual characteristics." As support for this statement she references and quotes Eckerman's article, quoting directly that, "[a]s tool manufacturers minimize the steps necessary to produce tools in an effort to become more efficient and economical, the possibility for tools produced with similar characteristics increases." (Eckerman, S. "A Study of Consecutively Manufactured Chisels." *AFTE Journal*, Vol. 34, No. 4, Fall 2002, 379.) A review of Eckerman's article clearly demonstrates that this statement was made in the introduction part of her report, in the context of developing a hypothesis to be tested. Eckerman also said (on the very same page that this statement can be found) that, "Results showed that each ground chisel produced individual and identifying characteristics, and that there was no carry-over of features due to the finishing process between consecutively finished tools. Consecutively forged and trimmed tools did possess similar features prior [emphasis added] because in casework we are dealing with finished tools to a grinding step." (Eckerman, 379)

⁶⁵ *Supra* note 1, at 11, n. 33.

drew from this observation when they wrote, "[As a result] the firearms and toolmark examiner must be alert to the possibility that evidence toolmarks may have been produced by a tool working surface having subclass characteristics."⁶⁶

The author discusses a very legitimate concern of the firearms and tool mark identification discipline; that of subclass characteristics. However, unlike the impression Schwartz leaves the reader, there is a vast amount of literature dealing with this very issue. Furthermore, firearm and tool mark examiners are very aware of the issue and are in a position to evaluate submitted evidence for the potential of subclass characteristics. Finally, they are also in a position to evaluate the specific action of the tool on the substrate to determine the relevance of any subclass characteristics that *may* be present.

3. Changes of Characteristics on Tool Surfaces Do Not Render Firearms and Tool Mark Identification Impotent

It is important to understand that it has never been asserted that characteristics on tool working surfaces would not change and that change does not necessarily negate the potential for a qualified examiner to examine two tool marks and determine that they were produced from the same source. Schwartz asserts otherwise, citing this fact as a "barrier in the way of firearms and toolmark identification's goal of individualization."⁶⁷ Others have expressed similar concerns.⁶⁸

The surface of a tool will change over time, but it is important to understand that this does not make identification unreliable. This is true for two reasons. The first is that it is through use that a tool will continue to acquire individual characteristics that are vital to the comparative identification process. It has been established that under most circumstances even consecutively made tool marks will not produce identical marks. Yet there will be sufficient similarity such that the similarity would not be confused with that expected in a known non-match situation. That is why the conscientious examiner will examine a multitude of tool marks, made by different and the same tools, to develop a criterion for identification as specified in the aforementioned AFTE Theory of Identification. This theory accounts for these differences, as do the many studies that affirm the scientific reliability of firearm and tool mark identification.

The second is that were the change of a tool surface so rapid as to change from mark to mark (or bullet to bullet) then attempts at identification would be pointless. However, aside from possibly the first series of bullets fired from a newly manufactured barrel, published studies have shown otherwise.

Hamby test fired 501 bullets in a 5.56 NATO caliber, M16A1 military rifle.⁶⁹ Approximately 40,000 other rounds had been previously fired through this barrel. Every effort

was made to make the conditions as deleterious as possible, including test firing as rapidly as possible. The first bullet and every hundredth after that were collected for comparison. Although some differences were observed, there was sufficient similarity of individual markings to permit a conclusion that the first and last bullets were fired from the same firearm.

Biasotti performed a limited study that examined the effects of lead build-up in a .22 caliber barrel.⁷⁰ He demonstrated that lead buildup in a barrel from successive fires of lead bullets can cause markings to change such that cleaning of the barrel with a solvent and brush may be necessary to remove the deleterious effect of the leading. He concluded that the best reproducibility was between bullets fired with similar bore conditions.

Shem and Striupaitis performed a study of 501 test fires from a Raven, .25 Auto caliber, semi-automatic pistol.⁷¹ The first and every tenth set of test fires were recovered with comparison between the first and every fiftieth set of test fires. A gradual change of the individual characteristics on the bullets was observed. However, it was still possible to conclude that the first and last bullets were fired from the same firearm. With regard to the cartridge cases, the individual markings within the breech face markings were sufficient to permit a conclusion that the first and last test fired cartridge cases were fired in the same firearm.

In a study similar to Biasotti's, Kirby examined the effect of firing 900 cartridges from a .455 caliber Smith & Wesson revolver on individual markings produced on cartridge cases and bullets.⁷² Lead bullets were fired through the barrel and the firearm was not cleaned during the test. With regard to the cartridge cases, firing pin impressions and breech face markings on the first and last test fired cartridge cases showed no significant difference, such that it could be concluded that each was fired in the same firearm. The bullets revealed a different situation. The author had no difficulty in determining that the first and twenty-fifth bullets were fired in the same firearm. Indeed, some differences were being noted by the fiftieth test fired bullet but the coarser individual striations showed little to no change. Twenty-five bullets later, it could not be concluded that the first and 75th bullets fired were fired from the same gun. There was some similarity, but it was insufficient for an unequivocal identification. Further testing showed that test fired bullets #125 and #150 showed sufficient similarity to conclude that they were fired in the same firearm. It is apparent that the continual firing of lead bullets without cleaning has a deleterious effect on the bore condition. This has been well established in the literature prior to this study. However, like Biasotti's study, those bullets fired with similar bore conditions could be compared and a conclusion reached that they were fired from the same firearm.

In 1983, several authors collaborated on a study of 5,000 full metal jacketed, .45 ACP caliber bullets fired from a

66 Biasotti, A.A., Murdock, J. "Firearms and Tool Mark Identification." In: Faigman, D.L., Kaye, D.K., Saks, M.J., Sanders, J., editors. *Modern Scientific Evidence: The Law and Science of Expert Testimony*, Volume 3. St. Paul: West, 2002, 501.

67 *Supra* note 1, at 11.

68 Griffin, J. and LaMagna, D, "Daubert Challenges to Forensic Evidence: Ballistics Next on the Firing Line," *The Champion*, September/October 2002, 20 (stating "Unlike DNA or fingerprints, markings left by an individual gun on ammunition fired through it are neither unique nor permanent.")

69 Hamby, J. "Identification of Projectiles." *AFTE Journal*, Vol. 6, No. 5/6, Oct. and Dec. 1974, 22.

70 Biasotti, A. "Bullet Bearing Surface Composition and Rifling (Bore) Conditions as Variables in the Reproduction of Individual Characteristics on Fired Bullets." *AFTE Journal*, Vol. 13, No. 2, April 1981, 94-102.

71 Shem, R. and Striupaitis, P. "Comparison of 501 Consecutively Fired Bullets and Cartridge Cases From a .25 Caliber Raven Pistol." *AFTE Journal*, Vol. 15, No. 3, July 1983, 109-112.

72 Kirby, S. "Comparison of 900 Consecutively Fired Bullets and Cartridge Cases From a .455 Caliber S&W Revolver." *AFTE Journal*, Vol. 15, No. 3, July 1983, 113-126.

M1911A1 semi-automatic pistol.⁷³ Every tenth test fired bullet and cartridge case was recovered for comparison. With regard to the test fired cartridge cases, the breech face marks showed no significant changes with slight form variations of the firing pin and extractor. They observed that the ejector marks changed at a relatively rapid rate. With regard to bullets, it was observed that while some land impressions showed a faster relative change of some individual markings than others, a conclusion that the two bullets were fired from the same firearm was possible through all 5,000 test fired bullets.

Interested in ejector marks, Schechter and colleagues performed a study in which they fired 7,100 cartridges in a 5.56x45mm Galil rifle.⁷⁴ They observed change within the first several test fires, but once the ejector had seemingly stabilized, the ejector marks on test fired cartridge cases 9 and 7060 showed sufficient individual similarity to permit a conclusion that the same ejector was responsible for producing the mark.

Most recently, Doelling reported on the persistence of individual markings over the course of 4000 test-fired bullets.⁷⁵ He was able to determine that the first and last test-fired bullets could be identified as having been fired from the same firearm.

Hall also addressed this issue when he desired to determine the persistence of tool marks produced by bolt cutters.⁷⁶ When the marks were produced in lead, Hall saw no difference in marks produced by any of the bolt cutters to a maximum of 25 cuts. This was the maximum number of cuts produced. He did notice a difference in markings when the bolt cutters were used to cut lock shackles, but he indicated that this appeared to be more of an issue of the shackle hardness creating reproducibility problems.

In summarizing her concern with regard to the permanence of tool marks, Schwartz writes,

As a consequence of the impermanence of toolmarks, differences between evidence and test toolmarks will sometimes be correctly attributed to changes in the surfaces of the suspect tool between the time the evidence and test toolmarks were made. At other times, such an attribution will be wrong; the evidence and test toolmarks differ because the source of the evidence mark was a tool similar, but not identical to the suspect tool.⁷⁷

It would have been more accurate to state that, "as a consequence of the impermanence of tool marks, differences between evidence and test tool marks *will exist*" and end the sentence at that point. The rest of her concern is dealt with in the AFTE Theory of Identification where the examiner is exhorted to be mindful of the significance of the combination of differences *and* similarities.

73 Ogihara, Y., Kubota, M., Sanada, M., Fukuda, K., Uchiyama, T., and Hamby, J. "Comparison of 5000 Consecutively Fired Bullets and Cartridge Cases From a .45 Caliber M1911A1 Pistol." AFTE Journal, Vol. 15, No. 3, July 1983, 127-140.

74 Schechter, B., Silverwater, H., and Etzion, M. "Extended Firing of a Galil Assault Rifle." AFTE Journal, Vol. 24, No. 1, Jan. 1992, 37-45.

75 Dolleing, B. "Comparison of 4000 Consecutively Fired, Steel-Jacketed Bullets." Presented at the 53rd Annual AAFS Seminar, Seattle, WA, February 2001.

76 Hall, J. "Consecutive Cuts by Bolt Cutters and Their Effect on Identification." AFTE Journal, Vol. 24, No. 3, July 1992, 260-272.

77 *Supra* note 1, at 12.

It is recognized that a tool surface will change over time. However, the suggestion that individualization to a specific tool is therefore invalid is not an appropriate extension of the concern. The issue has been recognized and studied within the discipline. There will be differences in individual details from mark to mark produced by the same tool. However, the change is neither rapid enough to devalue firearms and tool marks as an identification science, nor is it necessarily significant enough such that an identification criteria based on similarities cannot be established. Furthermore, the worst possible scenario is that a particular mark will not be able to be associated with the tool from which it was made because the working surface of the tool has changed, thereby not permitting identification.⁷⁸

This concludes a review of three very critical issues specifically dealing with the value of firearms and tool mark identification as an identification science. Schwartz refers to these issues as "central pitfalls in firearms and toolmark identification."⁷⁹ Her argument is unrepresentative of the available literature published by the relevant scientific community. Furthermore, based on a review of that literature her claims are found to lack general support. While some legitimate questions were posed with respect to uniqueness of tool marks, her answers to those questions were not credible.

B. The Scientific Basis for Firearms and Tool Mark Identification Has Been Validated

As the preceding discussion has highlighted, the primary question of firearms and tool mark examiners of whether it possible to distinguish between tool marks produced by different tools has been empirically tested and validated. It is possible. There are some difficulties discussed. Rather than being insurmountable obstacles discipline-wide, they have been shown to limit a conscientious examiner's ability in some instances to make a determination whether two marks were or were not produced by the same tool. An example of this is subclass characteristics. At times they may be a very significant issue. Most times, they are not. The studies have demonstrated that.

Schwartz claims that it is necessary to have empirical statistical foundations, drawing once again on the DNA analogy. Her claim is lack of an adequate database disqualifies, in part, all firearm and tool mark evidence from being considered admissible. If she is relying on her analogy as a basis for support, then it rapidly disintegrates when one understands irreconcilable differences between the two disciplines.

The first is that firearms and tool mark identification relies on individual marks to render the final conclusion. However, "DNA identification as practiced worldwide relies entirely on subclass characteristics – a small number of discrete marks at a small number of fixed locations."⁸⁰ Statistics

78 *Supra* note 32, at 77.

79 *Supra* note 1, at 5.

80 Gutkowski, S. "A Response to: A Systematic Challenge to the Reliability and Admissibility of Firearms and Toolmark Identification, a recently published article by Adina Schwartz." *The Forensic Bulletin*, Winter, 2005, 23. Gutkowski goes on to say that "Schwartz uses DNA as an example of the right way to establish the empirical statistical base. As mentioned above this demonstrates a lack of understanding of DNA typing as being the analysis of ethnically biased assortment of a limited number of sub-class characteristics in which

are inherently necessary for DNA identification because there has to be some way of determining the frequency with which a combination of subclass characteristics will exist within the population. Not so for firearms and tool mark identification.

In addition, her argument throughout this section lacks coherency. It draws heavily on a discussion of consecutive matching striations (CMS) as an alternative comparative method to a traditional pattern matching method when such a dichotomy does not even exist. It will be important to discuss many of Schwartz's points because in making them she errs critically in a fuller understanding of the issues at hand, severely mischaracterizes the available literature, and neglects a good portion of available published literature.

