UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION AT COLUMBUS

UNITED STATES OF AMERICA,	:	Case No.2:08CR223-1
Plaintiff,	:	**Judge Marbley**
vs.	:	**Magistrate Judge King**
ANTHONY D. ALLS,	:	
Defendant.	:	

DECLARATION OF WILLIAM TOBIN

I, William Tobin, depose and declare as follows:

1. I have a Bachelor of Science degree in Metallurgy from Case Institute of Technology in Cleveland, Ohio, and graduate studies in metallurgy and materials science at Ohio State University and the University of Virginia. While in graduate school, I accepted an offer of employment by the Federal Bureau of Investigation (FBI) as a Special Agent in 1971. After serving approximately 3½ years as a "street Agent," I was assigned to the FBI Laboratory in Washington, D.C., as a Forensic Metallurgist, where I remained until my retirement as the chief forensic metallurgist in 1998. During my career at the FBI Laboratory, I undertook additional graduate studies in materials science (metallurgy) at the University of

Virginia, and also studies for a Master of Arts in Special Studies at George Washington University (GWU), a program sponsored and instructed by both the Forensic Science Department and Law School at GWU.

By congressional mandate, the FBI Laboratory is charged with providing "assistance to all duly-authorized law enforcement agencies" throughout the U.S. Because no forensic metallurgy component existed in any state, local, or other federal law enforcement entity in the United States, or even in most non-law enforcement entities such as OSHA, FDA, Department of State, *inter alia*, the FBI Metallurgy Unit provided requested assistance for all federal, state and local criminal, civil and nonlitigious matters, and periodically for the international community in foreign police cooperation matters. From the retirement of the Chief Forensic Metallurgist in 1986 until my own retirement in 1998, I was personally responsible for virtually all forensic metallurgical examinations requested of the FBI, for all local, state, federal, and foreign agencies. Such assistance included determination of the causes of the TWA 800 midair explosion disaster over Long Island, N.Y., the nation's worst rail disaster ("Sunset Unlimited" in Mobile, AL), the nation's second worst environmental disaster (oil spill by the "Emily Berman"), and numerous other high profile incidents. Because of the volume of high profile cases for which I was responsible, my scientific work product has been

subject to substantial public scrutiny in the United States and internationally throughout my career as a forensic metallurgist/materials scientist.

During my metallurgy studies and my tenure as an FBI forensic metallurgist, I visited many metal manufacturing and processing plants throughout the United States and Taiwan to observe a wide variety of industrial manufacturing practices in detail. I also served as a plant metallurgist in both the copper and aluminum industries. Part of my responsibilities as a plant metallurgist included evaluating toolmarks imparted by tools and dies during fabrication and production in efforts to insure efficacy of operations and production continuity, while reducing product variability and breakdown of production tooling. Additionally, I am very familiar with the current practice and methodology of firearm and toolmark examinations inasmuch as I used the same comparison microscopy instrumentation and methodology in my capacity as a forensic metallurgist. A copy of my *curriculum vitae* is attached as Exhibit 1.

2. In their evaluations of forensic evidence submitted for examinations, firearms examiners rely on markings ('toolmarks') left on bullets and cartridge casings by firearm components such as the barrel, firing pin, extractor and/or breech face of a gun during operation ('cycling') of the weapon. For conclusions of specific source attribution, one of two crucial premises upon which firearms examiners rely is that each firearm imparts individual characteristics (generally

'striae' and 'impressions') to bullets and cartridge cases cycled through the firearm that are purportedly unique to that firearm. Scientific acceptance of that premise is problematic for several reasons that will be discussed, below.

3. First, based on exhaustive literature research and review, I find no body of data, collective studies, or even single study, sufficiently meaningful and comprehensive as to warrant the premise of uniqueness status as a universal assumption in the field of forensic firearms/toolmarks practice. A relatively recent report issued by the National Research Council of the National Academies of Science has also concluded that the premise of uniqueness has not been scientifically established, stating:

> "A significant amount of research would be needed to scientifically determine the degree to which firearms-related toolmarks are unique or even to quantitatively characterize the probability of uniqueness." [1]

4. The Association of Firearms and Toolmarks Examiners (AFTE), is a trade association and is the principal source of guidelines for toolmark examiners. It is not a scientific body.