That being said, it is important not to be neglectful of a very good question. That question is whether statistics have a potential role in the discipline, and if so, in what form should those take. Such a question is healthy for the discipline to consider and a discussion of such consideration will be offered.

1. The AFTE Theory of Identification Does Not Support Claims of Absolute Individualization

Despite claims by prominent practitioners that individualization is not an unreasonable extension of the discipline, the AFTE Theory of Identification does not make claims of absolute individualization. Schwartz claims otherwise. In the introduction of her article she writes,

The expert testimony in the case, *United States v. Kain*, was typical [emphasis added] of that offered by firearms and toolmark examiners. The goal of the forensic science discipline of firearms and toolmark identifications is to identify particular tools, such as a bolt cutter or the barrel of a particular gun, as the unique source of marks on crime scene evidence, such as a fence or a fired bullet.⁸¹

The AFTE Theory of Identification, a statement of the relevant scientific community, does not make a claim of absoluteness. As mentioned, at no point did Schwartz quote or even paraphrase this critically important statement. The AFTE Theory of Identification states, "The statement that 'sufficient agreement' exists between the two toolmarks means that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility."⁸² This is not a statement of absoluteness.

She also mischaracterizes the role of the AFTE and current practice within the discipline. She states that,

The denial of the need to determine the statistical significance of "matches" is implicit in the restrictions that the Association of Firearms and Toolmark Examiners has set on examiners' conclusions. In accordance with the AFTE Range of Conclusions, examiners in the United States may only (1) identify a particular tool as *the* source of the toolmark(s) found

individuality is not a property of the characteristics being typed...On the other hand FATM [firearm and tool mark] identification is based on random individual characteristics superimposed on sub-class and class characteristics so individualization [sic] is to be expected. The DNA experience is irrelevant to pattern matching using individual characteristics in areas such as fingerprints, FATM, documents and hair morphology."

81 *Supra* note 1, at 2.

82 AFTE Glossary. "Theory of Identification as it Relates to Toolmarks." AFTE Journal, Vol. 30, No. 1, Winter 1998, 86.

on an object; (2) eliminate a particular tool as *the* source; (3) conclude that the comparison of test and evidence toolmarks is inconclusive, or (4) conclude that the evidence toolmark is unsuitable for comparison. [Emphasis is the author's]⁸³

AFTE does offer a Range of Conclusions based on the AFTE Theory of Identification.⁸⁴ However, unlike what Schwartz implied to the reader this range is "encouraged" and not "required." The actual statement of conclusions is based in individual laboratory policy, which may or may not choose to accept the AFTE model. To suggest that examiners in the United States are under these restrictions implies that there is a distinct difference in what other nations offer. Quite the contrary as AFTE is an international organization in which there are members from various countries in Europe, Africa, The Middle East, Asia, Australia, New Zealand, Northern America, and Southern America. This encouragement is expressed to all examiners, worldwide. Finally, the language of how identifications are defined is in line with the AFTE Theory of Identification in which there is no claim of absoluteness. Therefore, the implication that the range of conclusions has examiners identifying "the" tool is a mischaracterization.

Despite the official published position of the AFTE, Schwartz's point that testimony of firearm and tool mark examiners is *typical* in that claims of absolute identity are made cannot be denied. For purposes of clarity, examiners should communicate that conclusions of identity are reached because the chances of another tool producing the same mark are so remote that for practical purposes it can be ignored.⁸⁵

The issue at the root of this is not a new one. Kirk recognized this question of absolute identity versus practical identity as a source of much "quibbling of attorneys with expert witnesses."⁸⁶

83 *Supra* note 1, at 13.

84 *Supra* note 82 (stating "The examiner is encouraged to report the objective observations that support the findings of toolmark examinations. The examiner should be conservative when reporting the significance of these observations. 1. IDENTIFICATION – Agreement of a combination of individual characteristics and all discernible class characteristics where the extent of agreement exceeds that which can occur in the comparison of toolmarks made by different tools and is consistent with the agreement demonstrated by toolmarks known to have been produced by the same tool. 2. INCONCLUSIVE – A. Some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification. B. Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility. C. Agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for elimination. 3. ELIMINATION – Significant disagreement of all discernible class characteristics and/or individual characteristics. 4. UNSUITABLE – Unsuitable for microscopic comparison.")

85 Schwartz writes, "Firearms and toolmark examiners' absolute identity conclusions cannot be excused on the ground they are convenient shorthand for well-grounded probabilistic conclusions." (*Supra* note 1, at 13.) This author would agree in that language that does not offer the full meaning and intent of the AFTE Theory of Identification is not appropriate.

86 Kirk, P. *Crime Investigation*. New York: Interscience Publishers, 1953, 14. He goes on to say that, "Any attorney can state that two objects are not identical and be correct in the absolute sense, even though the identity is overwhelmingly positive from the practical standpoint of origin. The expert witness will be well advised to admit without argument that no two objects are ever completely identical, but he should at the same time be very certain of his ground as to

Emphasizing this distinction and the importance of clear articulation, Kirk writes,

In all matters involved in the examination and interpretation of physical evidence, the term *identity must be understood to signify practical and determinable identity only*. If necessary, the witness must be very willing to admit that he has not and cannot ever establish absolute identity, and in fact there is no such thing when applied to tangible objects.⁸⁷

Furthermore, Kirk cautions that “accurate identification must rest on a proper basis of training, experience, technical knowledge and skill and an understanding of the fundamental nature of identity itself. It should not be attempted without this kind of background, either by the police officer or the amateur.”⁸⁸

In 1991, David Stoney discussed this concept as being analogous to a “leap of faith”⁸⁹ when addressing statistics in the framework of fingerprints and (at the time) newly emergent DNA analysis. Despite her repetitive analogies and contrasts with fingerprints and DNA and her concern in this section with statistics and absolute identifications, Schwartz makes no reference of Stoney’s work, which focuses on this very issue.

Stoney’s claim was that we move from a subjective interpretation of the observed characteristics (in Stoney’s example, it was fingerprints) and declare an absolute identity. Stoney writes,

The conclusions [of a fingerprint examiner] are accepted and supported as subjective; very convincing, undoubtedly valid, but subjective. In fingerprint comparisons, the examiner notes the details in the patterns of the ridges. Beginning with a reference point in one pattern, a corresponding point in a second pattern is sought. From this initial point the examiner then seeks neighboring details that correspond in their form, position, and orientation. These features have an extreme variability that is readily appreciated intuitively, and which becomes objectively obvious upon detailed study. When more and more corresponding features are found between two patterns, scientist and layperson alike become subjectively certain that the patterns could not be possibly duplicated by chance. What has happened here is somewhat analogous to a leap of faith. It is a jump, an extrapolation, based on the observation of highly variable traits among a few characteristics, and then considering the case of many characteristics. Duplication is inconceivable to the rational mind and we conclude that there is an absolute identity.⁹⁰

Stoney moves on to suggest that trying to “prove uniqueness” is a “ridiculous notion.”⁹¹ Using the discipline of fingerprints he comments, “We hold fingerprint specificity and individuality up as our ideal, yet this is achieved only through a subjective process. In fingerprint work, we become subjectively convinced of identity; we do not prove it. And this works

just fine. For fingerprints [contrasted with DNA].”⁹² He then concludes by saying, “Even without theoretical models and statistics, we can, and do, make absolute identifications. We can apply scientific, critical judgment, expert and informed, to make the subjective determination of identity (or less absolutely, of ‘very very rare’).”⁹³

Schwartz claims that in *typical* testimony of firearm and tool mark examiners, claims of absolute identity are made. Inherent in this is a recognition (on the part of a *typically* trained firearm and tool mark examiner) that should be readily admitted, that not every tool in the world has ever been examined by a particular examiner nor would there ever be an opportunity to do so. However, the examiner is confident that such a claim could be made based on his or her training, experience, and the wealth of literature that is available.

2. Consecutive Matching Striations is a Means to Articulate Observed Striated Pattern Agreement

Recent literature has helped to clear up an early misconception within the discipline that consecutive matching striations (CMS) and the traditional pattern matching approaches were different methods of comparative examination – they are not. CMS is simply a convenient way to communicate with other examiners the extent of agreement being observed in a striated tool mark comparison.⁹⁴ Schwartz, however, does not recognize this in her argument.

Schwartz has linked the traditional approach of firearm and tool mark examiners as being “subjective” and the CMS approach as being more “objective.”⁹⁵ Dealing with the issue of objectivity and subjectivity within the firearms and tool mark discipline, it is important to understand the basic process of comparison. A comparative examination is a process in which a firearm and tool mark examiner compares two items, makes observations regarding similarities and differences, and then draws an interpretation (conclusion) based on observations.

Webster’s dictionary defines objective as, “publicly or inter-subjectively observable or verifiable esp. by scientific methods...of such nature that rational minds agree in holding it real or true or valid...perceptible to the senses or derived from sense perception.”⁹⁶ In a situation where two patterns are being compared, as in a firearm and tool mark situation, the examiner assesses the relative position, placement, and size of certain characteristics. For example, an examiner may declare two striations to correspond when they are present in the same relative location from the leading edge, have the same relative width, and the same relative height.⁹⁷ All

⁹² *Ibid.*

⁹³ *Supra* note 89, at 199.

⁹⁴ In a necessarily simplified explanation, a striated tool mark can be thought of as a series of horizontal lines having different widths and spacing (in a two dimension environment). When comparing two such marks some examiners find it convenient to say that they observe agreement of some of the pattern. Examiners who utilize CMS find it convenient to articulate the agreement in terms of the number of lines that match consecutively, without interruption. CMS is therefore a means of describing what one is observing. There are other ways in which this can be accomplished such as through a well-articulated written description or more simply through photography.

⁹⁵ *Supra* note 1, at 14-15.

⁹⁶ Gove, P.B., Editor-in-Chief. *Webster’s Third New International Dictionary of the English Language Unabridged*. Springfield: Merriam-Webster, 1993.

⁹⁷ *Supra* note 6, at 337 (where the AFTE Theory of Identification

what constitutes a sufficient identity for practical use.”

⁸⁷ *Supra* note 86, at 16.

⁸⁸ *Supra* note 86, at 17.

⁸⁹ Stoney, D. “What Made Us Think We Could Individualize Using Statistics?” *Journal of the Forensic Science Society*. Vol. 31, No. 2, April/June, 1991, 198.

⁹⁰ *Supra* note 89, at 197-198.

⁹¹ *Supra* note 89, at 198.

of these are objective observations as another equally well-trained examiner could look at the same two marks and make similar observations.⁹⁸

The fact that, aside from using numbers, it may not be easy to communicate does not make the observations any less objective. For example, if two individuals were to go outside on a cloudless day and observe that the sky is blue, that is an objective observation. Just because it is not particularly easy to describe the color blue does not make the observation any less objective.

This is where the concept of consecutive matching striations is helpful. It is a means of describing the pattern that one is observing. That's it. The issue of subjectivity enters the discussion because it is the actual interpretation of the significance of the culmination of objective observations that is subjective. The individual examiner then compares this collection of objective observations with past training, knowledge (including available literature⁹⁹), and experience to determine

specifies these quite clearly stating "Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours."

98 That they are, 1) "publicly or intersubjectively observable or verifiable," 2) "of such nature that rational [equally trained] minds agree in holding it real or true or valid," and 3) "perceptible to the human senses..."

99 See, e.g., Nichols, R. "Consecutive Matching Striations (CMS): Its Definition, Study and Application in the Discipline of Firearms and Tool Mark Identification." *AFTE Journal*, Vol. 35, No. 3, Summer 2003, pp. 298-306 (stating "Unlike the impression some may have given with regards to CMS, this author has not contended that CMS is either a more objective or a more scientific process than the traditional pattern matching approach. However, it must be remembered that two things need to be defended. The first is the validity of firearms and tool mark identification as a science. This is easily supported using the plethora of articles that have been published through the history of the discipline whether they deal directly with CMS or not. The second issue that needs to be defended is the validity of the individual examiner's criterion for identification. In support of this, a traditional pattern matcher is unable to rely on those non-CMS studies performed by others because those studies do not communicate a criterion for identification in a manner that can be visualized by others unless the work is repeated. Therefore, when asked what one's identification criterion is, the answer has to be based in one's own training and experience. Whether one cares to admit it or not, this sounds extremely subjective to a lay juror or judge because they do not see any sort of standard except one's own personal training and experience. However, an examiner who utilizes the CMS regime can rely on numerous studies that have been performed to show that the criterion for identification is supported by the work of others and is not based solely in his or her own training and experience. Whether one cares to admit it or not, this does have a more "objective" implication to the lay juror or judge."). Schwartz made reference to this article, though not in this context (*supra* note 1, at 15, n. 52). Addressing similar concerns, Schwartz cites an earlier work (*supra* note 10) as support for her statement, "emphasizing that articles that do not explain why an examiner concluded that a particular tool was the unique source of a questioned toolmark, but instead include only subjective comparisons of toolmarks, are 'very difficult for other examiners to utilize.'" (*Supra* note 1, at 15, n. 50.) That very same reference Schwartz used to support her contention also reported, "Not all [34 summarized studies] have generated quantifiable numbers which those in the legal field inextricably link to scientific progress. However, as was discussed in the early part of this article, all of these appear to be based at least in part on the scientific method, which tests hypotheses by experimenting and making observations. ..Certainly though, part of the problem stems from the way this

whether it meets the criteria as set forth in the AFTE Theory of Identification.

In 1997, Biasotti and Murdock first presented their conservative minimum quantitative criteria for identification in CMS language, which reads as follows

In three dimensional tool marks when at least two different groups of at least three consecutive matching striae appear in the same relative position, or one group of six consecutive matching striae are in agreement in an evidence tool mark compared to a test tool mark. In two dimensional tool marks when at least two groups of at least five consecutive matching striae appear in the same relative position, or one group of eight consecutive matching striae are in agreement in an evidence tool mark compared to a test tool mark. For these criteria to apply, however, the possibility of subclass characteristics must be ruled out.¹⁰⁰

Based on the previous discussion it can be readily discerned that their language simply communicates the correspondence necessary to exceed the best-known non-match as specified in the AFTE Theory of Identification. Several studies have examined the appropriateness of these quantitative criteria and with a combined population total of over 6,000 known non-match comparisons (including both two dimensional and three dimensional tool marks), not one time would there have been a false inclusion based on the criteria offered by Biasotti and Murdock.¹⁰¹

Schwartz highlights three concerns regarding the actual practice of using CMS. The first is concerned with impression evidence, the second with differing counts of CMS runs, and the third with examination protocol when utilizing CMS. Given an appropriate understanding of CMS, which was not evident in Schwartz's discussion, it is easily seen that such concerns are primarily applicable in discussing the suitability for using CMS as a means of communicating the pattern one is observing. As such they are not relevant to the issue of scientific basis for firearms and tool mark identification. Therefore, the logical flow of discussion will not be interrupted to address these matters.¹⁰²

3. Extensive Statistical Databases are Not Necessary for Substantiating Scientific Basis

Much confusion in the area of statistical databases for firearms and tool mark identification exists because of the uneducated and uninformed comparisons with DNA identification, so different from firearms and tool mark identification that any analogies are intellectually inappropriate. Furthermore, an examination of the typical arguments proposing

material is presented (or not presented) in courts of law. It is incumbent upon qualified examiners to know their field and know it well. Bad and ill-prepared examiners do not mean the science is bad, it just means they are bad and ill-prepared examiners." (*Supra* note 10, at 473.)

100 Biasotti, A.A., Murdock, J. "Firearms and Tool Mark Identification." In: Faigman, D.L., Kaye, D.K., Saks, M.J., Sanders, J., editors. *Modern Scientific Evidence: The Law and Science of Expert Testimony*, Volume 3. St. Paul: West, 2002.

101 *Supra* note 32, at 84-85.

102 The reader should note however, that Schwartz's discussion of these three concerns was replete with gross and flagrant mischaracterization of the cited literature, an ignorance of other available literature, and an unsupported digression into the ethics of practitioners and researchers.

such databases demonstrates a lack of fuller understanding of the real relevant issue at hand – it is not necessarily the tool itself, but, rather, the manufacturing process for the working surface of the tool that is the critical feature in the scientific basis of firearm and tool mark identification.

In her argument, Schwartz emphasizes the actual tool as opposed to the tooling action that was used to form the working surface of the tool. For example, she states that, “To date, the only other statistical empirical support for the claimed absence of any realistic chance that CMS criteria will produce misidentifications consists of published studies of bullet striae and unpublished studies of chisel and knife toolmarks.”¹⁰³

By concentrating on discrete populations of tools that share common methods of tool manufacture, the focus of the criticism is misdirected. Striated tool marks are formed by the movement of the working surface of the tool against an object. Yet, the striations are actually influenced not by the actual object, but, rather, the manner in which the working surface of the tool was finished. The rifling process of a barrel results in metal being cut or swaged. Tools such as screwdrivers might be stamped with final grinding. The cutting tips of knives are typically ground. There are only so many ways to finish a tool surface. And, as it has been already demonstrated, many of them result in random tool marks.¹⁰⁴

Schwartz is correct in her contention that CMS may vary because of the size and quality of the working surface of a particular tool.¹⁰⁵ However, it is not relevant. She cited Miller as a source for this information who does indicate that the number of striations and groups of CMS will be affected by the size of the tool. However, not in one of those instances, and he did a variety of studies with tool marks of varying widths (different bullet diameters, different rifling impression widths, etc.) did he find that using the conservative criteria for identification would result in a false inclusion.¹⁰⁶ As another example, in personal studies of consecutively manufactured knives, the tool size was quite large and there were hundreds of striations present. Yet, in no case of known non-match comparisons would the criteria have permitted a false inclusion.¹⁰⁷

Many studies have demonstrated that tool marks pro-

103 *Supra* note 1, at 21. Later Schwartz states with regard to Miller’s study (Miller, J. “An Examination of Two Consecutively Rifled Barrels and a Review of the Literature.” *AFTE Journal*, Vol. 32, No. 3, Summer 2000, 259-270) that “an observation of bullets worked through *two guns of one type* cannot eliminate the possibility that misidentifications could result from applying CMS criteria to all the land impressions of bullets fired from, or otherwise worked through, *all types* of guns.” (*Supra* note 1, at 23, n. 93) While Miller was dealing in that article with two guns of one type, Schwartz’s statement appears to ignore the other data of which she has already admitted having knowledge. Therefore, her statement is unsubstantiated by any of the published CMS literature. Furthermore, it deals more with the issue of CMS and thus confuses the argument.

104 Therefore, the analogy with DNA identification is wholly inappropriate because, as it is currently practiced, DNA identification is based on a combination of subclass characteristics for which a statistical treatment is inherently necessary.

105 *Supra* note 1, at 21.

106 *Supra* note 32, at 84.

107 *Ibid.* Though, the actual amount of striations on each was not cited in that summary or in any other format.

duced by different tools can be readily distinguished. Furthermore, significant work has focused on defining more discretely the identification criteria by which this is done. The implied need for representative statistical databases for each and every tool one might encounter is not founded because the science of firearm and tool mark identification is based on manufacturing methods and an ability to assess and distinguish among the class, subclass and individual characteristics produced by the tool manufacturing process.

However, that being said, it is important not to ignore a pertinent and very relative question. That question is, “Is there a role for statistics in the discipline of firearms and tool mark identification?” This attempts to address Schwartz’s concern from a broader perspective. The next section will be devoted to examining that very question.

4. The Role of Statistics in Firearms and Tool Mark Identification Has Received Extensive Continuing Attention by the Community

If statistics has a role in the firearms and tool mark identification discipline, it is most appropriately directed at the logical question that would emanate from the statement in the AFTE Theory of Identification that specifies the criteria needed to make an identification and how that identification is defined. Restating the relevant portion of the AFTE Theory of Identification, it states “The statement that ‘sufficient agreement’ exists between two tool marks means that the agreement is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.”¹⁰⁸ The logical question to which statistics could be directed is, “How remote is that practical impossibility?”

Schwartz claims “Firearms and toolmark examiners do *not* even attempt to answer this question.”¹⁰⁹ While that may be true in the context of testimony she has personally observed, within the scope of the published literature it is not. Biasotti made that attempt in his article published in 1959.¹¹⁰ In 1970, Brackett examined the use of various models to study “idealized” striated marks.¹¹¹ These “idealized” marks consisted of individual elements within a set of striations defined by position only, without the additional defining characteristics of width, contour or height. The purpose of these models was to examine statistical and probabilistic application to striated tool marks.

Blackwell and Framan ran simulated studies based on Brackett’s formulae and models resulting in numbers similar to those produced by Biasotti in 1959.¹¹² Uchiyama was responsible for another computer simulation granting greater than practical tolerances for striation correspondence and produced numbers similar to those of Biasotti.¹¹³ In his ar-

108 *Supra* note 6.

109 *Supra* note 1, at 13.

110 *Supra* note 17.

111 Brackett, J. “A Study of Idealized Striated Marks and Their Comparison Using Models.” *Journal of the Forensic Science Society*, Vol. 10, No. 1, Jan. 1970, 27-56.

112 Blackwell, R. and Framan, E., “Automated Firearms Identification Systems AFIDS: Phase I.” *AFTE Journal*, Vol. 12, No. 4, Oct. 1980, 11-37.

113 Uchiyama, T., “A Criterion for Land Mark Identification.” *AFTE Journal*, Vol. 20, No. 3, July 1988, 236-251.

ticle he developed a probability equation and a significance level based on actual, test-fired bullets. Deinet published a study¹¹⁴ the purpose of which was to "calculate the probability of random occurrence of matches using actual striated tool marks."¹¹⁵

There have also been more recent attempts to answer a statistical question. Miller and Neel evaluated the statistical significance of various runs of consecutive matching striations (CMS) for 1000 comparisons.¹¹⁶ Rocky Stone ventured into a mathematical model to describe the probabilities of impressed tool marks on a theoretical hammer face.¹¹⁷ Just recently, Collins has offered a follow-up to Stone's model by empirically assessing such marks on 20 actual hammer faces.¹¹⁸

The literature indicates that firearm and tool mark examiners have found some usefulness in the area of statistics. It very well could be that it is because there was early recognition that an examiner, at best, could individually examine no more than a small fraction of the firearms that actually exist. Yet, using probabilities, an examiner would still be in a position to discuss the uniqueness of an identification.¹¹⁹

Even so, there have been dissenters. Deschênes *et al* would argue differently.¹²⁰ In support of their contention, they cite two objections. The first is, "statistics never permit one to draw conclusions concerning a particular situation."¹²¹ In support of this they use a weather analogy. "It is not going to rain just because there are 97% chances that it is going to rain. Statistics do not yield a "cause to effect" relationship."¹²² The second is that a firearms and tool mark examiner is in a better position to interpret the meaning of what is being observed.¹²³

114 Deinet, W. Studies of Models of Striated Marks Generated by Random Processes. *Journal of the Forensic Science Society*, Vol. 26, No. 1, Jan. 1981, 35-50.

115 *Supra* note 10, at 472. It should be noted that the previous four citations were all reviewed in this article written in 1997. Dr. Schwartz relies extensively on this review article but nowhere in her discussion are any of the references cited in notes 112-115 found.

116 Miller, J. and Neel, M. "Criteria for Identification of Toolmarks Part III Supporting the Conclusion." *AFTE Journal*, Vol. 36, No. 1 Winter 2004, 7-38. Also presented at the AFTE 34th Annual Training Seminar, May 2003, Philadelphia, PA. These statistics were not among the previously discussed 6,000 known non-match comparisons that have not violated the CMS criteria.

117 Stone, R. "How Unique are Impressed Toolmarks?" *AFTE Journal*, Vol. 35, No. 4, Fall 2003, 376-383.

118 Collins, E. "How 'Unique' are Impressed Toolmarks? An Empirical Study of 20 Worn Hammer Faces." Presented at the CAC Semi-Annual Seminar, May 2005, Oakland, CA. Also presented at the AFTE 36th Annual Training Seminar, June 2005, Indianapolis, IN.

119 Hatcher, J.S., *Textbook of Firearms Investigation, Identification and Evidence*. Marines, NC: Small Arms Technical Publishing Company, 1935.

120 Deschênes, M., Chaltchi, A., Desjardins, G., Desrochers, C., Dion, J., Gaulin, R. "Statistics and Toolmarks Comparisons." *AFTE Journal*, Vol. 27, No. 2, April 1995, 140-141.

121 *Supra* note 120, at 140.

122 *Ibid*.

123 *Supra* note 120, at 140-141 (stating "The specialist in statistics uses his knowledge, experience and judgment to form a statistical model which represents reality, and to apply that model to a particular situation. He then uses his judgment to conclude, according to the statistical results he obtains, if this tool mark was or was not made by that particular tool. In the same way, the specialist in tool marks uses his knowledge, experience and judgment to

This article received some relatively rapid criticism.¹²⁴ The criticism focused on the fact that statistics does have a role to play and that is in the area of uncertainty. They argue that because the examiner does not have a complete set of circumstances regarding a particular tool, "...the tool mark examiner is never in a position to identify a tool. But when considering the whole population of the world, the expert estimates that the probability of another match is very close to zero, then it is common sense to declare an identification."¹²⁵

Bunch's article supports a similar view.¹²⁶ He states that firearm and tool mark examiner have the goal of determining the likelihood ratio, a Bayesian reference, that a tool mark was made by a particular tool.¹²⁷

Use of the word "likelihood" or phrase "likelihood ratio" implies reference to Bayesian inference because it specifically deals with measuring likelihood. This is one manner in which the question can be approached. Indeed, some favor it because it allows for an assessment of more than just the questions of the comparative results.¹²⁸ However, a review of some work in which there has been discussion of applicability to firearms and tool mark identification shows that it does not answer the question as discretely as the judicial system may like. It is true that numbers representing a likelihood ratio are generated but, the explanation for what those numbers mean in a real sense leaves the judicial system no closer to real answer that has much more meaning than what is being offered now.¹²⁹

A different approach is a more routine probabilistic approach such as that most oft cited in the literature. In essence, this latter approach deals with the question, "What are the chances that another tool made these marks?" Those favoring Bayesian inference would suggest that a more complete answer is given by the likelihood ratio because prior odds favoring a particular conclusion are factored into a likelihood ratio. Therefore, they would argue that the discrete "chances that another tool made the mark," offers an incomplete picture.