5. The "AFTE Theory of Identification" is the criterion by which examiners declare a purported "match." There is little consensus in either the scientific community or the forensic community of firearms/toolmarks examiners as to number, type, quality and characteristics of striae/impressions that must

[1] *Ballistic Imaging*, Report of the National Research Council; National Academies Press, Wash., D.C. (2008), p3.

match before a source attribution can be claimed. Within the firearm community, the AFTE "standard" that examiners are obliged to follow provides no practical guidance. Instead, it provides vague and subjective benchmarks of "sufficient agreement," "best agreement," and "practical impossibility." In more expanded form it states:

> "[a]greement 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." (AFTE Theory of Identification)

This is a subjective criterion, a characteristic that AFTE concedes. *See* 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. The National Research Council (NRC) of the National Academy of Sciences (NAS) concurs, finding:

> "A fundamental problem with toolmark and firearms analysis is the lack of a precisely defined process. As noted above, AFTE has

> adopted a theory of identification, but it does not provide a specific protocol. It says that an examiner may offer an opinion that a specific tool or firearm was the source of a specific set of toolmarks or a bullet striation pattern when "sufficient agreement" exists in the pattern of two sets of marks. It defines agreement as 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 meaning of "exceeds the best agreement" and "consistent with" are not specified, and the examiner is expected to draw on his or her own experience. This AFTE document, which is the best guidance available for the field of toolmark identification, does not even consider, let alone address, questions regarding variability, reliability, repeatability, or the number of correlations needed to achieve a given degree of confidence."[2]

6. In evaluating toolmarks used as a basis for purported individualization (specific source attribution), the forensic toolmark examiner profession defines three groups of characteristics: class, subclass and individual. Class characteristics are considered common to every member of a relatively large group of items or product, such as the number and direction of lands and grooves on a bullet that are common to numerous weapons but which still serves to reduce the population of items or products in the universe of all possible products of the general type

[2] "*Strengthening Forensic Science in the United States: A Path Forward*", National Research Council, National Academy of Science; National Academies Press (2009), p.155.

described. Subclass characteristics are produced during the manufacturing process by a tool that, during its useful life (which can encompass many production lots), leaves virtually identical markings on a number of firearms. The number of products bearing the subclass characteristics can be very large and can exist across many production lots. However, that number is a subset (smaller) population of items or product within the class defined, hence the term 'subclass.' Individual characteristics are, by definition, unique to one firearm.

7. When two metals are in forced contact with each other, the 'softer' material typically acquires characteristics of the 'harder' material (although hardness is not always the sole metallurgical determinant, it is a general guideline). Such forced contact occurs during the cycling of a cartridge through a firearm when the cartridge case is impacted (struck) by the firing pin, the cartridge head is forced (in compression) against the breech face, the bullet is propelled through the barrel, the expended cartridge case is extracted from the chamber, and the case is ejected from the weapon. Comparisons of striations and/or impressions imparted during these forced contacts are the basis of conclusions by firearms examiners.

8. Two underlying premises are critical to validity of toolmark conclusions of individualization (specific source attribution): uniqueness and reproducibility. For a conclusion of specific source attribution to be valid, the characteristics imparted by a weapon to a cartridge case and bullet must be unique

to that particular firearm and no other. In other words, the characteristics used to declare an exclusive source attribution must be individual (belonging to the particular weapon) and not subclass (belonging to one or more production lots). This is a critical distinction which will be discussed shortly. Further, those characteristics must be reproducible over repeated firings in order for successful comparisons to be made with suspect bullets.

9. The nation's most prestigious authority in matters of science, the National Academy of Sciences (NAS), concluded that the basic premises of toolmark identifications had not been scientifically established. In its report, the NAS concluded that "the needs for research are extensive" and that additional research would be required for the critical underlying premises to be "put on a more solid scientific footing."[3]

10. Notwithstanding that the premise of uniqueness has not been scientifically established, the ability to differentiate between class, subclass, and individual characteristics is *critical* to support claims of specific source attribution (individualization).