The question of Bayesian versus straight probabilistic statistics has been debated but really has not seen resolu-

conclude, from what he observes under the comparison microscope, if the tool mark was or was not made by that particular tool. In theory, the human judgment of the specialist in statistics is as valid as the human judgment of the specialist in tool marks. But for real tool mark comparison, the specialist in tool marks has the advantage of working directly with the exhibits, without intermediaries... Thus, in the event of an expert's testimony concerning tool marks, the opinion of the specialist in tool marks should have more weight than the opinion of a specialist in statistics, although the second one might more easily impress the jury... Numbers always look so scientific!").

124 Taroni, F., Champod, C., Margot, P. "Statistics: A Future in Tool Marks Comparison?" *AFTE Journal*, Vol. 28, No. 4, Oct. 1996, 222-229.

125 *Supra* note 124, at 126.

126 Bunch, S., "Consecutive Matching Striation Criteria: A General Critique." *Journal of Forensic Science*, Vol. 45, No. 5, September 2000, 955-962.

127 There is criticism of Bunch's work with respect to the treatment offered CMS, as CMS was criticized in the framework of Bayesian inference. *Supra* note 11.

128 *Supra* note 126.

129 *Supra* note 126. See also, Champod, C.; Baldwin, D.; Taroni, F.; and Buckleton, J.S. "Firearms and Tool Marks Identification: The Bayesian Approach." *AFTE Journal*, Vol. 35, No. 3, Summer 2003, 310 (offering that a range of likelihood ratios of 1 to 10,000+ would represent conclusions of "limited evidence to support" an identification to "very strong evidence to support" an identification. However, the assignments appear arbitrary without a definable, quantifiable basis for support.

tion. Two primary articles in support of Bayesian inference used it as a framework to critique the concept of CMS.¹³⁰ Strong responses to those articles suggested that the connections being drawn were not truly legitimate, but based in a misunderstanding of the concept of CMS and the practice of those utilizing it.¹³¹ Similar misunderstanding is apparent in Schwartz's argument as she pursued this issue of statistics.

The potential role for statistics in the firearms and tool mark discipline has been, and continues to be studied, unlike the assertion made by Schwartz. While it may have some utility in its current form, the debate among the relevant scientific community is not completely resolved. However, it is getting a significant amount of attention.

Given the incomplete picture currently offered by statistics and their potential role in the discipline, it is recommended that the reader explore the applicability of proficiency testing and error rates to assist the judicial system in evaluating the validity of the scientific basis for the firearm and tool mark discipline.

C. The Role of Proficiency Tests and Error Rates in Practical Determination of Validity of Firearms and Tool Mark Identification

While less than ideal, proficiency tests can be of value in providing a general indicator of error rates in firearms and tool mark identification.¹³² As recognized, individuality cannot be proven because it is impossible for an examiner to examine every tool in the world to a tool mark of question. Furthermore, because of the difficulty in assessing the non-quantitative aspects of firearms and tool mark identification, statistics cannot wholly answer the question.¹³³ Therefore, proficiency tests can offer to the court a reliable practical indicator of how often the profession, using accepted procedures, practices and controls, makes a false identification.¹³⁴

130 *Supra* notes 126 and 129.

131 *Supra* note 11. See also, Nichols, R. "Letter to the Editor, Re: 'Firearm and Tool Marks Identification: The Bayesian Approach,' Champod, C., *et al.* AFTE Journal, Vol. 35, No. 4, Fall 2003, 354-355.

132 Grzybowski, R.; Miller, J.; Moran, B.; Murdock, J.; Nichols, R.; Thompson, R. "Firearm/Toolmark Identification: Passing the Reliability Test Under Federal and State Evidentiary Standards." AFTE Journal, Vol. 35, No. 2, Spring 2003, 209-241.

133 See e.g., Gutowski, S., "Error Rates in the Identification Sciences," *The Forensic Bulletin*, Summer 2005, p. 23 (stating "An estimate of the actual or potential error rate is crucial to the probative value of all evidence. This is certainly true of the field and identifications sciences where hard statistics on the frequency of occurrence of a particular pattern are impossible to come by and individuality is assumed but cannot be proven.").

134 See e.g., *supra* note 132, at 216 (stating "The statement that the science of firearm and toolmark identification has a '0%' error rate is clearly not responsive to the court when questions of error rate are brought forward. The court is not interested in "theoretical error rate", which assumes everything has been done correctly and the correct answer obtained, but is interested in the real life potential error rate that is reflective of all human endeavors....To proffer that firearm and toolmark identification is "infallible" is simply not true and will be met with immediate suspicion. The court is interested in "known or potential error rate" as a means by which to assign weight to the examiners testimony. The examiner will be more credible by readily discussing the reported error rates in the process of firearm and toolmark identification (*i.e.*, the first half of the *Daubert* element) and then be prepared to discuss what steps have been taken as an individual and through laboratory peer and administrative review processes to eliminate the possibility of error in the work currently

Grzybowski *et al* recognize that even with their limitations, "Collaborative Testing Service (CTS) is currently the only source of international proficiency testing results in the firearm and toolmark identification discipline from which a source of potential error rate may be inferred."¹³⁵ Given that, the authors provide a review of the Peterson and Markham data¹³⁶ in addition to CTS data subsequent to that examined by Peterson and Markham with the specification that inconclusive conclusions are not necessarily incorrect or correct.¹³⁷ Therefore, such inconclusive conclusions will not be deemed as incorrect responses as was done by Peterson and Markham.

Given this structure of examination Robert Thompson assessed the CTS data for two time periods, the first 1978 through 1997 (the same as Peterson and Markham) and 1998-2002. The percentage of false identifications for firearms was 0.9% and 1.0%, respectively. The percentage of false identifications for tool marks was 1.0% and 1.5%, respectively.¹³⁸ Based on this evaluation the authors offer the following,

So, what does this mean for the individual examiner? The examiner must first acknowledge that errors can be made. The examiner must then be prepared to discuss the CTS tests and their limitations, and recognize that, despite their limitations, they may offer the court some indication of error. It does not mean, for example, in the instance of a 1.5% CTS error rate, that every toolmark identification case report is subject to being right only 98.5% of the time, but rather that for all those respondents, 1.5% made an incorrect association. Secondly, assuming that the work has been done thoroughly and the conclusions fully supported by clear and complete notes, it is suggested that examiners advocate that it's his/her opinion that he/she has made no error in the case at hand. It is easier to convince others of this if: 1) he or she has graphically demonstrated the basis for the opinion with the use of photographs; 2) comprehensive notes have been taken that fully support the conclusions in the lab report and; 3) the examiner's work has been technically peer reviewed and administratively reviewed per ASCLD/LAB requirements (whether or not the individual's laboratory participates in this program). Such actions would serve to further minimize any reasonable chance of error in reaching a correct conclusion and will be persuasive to those in court responsible for determining the weight to be accorded the examiner's testimony.¹³⁹

Recent validation studies might also assist in this venue. In 1992, Brundage reported on a study of ten consecutively step-broached 9mm Luger caliber barrels.¹⁴⁰ He provided thirty different laboratories across the country with pairs of test fires from each of the ten barrels along with fifteen un-being presented in court (*i.e.*, the second half of the element).").

135 *Supra* note 132, at 216.

136 Peterson, J. and Markham, P. "Crime Laboratory Testing Results, 1978 - 1991, II: Resolving Questions of Common Origin." *Journal of Forensic Sciences*, Vol. 40, No. 6, November 1995, pp. 1009-1029.

137 See e.g., Grzybowski, R. and Murdock, J., "Firearm and Toolmark Identification - Meeting the *Daubert* Challenge," *AFTE Journal*, Vol. 30, No. 1, Winter, 1998, pp. 3-14 (stating [the belief that] "this is the error rate the judicial system is interested in.").

138 *Supra* note 132, at 218.

139 *Supra* note 132, at 219-220.

140 Brundage, D. "The Identification of Consecutively Rifled Gun Barrels." Presented at the 25th Annual AFTE Training Seminar, Indianapolis, IN, June 1994.

knowns, with at least one from each of the ten barrels. In each and every instance the unknowns were properly associated to the barrel from which they were fired. At the 2003 AFTE Training Seminar Hamby reported that 294 different examiners from 15 countries had examined and compared the bullets without a single instance of a misidentification.¹⁴¹

A study that involved the ten consecutively manufactured knives was reported in 2003.¹⁴² The authors obtained 10 consecutively manufactured knives and produced a series of test marks and questioned marks. The final sharpening was accomplished with a 24" diameter grinding wheel. One hundred and three examiners provided a total of 1030 results (ten questioned marks per examiner). Of the 1030 results, there were 8 errors for a calculated false identification rate of 0.77%.

A third study involved cartridge cases fired using ten Glock pistols.¹⁴³ The total number of comparisons conducted was 360 with no errors reported.

A fourth study was directed at assessing the validity of the CMS criteria for two dimensional tool marks.¹⁴⁴ If one considers CMS to be a validate representation of a comparative examination of a striated tool mark comparison, then it may be of interest to note that of 1000 known non-match comparisons, not one violated the CMS criteria for two dimensional tool marks.

While valuable, the validation studies provide only a part of the picture. Proficiency tests offer an assessment of laboratory practice, quality assurance and quality control procedures. In addition, the wide range of proficiency tests offered involves tools and firearms from a variety of manufacturing methods. In combination, the material offered provides a good picture of how often the profession will make an incorrect association.¹⁴⁵

D. Computerized Firearms Identification is a Misnomer

The Integrated Ballistics Identification System (IBIS) is not a means of computerized firearms identification by a strict usage of the language. In fact, no such system exists as all comparisons are conducted for final determination not by computers but trained and qualified firearms and tool mark examiners. Therefore, Schwartz's assessment of the system and conclusions drawn as a result are both inaccurate and irrelevant to the issue of validation of firearms and tool mark identification and its admissibility.

In the introduction to her argument, Schwartz writes, "As will be seen, however, computerization has not eliminat-

ed the risks of misidentifications and missed identifications by firearms as well as toolmark examiners."¹⁴⁶ The current technology was never intended to even address this issue. The point of the Integrated Ballistics Identification System (IBIS) is to serve as a computerized database of data and images from bullets and cartridge cases for rapid searching of these images in an attempt to link cases that might have otherwise not been linked. As such it is an investigative aid only.¹⁴⁷

Schwartz entered into discussions questioning the accuracy of IBIS and issues involving national gun registries. Had her assertion regarding IBIS been correct, which it was not, these discussions might have had limited value. As it is, because her assertion completely mischaracterizes IBIS, these discussions are of no value. None of the material offered by Schwartz with regard to IBIS truly addresses the predominant issue of the scientific validation of firearm and tool mark identification or its admissibility.

II. The Judiciary Appears to Have a Solid Grasp of Critical Elements of Firearms and Tool Mark Identification

A review of case decisions involving evidence related to firearms and tool mark identification indicates that the court has a solid grasp on the critical elements regarding the discipline. Many elements contribute to the court's understanding regarding particular forensic science disciplines, chief among which is the expert witness's capability to articulate the discipline's scientific foundations such that the court is able to understand that there is a solid basis for the proffered testimony. Also important to understand is that such testimony takes place in a contentious environment. The scientific witness is caught in the middle of this contentiousness with a supposed goal of impartiality, to let the evidence speak for itself. Considering that testimony is often restricted, it is important that the two sides elicit from the expert witness the important items for a jury to consider by asking intelligent, probing questions.

If nothing else, the article by Schwartz highlights that the various forensic science disciplines should be probed and examined. Such probing and examination should lead to more intelligent and complete questioning of a witness such that the court will develop a fuller picture of the interpretations of the evidence being offered by the witness. That can

¹⁴⁶ *Supra* note 1, at 28.

¹⁴⁷ This was completely mischaracterized by Schwartz. See e.g., *supra* note 1, at 28-29 (stating "The National Integrated Ballistics Identification [Information] Network (NIBIN), formed in 1997, makes the BATF's [emphasis added] computerized comparison system, IBIS (Integrated Ballistics Information [Identification] System), available to federal, state and local law enforcement agencies for inputting, storing, and *matching* [emphasis added] digital images of bullets and cartridge cases that they recover from crime scenes or use crime guns to test fire. Agencies that participate in NIBIN are linked through the FBI's telecommunications network, allowing inter-agency comparisons of digital images of ammunition components."). The reader should be aware that IBIS is not the property of the "BATF" (Bureau of Alcohol, Tobacco, Firearms and Explosives). The BATF is a customer of Forensic Technologies, Inc. who markets the system not only within this country but, worldwide. Second, the system does not "match" digital images. It compares the acquired images and provides the user of the system with a scored list of potential candidates that might be linked to the questioned bullet or cartridge case. Finally, while digital images can be compared between agencies, actual confirmation takes place using the actual evidence and standard methods and procedures for firearm and tool mark comparison and identification.

¹⁴¹ Hamby, J. "An Update on the Identification of Bullets Fired From Consecutively Rifled 9mm Ruger Pistol Barrels." Presented at the 34th Annual AFTE Training Seminar, Philadelphia, PA, May 2003.

¹⁴² Thompson, E. and Wyant, R. "KIP (Knife Identification Project)." Presented at the 34th Annual AFTE Training Seminar, Philadelphia, PA, May 2003.

¹⁴³ Bunch, S. and Murphy, D. "A Comprehensive Validity Study for the Forensic Examination of Cartridge Cases." *AFTE Journal*, Vol. 35, No. 2, Spring 2003, 201-203.

¹⁴⁴ Miller, J. and Neel, M. "Criteria for Identification of Toolmarks Part III Supporting the Conclusion." *AFTE Journal*, Vol. 36, No. 1, Winter 2004, 7-38.

¹⁴⁵ An alternative is offered by Gutowski who writes, "A better estimation of error rate in casework would be most rigorously achieved by the re-examination of several thousand cases where each case was examined by a panel of experts to achieve consensus. In the absence of a massive increase in funding, this is unlikely to happen." (*Supra* note 133, at 28.)

lead only to better and sounder practice where it may have been lacking otherwise.

To conclude, as Schwartz does based on her review of case decisions, that the courts do not understand the critical elements regarding firearms and tool mark identification is inappropriate based on a more critical review of the case decisions. In opening her discussion, Schwartz states that, "No court, including the two recent courts that have excluded particular identification testimony, has recognized the systemic scientific problems with the field."¹⁴⁸ There is an alternative conclusion that is not given, that the court has examined such issues and they have concluded that they do not have the significance attributed to them by Schwartz. Considering the misunderstanding demonstrated by Schwartz in many of these issues, it would behoove the reader to give these case decisions a more critical read.

Following will be a review of some of the case decisions cited by Schwartz with some additional information being given that was lacking in Schwartz's presentation. The additional information should provide a fuller picture though the fullest could be achieved only through an examination of the decisions.

A. Firearms Cases

1. *Sexton v. State* (2002)¹⁴⁹ [Court Recognizes Potential Subclass Impact]

In this particular case, the court held that while the foundation of the discipline as a whole was sound, the specific application in this case, *e.g.*, the identification of cartridge cases to a magazine based on magazine marks present on cartridge cases, was not reliable. Therefore, the court reversed the appellate decision, which deemed that the scientific testimony was properly admitted. The case was remanded to perform an analysis of potential harm.

Schwartz vigorously opposes this more specific approach.¹⁵⁰ It should be noted that Schwartz offers her view as being opposed to that of "prominent commentators [who] have endorsed the *Sexton* court's decision to focus on the distinctive problems with the identification in the case and not consider the systemic scientific problems..."¹⁵¹ A review of the case appears to demonstrate that this latter approach was actually more appropriate than that offered by Schwartz.

The foundation for the testimony appeared to be poor. Scant references were offered and those that were did not speak directly to the issue of marks produced by ammunition magazines. There is no indication that sufficient parallels were drawn so that the court would be able to recognize that the concepts that apply to tool marks in general could be applied to marks made by ammunition magazines specifically. Finally, when questioned regarding the manufacture of such ammunition magazines, the expert could not provide the court with an explanation of how they were manufactured. In light of the absence of the actual magazines, such knowledge is essential. Considering the poor foundation the court's decision is quite legitimate, singly applied to this issue in particular.

¹⁴⁸ *Supra* note 1, at 32.

¹⁴⁹ *Sexton v. State*, 93 S.W.3d 96.

¹⁵⁰ See *e.g.*, *supra* note 1, at 34 (stating "[This] Illustrates the danger that courts focus narrowly on the problems with particular expert testimony may fail to understand the systemic scientific problems with a field of expertise and therefore write opinions that set too low a bar for the admission of future expert testimony.").

¹⁵¹ *Supra* note 1, at 34.

2. *People v. Hawkins* (1995)¹⁵² [Court Recognizes Importance of Training and Experience in Forming Identification Criteria]

The issue at hand in this particular was focused on the trial court's prerogative to question an expert witness for purposes of clarification of the evidence and in this the appellate court found there was no error and the evidence was properly admitted. Schwartz contends that the court erred in that they missed what she erroneously opined to be the point of Biasotti's work. She commented that, "Biasotti's point, however, was that absent a database and calculations of statistical significance, examiners cannot know when the resemblances between toolmarks are so great that they must have come from a single firearm."¹⁵³

However, Schwartz has erroneously characterized Biasotti's point. The primary thrust was to develop a numerical threshold at which an examiner can feel confident an identification has been effected. Alternatively, he sought to identify a CMS threshold that could define the best-known non-match. Therefore, the point of Biasotti's work was not at odds with any of the testimony and the court recognized this. The court also recognized the value of training and experience as well as how Biasotti's valuable work fit into the scheme of that training.¹⁵⁴

3. *Commonwealth v. Ellis* (1974)¹⁵⁵ [Court Properly Considers with Differing Identification Criteria and Changing Marks]

In this case, the suspect firearm was not available.¹⁵⁶ The firearms evidence consisted of an evidence bullet from the victim and bullets known to be fired from the suspect weapon into a tree. Therefore, the comparisons were of the bullet from the victim to bullets from a tree. The court contended that the evidence was properly admitted in the discretion of the trial judge and that the weight to be given the evidence was appropriate for the jury to decide.

There were two issues in particular that were addressed by Schwartz and considered by the court. One was the issue

¹⁵² *People v. Hawkins*, 10 Cal.4th 920, 897 P.2d 574, 42 Cal. Rptr.2d 636.

¹⁵³ *Supra* note 1, at 35.

¹⁵⁴ See *e.g.*, *People v. Hawkins*, 10 Cal.4th 920, 897 P.2d 574, 42 Cal. Rptr.2d 636 (stating "These experts explained that the copper jackets of the respective bullets were examined under a microscope to compare the striations or lines imprinted on the jackets. The striations are produced when the bullet is fired, and thus reflect the unique characteristics of each gun barrel. The experts compared the number and configuration of matching and nonmatching lines in the two jackets to determine that they were fired from the same gun. They conceded that ballistics identification is not an exact science. Rather, ballistics experts develop proficiency by microscopically observing a large number of bullets known to have been fired from the same gun, and from different guns, so that they acquire knowledge of when the similarities of the bullets' striations are sufficient to establish that the bullets were discharged from the same firearm... The court then asked Garbutt if his ballistic identification in this case 'was weakened any degree by having been reminded today of Mr. Biasotti's concerns about how a statistical model might lend an even additional dimension to your field?' Garbutt responded by stating that his opinion 'is not diminished and is as strong. Biasotti's article is part of my training and learning, and I do consider his work in part in forming the opinion which I have formed.'").

¹⁵⁵ *Commonwealth v. Ellis*, 373 Mass. 1, 364 N.E.2d 808.

¹⁵⁶ The court cited several cases from outside its own jurisdiction that dealt with the comparison of fired ammunition components without a firearm. These cases included *State v. Lane* (72 Ariz. 220, 233 P.2d 437), *People v. Williams* (15 Mich. App. 683, 167 N.W.2d 358), and *State v. Boccadoro* (20 Gummere 352).

of identification criteria. Schwartz claims one systemic failing of the discipline is the lack of specific identification criteria. In this case, two experts agreed on conclusions with regard to two bullets, differing on a third. Considering the expected condition of the evidence, it is not surprising that two experts would potentially disagree. One examiner concluded that while similarities did exist, the final results were inconclusive. The other felt enough information was available to declare that two bullets were fired from the same firearm.

While such situations are not typical, they are not surprising. The reader needs to be mindful of the fact that while observations are objective, the interpretation of those observations is subjective. In the absence of a specific criterion such as CMS, there will be some difference between examiners as to what constitutes the best-known non-match situation. This is especially the case with damaged items such as bullets from trees. In those comparative examinations in which the observed correspondence is borderline, it is not necessarily unexpected that one examiner would reach an inconclusive determination while another might conclude a more positive association. Therefore, with regard to this issue the court did adequately assess the limitations of the discipline and appropriately assigned the task of weight to the jury.

The second issue concerned the time elapsed between the firing of the different bullets. The court specifically addressed the issue of the character of a barrel changing over a period of time and felt that the expert witnesses adequately addressed the issue, and that it did not present a systemic problem to the overall discipline itself. In finding this, the court did address an appropriate concern but, unlike Schwartz, realized that it was not a systemic failing of the discipline.

B. Tool Mark Cases

1. *State v. Fasick* (1928)¹⁵⁷ and *State v. Clark* (1930)¹⁵⁸ [Court Is Capable of Assessing Sufficiency of Science]

Both cases involve the state of Washington, involve marks produced by knives on branches, were decided just two years apart, and yet have two very different results. The reason for the different results are linked directly to the sufficiency of the science, the court's ability to make a proper distinction between bad and good science, and issue a proper ruling based on that understanding.

In *Fasick*, the court reversed the judgment of the trial court holding that the evidence was improperly admitted. The reason was that the experimental procedure by which the examiner produced test marks and the criteria for identification were both insufficient to allow a determination that a particular knife produced marks observed on branches from a scene. In a completely appropriate ruling to reverse the ruling based on improperly admitted evidence, the court was quite scientifically inclined, addressing for itself many of the issues that can affect how a tool will mark an object¹⁵⁹ Based

on their expectations, they understood what would generally be accepted as good practice for a conscientious tool mark examination. In fact, the court was more scientifically inclined than the State's own supposed expert.

In *Clark*, the court affirmed the trial court's judgment permitting the admission of tool mark evidence involving the marks produced by a knife on branches. In making that decision the court does not ignore the previous *Fasick* decision, stating "The facts in *State v. Fasick*...distinguish that case from the case at the bar. In the *Fasick* Case there was only one mark on the two pictures admitted in evidence, which compared one with the other. In the case at the bar there are more than fifty marks appearing on the pictures of the cut surfaces of the fir boughs which can be identified as appearing on the cut surfaces of the cedar boughs."¹⁶⁰

According to Schwartz, Saks characterizes this distinction as "superficial."¹⁶¹ Based on what was presented in the written opinion and in associated references, this distinction is far more than superficial. Specifically, a review of the firearm and tool mark literature identifies this particular case as being published in the *American Journal of Police Science*.¹⁶² The examination process was far superior to that exercised by the detective in the *Fasick* case.¹⁶³ The work was compelling and detailed. Accompanied by photographs there is obvious evidence that he potentially considered CMS as there is a photograph in the work with groups of CMS delineated and counted. That he considered statistics is obvious.¹⁶⁴ The

is common knowledge that a knife with a faulty edge used in the right hand, one side of the blade being down, often makes a different impression on wood than if used in the left hand with the other side of the blade down. Again, such a knife used in the hand will oftener than otherwise make a different impression upon wood cut by it whether tested by the microscope or not, according to whether it is forced through wood at right angles, with the point forward or with the point following and according to the angle of the slant of the knife with respect to the wood cut. There was no attempt in the evidence in this case to overcome these things. The knife, pieces of boughs and photomicrographs were, of course, strong invitations to the jury to guess, speculate and conjecture, but they fell far short in our opinion of being admissible. It was in our opinion reversible error to admit these articles in evidence.")

160 *Supra* note 10.

161 See e.g., *supra* note 1, at 36, n. 163 (citing Saks who Schwartz purports, "acknowledges that the Clark opinion distinguishes *Fasick* away on the facts, but describes the distinctions as 'superficial' and criticizes the Clark court for 'fail[ing] to explain what changed in its understanding of the scientific claims of toolmark identification.'").

162 May, L.S. "The Identification of Knives, Tools and Instruments A Positive Science." *American Journal of Police Science*, 1930, 246-259.

163 See e.g., *supra* note 162, at 255 (stating "An instrument was designed by the writer resembling the human arm including shoulder, elbow and wrist joints, with variable adjustments simulating the shoulder and elbow movements. The part holding the knife has adjustments, which can be controlled and varied by a series of cams, pawls and levers, allowing the holder to simulate the degree of circumduction, supination and pronation of the wrist in the act of making a given cut. With this device it is possible to duplicate repeatedly the same cut, using the same portion of the blade each time, the blade entering and passing through the wood at the same angle with relation to the plane surface of the portion cut.").

164 See e.g., *supra* note 162, at 255 (stating "Considering only the major marks on this cut, it can be mathematically determined that no other blade in the world would make a cut like this. Invoking the law of probabilities, using the algebraic formula for determining combinations and permutations, with only one-third of the marks shown here as factors, there would only be "one" chance of there being another blade exactly like this if every one of the hundred

157 *State v. Fasick*, 149 Wash. 92, 270 P. 123.