The probative significance of these markings depends on, among other factors, the particular alloys involved, manufacturing processes used to produce the part(s), type and nature of the lubrication process operative during production,

[3] Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database, National Research Council, *Ballistic Imaging* (National Academies Press 2008), at ES 2-3 and p.82, respectively, available at http://books.nap.edu/catalog/12162.html.

equipment maintenance practices, production lot sizes, product distribution, and circumstances of subsequent service. It has been my experience as a metallurgist that most metal forming operations generally impart characteristics of forced contact on the workpiece (firearm components in this case) that are overwhelmingly subclass in nature, although it is not uncommon that some individual characteristics may be present, as well.

11. The second, equally crucial, premise upon which firearms/toolmarks examiners rely is one of reproducibility (persistence): that toolmarks imparted by a firearm component to a bullet or cartridge case are persistent over sufficiently long periods of time such as to allow test firings to duplicate the conditions of the toolmarked surfaces as they existed at a previous, sometimes lengthy, period of time and across many cycles ('firings'). This premise has two significant implications, however, one at the time of cartridge cycling ("firing") and one during manufacture. The latter issue will be discussed shortly.

12. Different fabrication methods, using a variety of forming and shaping techniques, are available for production of gun barrels and other components such as the extractor, firing pin and breech face. For example, rifling techniques for barrels include swaging over a fluted mandrel, rotary hammer forging over fluted mandrel, broaching and carbide button rifling. Some processes effect rifling by metal removal (*e.g.*, broaching) and others by metal displacement (flow) (swaging,

forging, carbide button). Other metal forming, shaping, treating, and finishing processes are used for other components in each firearm, with various metallurgical considerations involved in the selection and manufacture of each component.

13. Alloys used can vary for each component in a firearm and among manufacturers, although it is not uncommon for the same alloy to be used for different components in the same product, such as both the barrel and receiver. For example, one manufacturer generally uses a cold-rolled 4140 resulfurized steel and 414 free-machining stainless steel for barrel and receiver production, respectively; another uses 416 grade resulfurized stainless steel for both.

14. To a plant metallurgist, probably the most critical consideration for many manufacturing operations in full production is tool and die wear, for several reasons. Tooling is not an insignificant consideration in production costs; various techniques are used to eliminate or reduce tool and die costs. Tooling breakdown, caused by die wear, malfunctions or failures, also results in production "down time" and is a costly consideration in many, if not most, production processes. Accordingly, efforts to maximize die life have been a dominant concern for plant metallurgists for many decades. It is so important that a very significant amount of scientific research has been, and is being, conducted in the field of tribology, the branch of engineering that deals in the study of friction, wear and lubrication of

component surfaces in relative motion against each other as occurs in most manufacturing and forming processes, and also in product service, such as bearings and gears.

15. The primary metallurgical consideration for the selection and design of tool & die materials, such as for the rifling tool surfaces, is that the materials selected remain chemically, thermally and mechanically stable under production operating conditions. Relative hardness of tool & die material is a significant consideration in die longevity but, generally unknown to toolmark examiners, *material hardness alone is generally not a sufficient indicator of wear resistance or wear performance in specific situations.*

16. In general, the use of lubricants in production tends to reduce tool & die wear by one to two orders of magnitude. However, there are some situations in which they can increase wear such as inhibiting formation of a beneficial tribofilm. They can also act as a carrier of indigenous abrasive chips and exogenous debris if not properly filtered or maintained. Further, lubricants tend to break down over various periods of time, in part depending on the nature of the production process.

17. In brief overview, it is almost always economically beneficial for a manufacturer to obtain the longest die life possible, not only out of concerns for production continuity (elimination/minimization of production "down-time"), but also because of the costs of purchasing and reworking various tool & die materials

such as tool steels and tungsten carbide. Additionally, a strong trend has existed in almost all metalworking industries to reduce variability in manufacturing processes. The effect of these motivating concerns has been increasingly larger production lots before tooling changes are required. This consequently means that the subclass characteristics (toolmarks) imparted to workpieces such as a barrels, extractors, and ejectors during production have tended to exist in larger production lots over time.