158 *State v. Clark*, 156 Wash. 543, 287 P. 18.

159 See e.g., *State v. Fasick*, 149 Wash. 92, 270 P. 123 (stating "It will not do to compare this kind of evidence with the shoe tracks of a person or a horse, nor with finger prints, because in those cases the thing making the impression comes to rest in making the impression. It may be admitted that an edged tool with gaps in it firmly set in machinery and driven through two pieces of wood of the same kind would make practically the same kind of impression on both pieces of wood. Not so, however, with a knife used by the hand. It

court in Clark made a decision based on much more significant and compelling information than for which either Saks or Schwartz gives them credit. Furthermore, the evidence as presented appropriately addressed and answered the concerns of Schwartz such that the courts made an appropriate and informed decision.

2. *Ramirez v. State* (1989, 1995, 2001)¹⁶⁵ [Court Questions Infallibility of Firearms and Tool Mark Identification]

These three cases involved the identification of tool marks in cartilage to a specific knife. Despite the holding of the court, which finally resulted in the evidence to be excluded, Schwartz argues that even these holdings were misguided. Of these three, Schwartz argues that the first two cases dealt with the reversal of procedural issues and therefore does not discuss them.¹⁶⁶ She cites the third case in 2001 as being the one that critically examined the scientific issues, but again, still failing to see her perceived systemic failure in the discipline as a whole. Schwartz states that, "The *Ramirez III* court failed to understand that its criticisms of the expert testimony in the case were applicable to firearms and toolmarks examination as a whole."¹⁶⁷ Later she says that the "court criticized the expert for pursuing a novel method, when his identification was based on the traditional, subjective approach."¹⁶⁸

A reading of the case would show that the court did focus its direction on this particular application of firearm and tool mark identification theory and methodology. While it is true that the examiners did approach the comparative examination from the traditional perspective (evaluating and comparing patterns without quantifying them), it has already been shown that linking this traditional perspective automatically to "subjective" is not completely appropriate. Furthermore, the court was calling the method used by Hart novel based on claims of infallibility and the lack of concrete items for the court to consider as objective criteria. While the court may have erred in this characterization of a novel method, there is no question that they were rightly concerned about the claims of infallibility and poor explanation of identification criteria.

Schwartz later strongly criticizes the court for its "ignorance of the firearms and toolmark literature [which] was also betrayed in its failure to recognize that CMS is the only widely accepted alternative to the expert's traditional subjective approach."¹⁶⁹ A review of the literature focusing on CMS shows that it is not an alternative method different than the traditional approach, but, rather, an alternative means of articulating what one is observing. Therefore, her argument is misplaced.

She also states "Similarly, the court claimed that the expert's method did not have an error rate [emphasis added], instead of recognizing that, despite its insufficient rigor, CTS testing belied the expert's claim that toolmark examiners never make mistakes."¹⁷⁰ The court never claimed this. They questioned it

because they could not find evidence for claims of infallibility. With respect to this very issue the court said, "First, the record does not show that Hart's methodology – and particularly his claim of infallibility – has ever been formally tested or otherwise verified."¹⁷¹ Later the court writes, "None [studies] address Hart's testing methodology and the absolute certainty of identification deduced from such a test."¹⁷² The issue of infallibility has already been discussed at length and need not be repeated here.

Based on a review of this case, it appears that the court did have a good understanding of some of the critical issues with firearms and tool mark identification such that it recognized when appropriate questions were not being adequately addressed by offered testimony. However, that is not to say they could not have been. The concerns are readily answerable as has been discussed in Part 1. That they were not gave the court proper cause in excluding the evidence in this particular instance. To apply such reasoning beyond this case is not supported.

Conclusion

Firearms and tool mark identification is rooted in sound scientific foundations. A wealth of literature demonstrates that it has been critically studied according to the precepts of the scientific method. This has culminated in the AFTE Theory of Identification – the published statement of the relevant scientific community.

Three primary concerns of the discipline, identification criteria, the potential for subclass characteristics, and changes in tool surfaces over time, have been adequately studied and, if accounted for, do not invalidate the identification discipline as a science. Furthermore, the firearm and tool mark identification discipline has been validated in a manner appropriate for evidence of the kind to be expected in firearms and tool mark examinations. Finally, proficiency tests and error rates have been studied and can provide the court and community with a useful guide as to the frequency with which misidentifications are reported in the community using appropriate methodologies and controls.

Based on a review of the same court decisions offered by Schwartz, it appears that the courts do have adequate and sufficient knowledge regarding the intricacies of firearms and tool mark identification. Indeed, testimony offers a wonderful opportunity for the science of firearms and tool mark identification to stand the test. It appears that in those instances in which the discipline and interpretation of results has been well articulated, the courts have recognized this.

Schwartz presents some very critical issues, such as the potential for subclass characteristics and identification criteria that, if not adequately addressed by an individual examiner, could lead to an incorrect interpretation of the observations made in a particular case. Questioning, as Schwartz does, is valuable in probing the sufficiency of knowledge and application on the part of the individual examiner in a particular case. Extending this discipline-wide, as Schwartz does, is a definite error.



million people in the United States had six hundred and fifty quadrillion knives each. Using all of the marks, and the factors of depth, width, shape, etc. it would be carried to infinity.").

165 *Ramirez v. State*, 542 So.2d 352 (1989); *Ramirez v. State*, 651 So.2d 1164 (1995); *Ramirez v. State*, 810 So.2d 836 (2001).

166 Interestingly, some of the cases that were criticized earlier were held or dismissed based on similar procedural issues.

167 *Supra* note 1, at 39.

168 *Ibid.*

169 *Supra* note 1, at 40.

170 *Ibid.*

171 *Supra* note 165, *Ramirez v. State* (2001).

172 *Ibid.*

Proceedings

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Crime Scene Analyst and Critical Incidents

The Counseling Team International, D. Harris Psy.D., Retired L.A. County Sheriff's Department

At 1152 hours on August 11, 1986, Aero Mexico Flight 498 (McDonald Douglas DC-9-32) was on final approach to L.A. International Airport when it collided with a Piper PA-28-181 Archer. The DC-9 inverted and fell to earth in the residential neighborhood of Cerritos, killing 64 passengers and crew, 15 residents on the ground, destroying 5 homes, and damaging 7 others. The pilot and 2 passengers on board the Piper PA-28 were decapitated by the rear stabilizer of the DC-9 and fell into a schoolyard $\frac{1}{4}$ of a mile from the impact area of the DC-9.

At 0800 hours the following day, the National Transportation and Safety Board established a grid pattern for the entire crash site. Their rationale for doing so was not for the purpose of establishing the cause of the crash but more for the purpose of identification of the deceased.

The temperature reached the 90°+ mark and by the second day the odor of decaying flesh permeated the area. The Coroner's Office and members of the Homicide Bureau began the grizzly task of recovering body parts and continued this task until dark.

Within 10 days it was all gone. Every piece of the aircraft, every burnt cinder of 5 homes, all the destroyed cars, and every human body part had been cataloged and carted away.

Two hundred deputies from the Los Angeles County Sheriff's Department had been exposed to carnage on an incredible scale and not one deputy retired as a result of developing a stress related disability. The reason, quite simply, is because of lessons learned from the San Diego Police Department who experienced a similar incident when PSA Flight 182 crashed short of the runway approximately 2 years earlier.

Dr. Audrey Honig, Director of Employee Support Services, and her staff, conducted mandatory "defusing" and "debriefing" meetings for every member of the L.A. County Sheriff's Department that was on the scene of this **Critical Incident**. The ultimate goal of these meetings was to allow the deputies to talk about their personal experiences.

The term "Critical Incident" can be defined as *any event beyond the normal human experience*. However, what is normal in the world of John Q. Citizen and what is normal for a Crime Scene Analyst are distinctly different. Repeated exposure to the analysis of graphic violence, or the examination of physical evidence critical to successful prosecution, can cause desensitization.

The best analogy to the desensitization process is illustrated in the examination of the "hands of a carpenter." An examination of the hands of an apprentice carpenter on the first

day would reveal relative smooth and unblemished hands. The same examination on the second or third day would reveal abrasions, cuts, bruises and splinters. If the examination were conducted 6 months later, calluses would be found.

The calluses are put in place to protect the hands of the carpenter from the pain of the job. Unfortunately, crime scene analysts as well as police officers, paramedics, and emergency room personnel attempt to accomplish a similar task by placing calluses over their *emotions*. However, we all occasionally bump into gruesome situations that penetrate all the calluses we have put in place.

Dr. Nancy Bohl, Director of The Counseling Team International, identifies the reason for this vulnerability as a connection with an "anchor" to the past. The "anchor" is defined as a recollection, or sensory **connection**, to a specific unresolved traumatic event. For example, deputies at the Cerritos air crash who had also served in Vietnam, spoke of the odor of jet fuel mingled with decaying flesh being similar to their military experience. In other words while they stood in the middle of the quiet suburbs of Cerritos, their olfactory senses took them back 14 years to the hamlet or village that had recently been charred by an air strike of "snake and nape" (white phosphorus and napalm).

Memories and sensory connections to past unresolved traumatic events can be very powerful and if not normalized and validated through the **Debriefing Process** may lead the individual to ruminate about the past so intensely that the emotional pain and fear which had been carefully concealed beneath layers of emotional calluses awakens with great intensity.

This is clearly an issue for the crime scene analyst that vicariously identifies with the pain of a victim(s).

Hypothetical Example: A crime scene analyst responds to a murder/suicide. They follow the steps of the incident, which begins in the upstairs bedroom, and logically, with the presence of all the physical evidence, determine the actions of the suspect. The suspect shot and killed his wife following a heated argument. The suspect left the bedroom and fatally shot his mother-in-law in the hallway outside the bedroom. He then walked downstairs to his 7-year-old son's bedroom and shot him in the head while he lies in his bed. The suspect then walks to the bedroom next to his son's room and first shot his 12-year-old daughter lying in the upper bunk bed and then shot his 5-year-old daughter lying in the lower bunk bed. The suspect then walked to the living room where he called the police and killed himself.

When the investigation is completed, the crime scene analyst sits down in his/her car and begins to drive back to the office. The process of vicarious identification begins with one question that very well may scream out during the drive to the office.

Why Did The Children Lay There In Bed When All The Shots Were Being Fired?

Post mortem lividity clearly showed that they weren't moved. They were snuggled up in their blankets with their backs to the bedroom door. Did they not want to see what was about to happen? Was there so much anger and screaming on a regular basis that they didn't pay any attention to their parent's rage?

It is common for a crime scene analyst to vicariously identify with the victim. However, this is sure to lead to emotional trauma to you, the analyst. If possible, avoid making an emotional connection with the victim. Just don't do it.

Later, after a scene has been dealt with, back at the laboratory, the true emotional pain begins, which, if not appropriately managed, can eat away at the crime scene analyst and over a period of time and cause a number of physical and psychological problems.

Debriefings (which are a type of counseling or discussion session following a critical incident) related to a Critical Incident of this nature allow the Crime Scene Analyst to openly deal with whatever emotions they may feel and thereby prevent "getting stuck" in the quagmire of *trying to understand what the victims felt. Just don't do it.*

If you suspect you are suffering as the result of exposure to a crime scene, note these potential signals: difficulty in going to sleep, sleeping through the night, or waking early; ulcers; colitis; headaches; gastro-intestinal problems; shortness of breath; arthritis; muscle tremors; profuse sweating; always angry; depression; anxiety attacks; violent outburst; Withdrawal from friends, hobbies, family.

Here are some things to do that could help: See your doctor on a regular basis; Exercise aerobically 3 times per week for 30 minutes each time; maintain friends outside the work environment; develop and maintain a hobby; find time for yourself; find time to spend with your family; avoid self medication; avoid abuse of alcohol or sedatives; find a trusted friend and talk about your feelings; if you have strong religious beliefs, talk with your priest, rabbi, pastor, etc.; seek counseling before you are overwhelmed.

Most important! change the things you can change. identify the things you can't change. *Know the difference.*

Consider calling your employer's EAP (Employee Assistance Program) and/or seeking a **debriefing** session that may be held by the investigating police department or sheriff for the police officers. Historically, these services have been more commonly available to law enforcement officers while laboratory personnel still struggle, in the same fashion, with critical incidents.

Dr. James Harris was a Deputy Sheriff for the Los Angeles County Sheriff's Department from 1971 to 2000. While he was with the Sheriff's Department, he was a training officer, a weapons specialist, an instructor for combat shooting, investigated officer involved shootings nationwide, and provided psychological services. He has made numerous presentations to law enforcement agencies and groups throughout California. Dr. Harris is a licensed psychologist with The Counseling Team International (TCTI) in San Bernardino. He received his BA in behavioral Science from National University in Irvine in 1991. He went on to earn his masters in Counseling Psychology from National University in Irvine in 1993 and in 1999 he received his doctorate in Clinical Psychology from Ryokan College in Los Angeles. Contact their office at www.thecounselingteam.com

The Counseling Team International (TCTI) has provided psychological services to governmental agencies, law enforcement, fire & emergency services, private industries and organizations in the State of California since 1983. Dr. Nancy K. Bohl is the Owner/Director of TCTI and is internationally recognized as an authority in trauma and an expert in the field of police and fire psychology. She is assisted by TCTI Staff who are also trained experts.