18. For some processes, particularly where primarily compressive stresses are involved, a die can last from many hours to many months (even in processes such as common nail production where 400-600 nails are made per minute) depending, in part, on production rates that are, in turn, dependent upon various parameters such as alloys involved, material temper, type of forming process, percent of cold work, lubrication, product demand, product specifications, and numerous other considerations. The general metallurgical principles involved in how subclass and individual tool markings are transferred to bullets and casings are no different in relevant aspects in the firearms industry and firearm service than they are for marks imparted to metals such as steels, copper, aluminum, *etc*. during various other manufacturing processes.

19. Due to the manufacturing processes and considerations described above, a number of firearms can be expected to exhibit significant concordance in

manufacturing subclass characteristics. It is economically undesirable for plant metallurgists manufacturing gun barrels, extractors and ejectors, for example, to accept such high rates of tool & die wear that a rifling broach or a blanking, piercing or coining die is required to be rehabilitated or resurfaced by grinding or a change of carbide inserts after only a few items are fabricated. Persistent tool and die surface characteristics, in turn, will likely impart such concordance of subclass characteristics onto bullets and shell casings that, based on the current subjective protocol and practice for rendering forensic "matches" by toolmarks examiners, it can be expected that consecutively formed components could readily be confused in specific source attributions, particularly when the examinations are temporally isolated. Due to the properties of both workpiece and die materials and to the manufacturing processes, a significant number of weapons may be indistinguishable in matchable characteristics, including any distinctions based on so-called individual characteristics.[4]

20. The seminal skill for toolmark examiners is the ability to discern subclass from individual characteristics. Discerning subclass from individual characteristics is of such importance that the profession's literature repeatedly confirms, and cautions of, the risk of confusing subclass characteristics with individual characteristics. One such article begins, "The spectre of subclass

[4] As an NRC Committee recently reported, two semiautomatic pistols purchased at the same time were found to produce sufficiently similar breech face markings that a match could be made to either weapon. *See* Report on Ballistics Imaging (2008), National Research Council (NRC) at 2-14.

characteristics has loomed over the field of firearms examination for a number of years" and indicates that it "documents an alarming example of subclass characteristics that could easily be mistaken for individual characteristics, and might lead an examiner to make a false positive identification."[5] The same article confirms other instances where consecutively manufactured pistols exhibit similar subclass characteristics.

21. Empirical confirmation of the persistence of subclass characteristics imparted by fabrication tooling was quite evident during my metallurgical investigation of the package bombing in the matter of Judge Robert S. Vance. Nails had been included as shrapnel in the bomb that killed Judge Vance. I tracked the source of nail production to header benches in the back yard of a Taiwanese citizen who produced nails for retail sale in the U.S. More than six months after the nails were sold on the U.S. retail market, exemplars removed from the then-current production in Taiwan were remarkably similar to those included in the bomb. Typical production rates for the particular equipment used in the Taiwanese manufacture, equipment also used for similar nails produced by U.S. Steel and Bethlehem Steel in my previous studies of production practices, were reportedly 444 to 595 nails *per minute*. Additionally, it was unknown how long the same tools and dies had been in use prior to retail purchase of the nails used in the bombing.

[5] Rivera, Gene C., "Subclass Characteristics in Smith & Wesson SW40VE Sigma Pistols," *AFTE J.*, Vol. 39 No. 3 (Summer 2007), at 247.

The bottom line, however, is that a staggering number of nails were assuredly produced with similar subclass characteristics. It should be noted that the five tools/dies used in the production of nails are subjected to similar stresses (primarily compressive, tensile and shear) as tools and dies used in the production of firearm and ammunition components.