Identification of Resizing Die Marks on .38 Special and .357 Magnum Cartridge Cases

Poster Presentation - Samantha Evans, CA DOJ BFS Santa Rosa

Reloading is not a hobby that is unique to the United States—approximately 15% of annual sales by RCBS, a major U.S. reloading equipment and supply manufacturer, are to buyers in Europe and Australia. Since reloading reaches across communities, cultures, and borders, it is expected that reloaded ammunition will appear as evidence in a case submitted to a forensic laboratory. In this study, thirty brass and nickel .357 Magnum and thirty brass and nickel .38 Special cartridge cases were resized with an RCBS steel resizing die, reloaded, and fired with one of three powder loads (standard, +P, or magnum). The steel RCBS resizing die was found to have a unique surface that left individual marks on the surface of the cartridge case. These marks were not affected significantly by the remainder of the reloading process or by firing, and the resized cartridge cases could be identified back to the steel resizing die. Seven .357 Magnum cartridge cases were also resized with an RCBS carbide resizing die, reloaded, and fired. The carbide die produced very few marks on the cartridge case and the cartridge cases could not be linked back to the die. *Samantha Evans is a graduate of the ATF firearms training academy.*

I Can't Believe it's not LSD!

Alice Symons, Matt Kirsten CA DOJ BFS Eureka

Alice Symons (formerly of Riverside BFS and now Eureka) co-presented with Matt Kirsten analysis of 4 bromo-2,5 dimethoxyamphetamine (aka DOB), which initially appeared to be LSD. DOB in Marquis reagent produced a brilliant green, Van Urk's gives a negative and DOB is negative under UV light. For more, contact Alice at alice.symos@doj.ca.gov. References are available.

Auto CAD-ulous

Rod Oswalt, CA DOJ BFS Central Valley

Rod Oswalt (of Central Valley, firearms section) showed Auto CAD use with aerial photography as applied to a trajectory analysis using the "skins" overlay function in Auto CAD. An easy-to-understand layout was the result of Oswalt's careful placement of information that was provided with help from his local police department and sheriff's office coordination. The criminal intelligence unit of your local agency may be able to help you provide such a display, which could be effective in analysis of a large scene. This was designed for court display ultimately, but was plead prior to its demonstration.

Islands in the Concrete: A Reconstruction

Kattina Repp, CA DOJ BFS Sacramento

Kattina Repp and others presented a husband-wife shooting they responded to that required some further firearms analysis and reconstruction. The garage floor and wall have pocked cement and plaster "islands" that were difficult to re-produce for reconstruction. If you have observed a similar pattern, contact Kattina at Kattina.Repp@doj.ca.gov.

S.T.E.P. , cont'd

Multiplex qPCR at the Jan Bashinski DNA Lab

Swango, K., Timken, M., and Buoncristiani, M.R., Jan Bashinski DNA Laboratory Richmond

Forensic scientists are always searching for better, faster, and/or cheaper ways to increase the first-pass success rate of analysis of forensic samples. Technological advances have continued to increase the sensitivity of analysis methods enabling genetic typing of samples containing minute amounts of DNA, yet there are few tools available that can simultaneously alert the analyst to the presence of inhibition and level of degradation in samples prior to genotyping so as to allow analysts to make appropriate protocol modifications upfront such that less sample is consumed overall. The Jan Bashinski DNA Laboratory has developed a triplex quantitative PCR assay that amplifies two human nuclear DNA target sequences of different length to assess DNA degradation and a third amplification target, a synthetic oligonucleotide internal PCR control, to allow for the assessment of PCR inhibition. The assay was validated on the Applied Biosystems 7500 Real Time PCR system, which is optimized for NED detection, but it can also be used on the ABI Prism® 7000 SDS instrument, albeit with a sub-optimal signal-to-noise ratio for the NED-labeled IPC. We will discuss the basic science of qPCR as well as the benefits of our qPCR assay over both the DNA quantification method currently used at the DOJ (Quantiblot) and the qPCR assay available from Applied Biosystems (Quantifiler™) and finish by focusing on results from the developmental validation which highlight the unique features of this assay and its potential utility in forensic DNA casework.



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Editor's Desk, cont'd from page 7

forensic alcohol analysis. This included not only the examination and analysis of various specimens and the biological concerns associated with them but the effects of alcohol on an individual's ability to drive. These were admittedly difficult to get through because I had no mentor to guide me through what was important to pull out of these articles. What would have been helpful, but absent, was a summation tying all these articles together so that it made sense as a whole picture. Ever try to put a jigsaw puzzle together without looking at the source? It's a definite challenge.

One solution for this would be for the various disciplines to work on developing a comprehensive summation of the scientific basis for what they do and get it published. This would go a long way towards helping the legal community understand what we do and the basis for it.

However, as great a stride forward as this would be, it would not be quite enough. What remains is for examiners to put this wealth of background into practice through good, solid casework and then, just as importantly, learn how to communicate the intricacies of the discipline to a non-scientific audience. Even with the wealth of support, the burden is not on the critics to stop criticizing or the courts simply to accept what is said *carte blanche*. The burden is on the individual examiner to step up to the plate and be effective not only in their casework but also in their ability to communicate this databank of knowledge. It does not speak for itself.

Boldly going...

"Captain's log, stardate 9529.1. This is the final cruise of the starship *Enterprise* under my command. This ship and her history will shortly become the care of another crew. To them and their posterity will we commit our future. They will continue the voyages we have begun and journey to all the undiscovered countries, boldly going where no man... where no one has gone before."

If you could not tell, I watched a favorite movie recently. But, there is a point to the last log Kirk made as captain of the *Enterprise*. There is a future that comes after us and we do have a responsibility to that future as well as our present. Our responsibility to that future is to provide the best opportunities for success and growth such that those who come after us will have the opportunity to achieve even greater heights than we ourselves did. Maybe even greater than we could have ever imagined.

Until next time, my best to you and yours.

Row

No Smoke— Just Lights and Mirrors

By Lisa Carson¹

The following footwear impression detection techniques; passed along to us by the “Bureau Voor Dactyloscopische Artikelen” (BVDA) International Forensics, prove themselves useful for the identification and visualization of footwear impressions on light-colored surfaces such as tile floors.

Searching for Footwear Impressions

Searching for footwear impressions on dark-colored surfaces can often be successful if oblique lighting is used—especially for footwear impressions that contrast well against a dark background. However, this technique is rarely useful for light-colored surfaces, on which footwear impressions contrast poorly or not at all. In addition, if fingerprint powders are used to discover and visualize footwear impressions, the fine details in the impressions may be damaged or completely obscured, potentially causing footwear impressions to be overlooked entirely. Fortunately, BVDA international Forensics has devised a good technique to visualize footwear impressions on lighter floors and other surfaces utilizing high-intensity oblique lighting and a mirror.

Step 1: Position the light source and mirror.

Position a mirror to stand on the floor to be examined. It should not stand upright but instead lean backward at a slight angle (figure 1). The angle depends on the distance between the mirror and the point from which you view the mirror. The closer you are to the mirror, the larger the angle must be. For example, if you are 6 feet from the mirror, its angle should be about 20 degrees from upright. At 12 feet, the angle is about 10 degrees.

Step 2: Use two laser pointers to indicate the footwear impression on the floor.

Use a high-intensity light to create oblique illumination (search light, ALS, or alternatively a slide projector). The path from the light-source to the mirror must be diagonal, at an angle of about 30 degrees in relation to the mirror surface (Figure 1). The footwear impressions; if present, are now visible in the mirror. However, your distance from the mirror and the angle of the mirror are critical to a successful result. Adjust these two factors until you get an image in the mirror that approximates what you would see without the mirror if you laid your head on the floor.

Step 3: Apply the Gelatin lifter so that the center-point of each end covers one of the laser dots.

Once the traces are visible in the mirror, they can be lifted. This will require that you move toward the mirror. In

doing so, you will note that the traces you just saw in the mirror will disappear. (As already mentioned, your distance from the mirror and the mirror angle are of utmost importance). To prepare for this, use two laser pointers to indicate the footwear impressions on the floor. Place one in the center of the toe of the footwear impression and one in the center of the heel of the footwear impression (see Image 1). Aim with the laser pointers on the floor in front of the mirror and then follow the movement of the dot while looking at the mirror. At this point, you know exactly where the footwear impression is located and you can lift it with a black Gelatin lifter. Holding the Gelatin lifter by its two short ends, plan to apply it so that the center-point of each end covers one of the laser dots (see Image 2). Apply one end first and then work toward the other end. BVDA recommends using a rubber roller to avoid any air bubbles.

Step 4: The footwear impression is lifted.

The footwear impression is now lifted and can be sent to the lab for further photography and examination. Image 3 shows the actual color of the floor from which the sample was lifted.

It is our goal to stay abreast of new products and methods and to share them with the field. Questions concerning evidence collection and processing can be directed to the Latent Print Branch at CM (404) 469-7040, DSN 797-7040, or email: lisa.carson@usacil.army.mil.

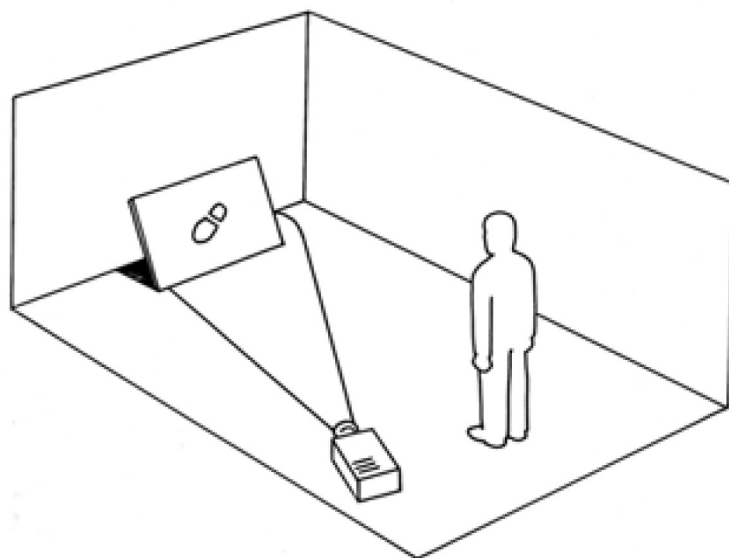


Figure 1:
Positioning the light source and mirror

¹Latent Print Branch,
US Army Criminal Investigation Laboratory
Reprinted by permission from the USACIL Bulletin, December, 2005.

UP&Coming

Spring 2006
Contra Costa (May 8-12)

Fall 2006
Riverside DOJ (Oct 9-13)

*** NORTH-SOUTH HOST**
SEASONAL SWAP OCCURS *

Spring 2007
Orange County

Fall 2007
Jan Bashinski Lab (Richmond)
DOJ DNA

Spring 2008
San Diego PD

Fall 2008
Sacramento County DA Lab

Spring 2009
San Bernardino

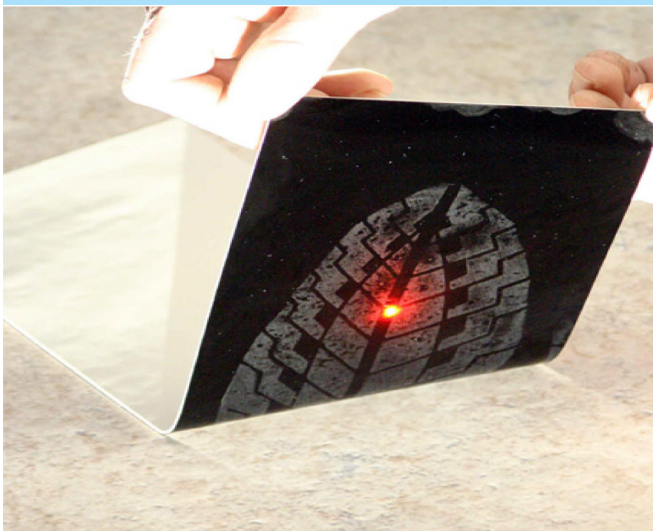
Fall 2009
Santa Clara County



1 Use two laser pointers to indicate the footwear impression on the floor



2 Apply the gelatin lifter so that the center-point of each end covers one of the laser dots



3 The footwear impression is lifted

Can't Find It?

To reduce the costs of publication, the *CACNews* may place calls for nominations and other items that were previously found in the newsletter mailing as inserts or ON THE WEB. Visit www.cacnews.org to see what is offered. Content changes periodically, so visit often!

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The Pen is Mightier than the Pipette



The skill of writing is to create a context in which other people can think.

—Edwin Schlossberg

Typos are very important to all written form. It gives the reader something to look for so they aren't distracted by the total lack of content in your writing.

—Randy K. Milholland,
Something Positive Comic, 07-03-05

I have made this [letter] longer, because I have not had the time to make it shorter.

—Blaise Pascal (1623 - 1662),
"Lettres provinciales", letter 16, 1657

The potentiality to promulgate the ramifications and judgments of the inquisitions of corporeal representations of substance perspicuously and without dubiety is an unwonted confabulation or appraised prowess amongst those practicing *forensis scientiam*.

—Keith and Norah

Today we convene at Chef Chu's in Los Altos for a change of pace, a quick lunch, and an even quicker discussion of this month's topic. One of the fortune cookies indicated that we should simplify our life, so after the weighty subject matter of several previous columns, we decide to communicate about communication; do we write and speak about our work and conclusions in such a way that people understand what we are trying to say, or does our attempt to translate science into English only succeed in obscuring the meaning of the results? After glancing at what's written on the menu, we make our choices, and decide to confine our attention to writing about writing.

The essential role of communication by a forensic scientist is rarely acknowledged within the profession. Anyone bothering to struggle through the fourth opening quote of this column should understand that this is how most science writing appears to the lay reader. That we must write about difficult technical subjects is part of the discipline, but we must not further complicate the material with poor writing. By the time an analyst has accumulated one or more science degrees from a university, it is reasonable to believe that such a graduate can parse a sentence, make tenses agree, and ensure that the subject of the sentence is acting upon the object. Failures in the area of grammar and punctuation can lead to some hilarious written opinions (see the end of this article for an extreme, but unfortunately not unusual, example). The inability to adequately express one's scientific opinion *in plain English* can lead to serious confusion and ambiguity that does not serve the criminal justice system well. Clear, succinct, and complete reports should be the goal of every analyst. The scientist risks wasting a brilliant analysis if the report is inarticulate, or worse, ambiguous in conveying scientific results.

Those who must make decisions based on forensic reports and testimony cannot understand the results for themselves; they must rely on the translation from science to English provided by the analyst. We believe that, in addition to standard laboratory proficiency, clear writing is among the skills that should reside in the arsenal of every competent criminalist.

We start with a simple example from a DNA typing report. After listing the evidence, the analyst begins an explanation of the examinations performed. Midway through the explanation, this sentence appears:

"The DNA extracts were used to analyze the gender marker amelogenin and nine short tandem repeat loci..."
(emphasis added)

At least two problems surface with this sentence. The first problem is that a literal reading suggests that the DNA typed itself! It is similar to saying that the hole was used to dig the soil; in fact, a shovel was used to dig the hole. The second is that because anyone steeped in DNA immediately knows what analysis was performed, this blinds them to the logical absurdity within the phrase. Of course, some combination of instrumentation, chemistry, hardware, and software was used to type the DNA. DNA can't be used to type anything; it can only be typed. Several alternate phrases can be constructed to properly convey what occurred, but they all involve the DNA being acted upon, not the DNA performing the action. Unfortunately, DNA folk will insist that this is a minor transgression, and the meaning is clear. To which we reply, it is not clear to someone who knows nothing about DNA, and that is precisely the person for whom the report is written.

Reviewing the reports, notes, and testimony of other analysts has provided us with numerous opportunities to assess the effectiveness of written communication among our professional colleagues. The variation among the many examples we have seen may kindly be described as uneven. While we have encountered writing that clearly and effectively conveys the complete meaning of the scientific results, we have frequently struggled through writing that leaves us wondering what the analyst intended to communicate. True, we write, in part, for a living, but we certainly claim no special adroitness with pen and paper (or keyboard and screen, as the case may be) other than a desire for the lucid expression of our thoughts and

ideas. We contend that clear writing is not a nicety in our profession, simply to be admired when encountered, but a part of the core competency of any forensic scientist. Failing to communicate our results adequately is tantamount to getting the wrong answer. Why bother to perform any analysis at all if you cannot or do not care to clearly communicate the import of your results? Why would you not want to ensure that the reader receives only the conclusion you intend? Why would you not want to clarify the capabilities of the test and limitations of the evidence? While you may be tempted to dismiss this viewpoint as extreme, we believe that poor communication sabotages even the best laboratory work. We spend the balance of this piece exploring the subtle but powerful sub-themes of competent expression.

Keith makes the point that how you write reveals how you think. If your writing is sloppy, it is likely that your thinking is also sloppy. This must spill into scientific thinking as well; if one cannot construct a sentence that flows logically from one thought to the next, it is unlikely that one can construct an experiment that flows logically from one question to the next, or that one can think critically about the limitations of the test being performed. Your skill in relating what you have done also reveals whether you are actually doing science; have you considered and tested more than one hypothesis, or are you merely looking for verification of someone's idea of what happened in a case?

This segue's into Norah's observation: If the reader already has a leaning, inclination, or bias about the meaning of a test, ambiguous writing will always be read as supporting the reader's preconceived notion. In other words, if the reader has a bias, that bias will be inflicted on the report. The report will be construed as verifying the belief of the reader, but overlaid with the patina of science that makes the belief seem fact-based rather than interpretive. The phrase "consistent with" (against which we have railed in the past) is the arch-villain of this phenomenon; it has as many meanings as writers AND readers. The person who believes that the evidence and reference can only originate from a single source will take that as the meaning of the phrase, while one who believes that other alternatives are possible will force that interpretation on the phrase. Neither may be what the writer actually meant.

If the writer is to communicate her analysis, thinking, and conclusions unambiguously, something more than a token effort at putting pen to paper is required. Sentences and para-

graphs must each have a specific point, and only one meaning. Attention to grammar and punctuation are necessary, not because your eighth grade teacher insisted on it, but because a misplaced comma or stray word may change the meaning of the phrase. Careful crafting, honing, and refining of your report will convey that a reliable scientific analysis was performed, and the conclusions carefully considered. A good report will serve to minimize reader bias; it unambiguously informs both professional colleagues and its intended audience of lay readers about your interpretation and opinion.

A competent scientist/writer will keep several tools nearby to assist in preparing comprehensible reports. We can suggest two. The first is a copy of Strunk and White's "The

Elements of Style," first published in 1952, but still the classic reference for clear writing¹. Small and inexpensive, it should occupy a place of honor on your bookshelf, and quickly become shop-worn and dog-eared from your constant perusal of it. The Chicago Manual of Style² is the classic writing reference, but may be more than most analysts want or need. A more accessible reference is an on-line resource for scientific report writing at <http://unilearning.uow.edu.au/report/2a.html>

This web site is maintained by the University of Wollongong in Australia, and contains a complete outline of scientific report writing, including sections on precisely specified results, appropriate use of figures, clear reporting of methodology, and lucid, accurate and appropriately formal expression.

We also suggest an exercise that is especially useful when composing materials for readers outside of your profession. Ask yourself at least three questions when writing a sentence: 1) What am I trying to say? 2) What words will express it? 3) Is there an analogy that will clarify the concept for the non-technical reader? Finally, read the passages out loud to yourself, and even to another person, preferably someone who doesn't know what you're trying to say. If someone without a clue finds it intelligible, unambiguous, and reflective of the totality of the conclusion, you have done your job. If the listener can inject his own bias, or can interpret a phrase in more than one way, more work is needed.

One final note about language and our profession. The word "forensic" is an adjective, and as such must modify a noun. From the Cambridge Advanced Learner's Dictionary³:

forensic

adjective [before noun]

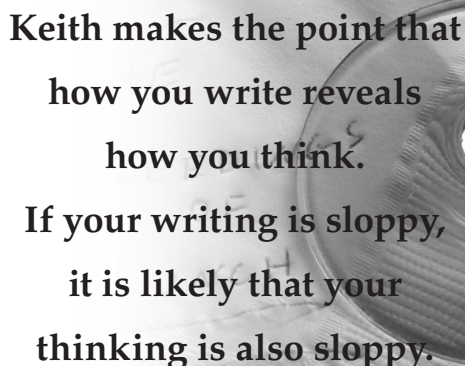
related to scientific methods of solving crimes, involving examining the objects or substances that are involved in the crime:

forensic evidence/medicine/science

Forensic examination revealed a large quantity of poison in the dead man's stomach.

The Online Etymology Dictionary⁴ traces the origin of the word to

1581, from the Latin *forensis* "of a forum, place of assembly," from *forum*. Used in the sense of "pertaining to legal trials," as in forensic medicine (1845).



**Keith makes the point that
how you write reveals
how you think.
If your writing is sloppy,
it is likely that your
thinking is also sloppy.**

John Thornton first brought this to our attention in 1975⁵.

The word “forensics” (note the final “s”) does not appear in the Cambridge Dictionary, while the American Heritage Dictionary lists the first definition as the art or study of formal debate, and the second definition as the use of science and technology to establish facts in criminal or civil court.

Deviating from the Latin origin of the word, it appears as though common usage has hijacked the adjective *forensic* and transformed it into the noun *forensics*. We would like to suggest that the proper use of the term “forensic” be confined to its adjectival antecedents, and as such we practice “forensic science,” not “forensics.”

We leave you with the example that prompted this diatribe. We have carefully examined it to ensure that it faithfully resembles the text that arrived in one of our laboratories, with the exception that specific names of weapons, evidence numbers, and photographs have been replaced with generic words within parentheses. Otherwise, there are no typographical errors. And, originating as it does from an accredited laboratory, the technical and administrative reviewers also signed off on the report.

The (questioned) bullet could not be identified nor eliminated as having been fired from the (reference) revolver. In some tests when compared to the evidence small areas of interest were apparent. However, the larger, overall picture showed many differences. The biggest difference can be seen in the photo below (not reproduced in this piece). This area photographed was present in all the tests from the (reference) revolver and were not present in the (evidence) bullet. However, since these marks are gross I could not rule out some damage that occurred to the firearm after firing which prevents any further association between gun and bullet.

So, I am concluding conservatively with a neither/nor. As is the indication is that the bullet was not fired from the revolver due to the differences in individual. But, without being able to know for sure if any subsequent event occurred to the revolver after firing, I cannot fully eliminate, especially since there are some areas of interest (just not sufficient) present.

P.S. If you find any typos in this document, you know (from one of the opening quotes) why they are present.

References

- 1 Strunk, William Jr. and White, E.B., 2000, *The Elements of Style*. Needham MA: Allyn and Bacon
- 2 The University of Chicago Press. 2003. *The Chicago Manual of Style* 15th ed. rev.
- 3 <http://dictionary.cambridge.org/>
- 4 <http://www.etymonline.com/>
- 5 Thornton, J, “Criminalistics -- Past, Present, and Future,” *Lex et Scientia*, Vol. 11, No. 1, pp. 1-44 (Jan-Apr 1975), Footnote 10 (at pg. 5)

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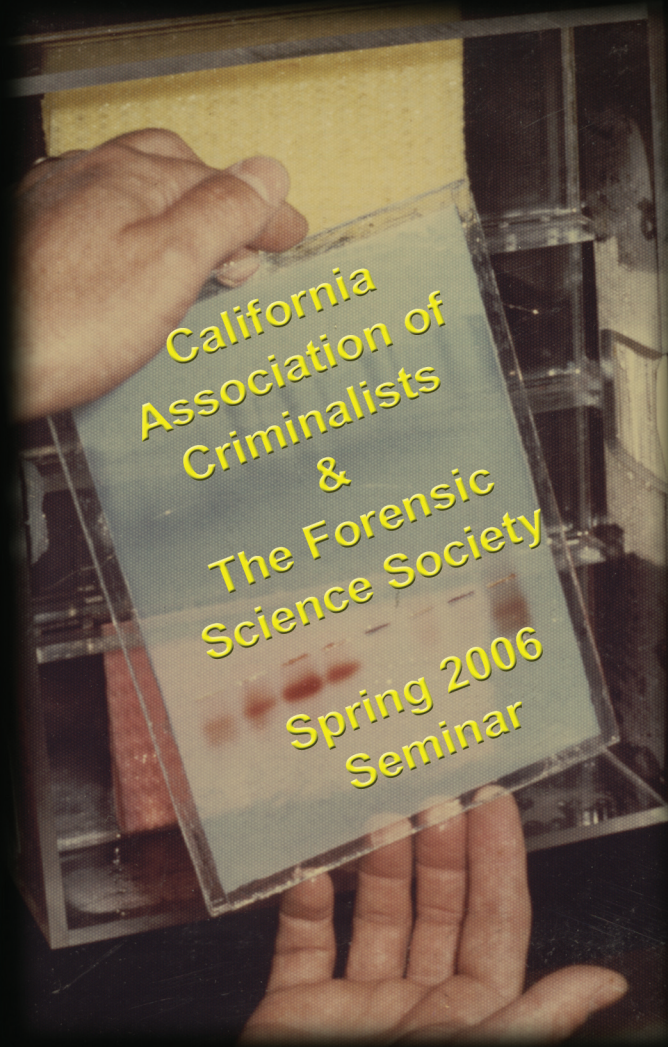
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