22. The studies of "consecutively manufactured" guns that I have reviewed that purport to show that each manufacturing forming tool is capable of producing unique toolmarks can not be considered representative of any significant aspect of firearm production and generally do not constitute scientifically acceptable validation methodology. They are, thus, unsuitable for extrapolation as universal assumption. The small samples studied are statistically meaningless without more thorough descriptions of sampling procedures and production methods, and are not necessarily representative of all makes and all models of firearms. It should be noted that neither "consecutively manufactured" nor "consecutively serialized" necessarily means "consecutively rifled", "consecutively machined" or any other relevant critical parameter because of mass production processes allowing for interchangeability and of variation in materials handling processes existing among firearms manufacturers. For example, two "consecutively manufactured" firearms may have non-consecutively rifled barrels, non-consecutively milled breech faces, or non-consecutively formed extractors.

23. The purported validation studies of which I am aware and/or reviewed are neither double-blind nor blind, may not have involved representative sampling, and/or do not constitute a statistically significant sampling. The most informative results from such studies are obtained when tests are double-blind, when the source of the firearm specimen is unknown to the test respondent, and when the exact production and movement (within the manufacturing facility) history of each specimen is known to the study evaluator. Even the timing and manner of test specimen submissions to respondents is a significant consideration in assessing test objectivity and possible examiner influence. My review of various studies of "consecutively" produced barrels, for example, revealed that not all critical parameters related to sample acquisition, selection of and presentations to respondents, reporting of test results, and methodology for evaluating correct responses, were disclosed in all articles or reports of the studies.

24. Even if such study results were based on proper scientific methodology, it is scientifically untenable to extrapolate study results for a specific make and model of firearm to all other makes and models.

25. There are no studies in the professional literature of the Firearms/Toolmarks (F/TM) community that are sufficiently well-designed and rigorously conducted as to provide scientifically valid indicia of error rates for the practice of F/TM, nor to establish the level of confidence which can be validly

ascribed to scientific validity of the premise of uniqueness upon which F/TM examiners rely.

26. Even if, *arguendo*, a single or handful of studies are considered sufficiently scientifically rigorous as to constitute proper basis for conclusion of a rate of error, they *may* be valid *only for the particular study* indicated. This fact was recognized and acknowledged in authoritative toolmark examiner literature with the admonition that even consecutively manufactured component studies are "subjective evaluations" that are "therefore only of value to the examiner who conducted the study" or other people in their lab.[6] Such studies cannot be extrapolated or imply similar rate of error for all F/TM examinations for numerous reasons.

27. As inadequate as validation studies of barrel-to-bullet characteristic transfer has been for both premises and rates of error, there has been even less focus on what are considered lesser-important (for validation studies) components, such as the extractor, ejector, firing pin, and breech face, some of which were used for comparisons and consequent bases for claims of specific source attribution in the case *sub judice*. These components are even more amenable than barrels to mass production and are less debilitating on the forming tools, allowing much larger production lots before forming tool rehabilitation is required.

[6] Biasotti & Murdock, ""Criteria for Identification" or "State of the "Art" of Firearms/Toolmarks Identification", 16(4) *AFTE J*. (Oct. 1984), at 19.

28. As the firearms examination community has started collecting and storing images of bullet and casing markings, there is evidence that confidence in the premise of uniqueness necessary for exclusive source attributions is being undermined by the availability of more data. It is logical that as a database sample size increases, the likelihood of an adventitious cold 'hit' increases, as well, when comparing unknown or questioned specimens with 'knowns' of a sample from the population. *See* Cole, Simon A., "MORE THAN ZERO: ACCOUNTING FOR ERROR IN LATENT FINGERPRINT IDENTIFICATION", *J.Crim.Law & Criminology*, 95:3 (2005) at 1064, referencing David J. Balding, *Errors and Misunderstandings in the Second NRC Report*, 37 JURIMETRICS 469, 470-71 (1997). It has been demonstrated by study of the Integrated Ballistic Identification System (IBIS), which "…is used successfully with numerous regional…" open case file" databases…[and] performs automated comparisons between bullets and cartridge cases from different crime scenes and is the cornerstone of the National Integrated Ballistics Information Network (NIBIN) deployed by BATF." *See* Review: AB1717 report, "Technical Evaluation: Feasibility of a Ballistics Imaging Database for All New Handgun Sales", Dr. Jan De Kinder, Ballistics Section Head, National Institute for Forensic Science, Department of Justice, Vilvoordsesteenweg 98-100, B-1120 Brussels, Belgium. De Kinder noted that "…the situation [correlation, or rankings, of firearms considered likely candidates] worsens as the

number of firearms in the database is increased" [De Kinder, *ibid* at 3] and "…increasing the database size, the ranking of a cartridge case decreases substantially" [De Kinder, *ibid* at 21]. Likewise, Joseph Masson, an ATF firearm examiner, noted that "[a]s the [computer] database grew within a particular caliber, 9mm for instance, there were a number of known non-match test-fires from different firearms that were coming up near the top of the candidate list. When retrieving these known nonmatches on the comparison screen, there were numerous two dimensional similarities." Joseph Masson, "Confidence Level Variations in Firearms," AFTE Journal 29(1) (Winter 1997). These striking similarities persisted even when the examiner looked at the bullets themselves. "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." *Id*. The phenomenon is not bullet-specific; it assuredly encompasses all firearm component comparisons.

29. There are two distinct primary issues to be resolved in assessing validity of purported source attributions (individualizations) of toolmarks: not only whether the premise of tool/firearm uniqueness is valid, but also (assuming, *arguendo*, that the premise of uniqueness is accepted) how accurate examiners' attributions of source are. Even if it is assumed that a firearm is capable of

producing unique toolmarks, there is no reliable method for declaring a 'match', as has been discussed and will be discussed in more detail in paragraph 32, *infra*.

30. It should be kept in mind, particularly recalling that there is significant concordance in characteristics among known non-matches, that: examiners are seeing only a relatively small portion of a bullet surface in the field of view of between 5X and 40X stereomicroscopy; comparisons are typically based on combinations of non-unique characteristics (primarily lines); human cognitive pattern retention (from previous cases and training) is not unlimited; and significant concordance occurs in characteristics imparted from different firearms of the same manufacturer.[7] As an example, tests on six 'consecutively machined' rifle bolts found a "startlingly" high correspondence of microscopic characteristics, according to one study.[8] In another, 51.7% of 'matching lines' was observed in known non-matches.[9] The issue of cognitive retention is particularly significant in view of the highly subjective nature of toolmarks examinations and the AFTE guideline that 'match' pronouncements are based exclusively on *recollection* of previous cases and training.

[7] *See* Biasotti, "A Statistical Study of the Individual Characteristics of Fired Bullets*"*, 4:1 *J.For.Sci*. 34, 34-50 (1959), *inter alia*.
[8] See "All we want you to do is confirm what we already know": A *Daubert* Challenge to Firearms Identifications", Lisa J. Steele, 38 *Crim.L.Bull.* 465 (2002), citing "Consecutively Machined Ruger Bolt Faces", *AFTE J.*19 (Winter 2000).
[9] Miller, J., and Neel, M., "Criteria For Identification Of Toolmarks Part III: Supporting The Conclusion", *AFTE Journal*, Winter 2004, Vol. 36 No. 1. at p.9.

31. Characteristics claimed as "individual" and observed on a cartridge case or bullet, the basis by which toolmarks examiners ascribe specific source attributions (individualizations), can derive from any of several sources: during manufacturing, subsequent materials handling/processing, and/or during service. Even assuming that discernible extraneous ("individual") characteristics are introduced in the fabrication process, it is difficult to understand, even as a former plant metallurgist, how a forensic examiner far removed from the production process can reliably assess the difference between "individual" characteristics and subclass characteristics imparted during production. Without personal knowledge of the individual and subclass characteristics produced by a particular manufacturing run, an examiner cannot necessarily tell the two apart. Such knowledge must be specific to a particular production run and/or even to subsequent use in service. While some examiners have a general knowledge of how firearms are produced, such general knowledge does not provide any information in a significant number of circumstances about whether a particular mark(s) on a bullet or casing is individual or subclass in nature.[10] As a plant metallurgist, I frequently observed that some of the characteristics imparted by a

[10] Some class characteristics are similarly difficult to distinguish from subclass or individual characteristics. However, many class characteristics are reliably identifiable, such as the caliber of a bullet or the direction and number of lands and grooves. These are useful pieces of data and can dramatically narrow the range of possible firearms that could have been used to fire a particular bullet or casing. However, these characteristics cannot be used to support the absolute individualization identification claims made by firearm examiners.

die and/or during production can be intermittent over various runs, and even during a single workpiece run during production, such that even if a firearm does not share a particular subclass, or what would likely be interpreted as individual, characteristics with a consecutively manufactured firearm, it may share the characteristics with earlier or later workpieces (firearms components in this case) manufactured with the same tooling. This is assuredly why many crime laboratories do not permit individualizations without benefit of the actual firearm claimed to be the source of a bullet or cartridge case, and why numerous articles in the toolmark literature caution examiners against specific source attributions without benefit of the particular weapons suspected of firing the cartridges.

32. Firearms and toolmark examiners do not have objective criteria for declaring a match, a fact which the Association of Firearms and Toolmark Examiners (AFTE) organization and toolmarks examiner community concede. The focus of a firearms/toolmark examiner is generally on finding *similarities* and dismissing or rationalizing non-matching (dissimilar) characteristics as irrelevant, without compelling objective evidence or scientific explanation to support rejection, in effect selecting the data they wish to use to support identification. They do not employ the 'single dissimilarity exclusion rule' employed in other forensic areas, such as DNA and even the now-defunct comparative bullet lead

analysis (CBLA).[11]. The quality of both agreements and disagreements can be difficult to assess, particularly given that the characteristics used for comparison are a generally low combination (3 to 5) of non-unique geometry (lines). Unlike some forensic disciplines such as fingerprints and DNA, firearms examiners do not follow the single dissimilarity rule whereby the examiner will declare exclusion if there is a single difference between two samples. Instead, firearms examiners generally do not make exclusions based on dissimilarity of individual characteristics within a field of view, under the theory that bullets or casings fired from the same gun may pick up a number of dissimilar individual characteristics. It should be noted that, according to one study, the toolmark examiner typically encountered 15-20% matching striations between bullets fired from different firearms of the same manufacturer and type, and 36-38% on bullets fired from the same firearm.[12] *See* Biasotti, *A Statistical Study of the Individual Characteristics of Fired Bullets*, 4:1 J.For.Sci. 34, 34-50 (1959). A more recent work indicates that "…up to 25% of the striae in a non-match and more than 75% of the striae in a match will show concordance." *See* Heard, *Handbook of Firearms & Ballistics: Examining and Interpreting Forensic Evidence* (1997). Inasmuch as firearm examinations are largely subjective in nature, each examiner must decide whether

[11] Even with its numerous flaws, the forensic practice of CBLA had that aspect correct: if any analyte in one sample was considered dissimilar in quantitative presence to that in another sample, an exclusion was declared.
[12] Biasotti, *ibid*, at footnote 6.

the non-matching characteristics viewed should prevent declaration of a match. As noted by one scholar of forensic science, "[disagreements among toolmarks examiners] stem from one examiner ascribing too much significance to a small amount of matching striae and not appreciating that such agreement is achievable in known non-match comparisons."[13] Even as a metallurgist/materials scientist and former plant metallurgist concerned with tool and die life, knowledgeable about how manufacturing dies are produced, used and rehabilitated ("reworked" as it is called in industry practice), it is doubtful that I could make a scientifically valid assessment of product source exclusivity in most cases without control samples acquired contemporaneously to fabrication of the firearm component claimed as an exclusive source of characteristics observed and compared. Among materials scientists, an inference of product source attribution (individualization) absent studies with control samples acquired contemporaneously to fabrication, or without a detailed personal knowledge of the individual and subclass characteristics produced by a particular production run(s), would not be generally accepted.

33. As critical as the skill is in discerning between subclass and individual characteristics, there is no articulated technique purporting to guide examiners in that regard. To rationalize the absence of articulated protocol, literature and research for such a purported skill, practitioners repeatedly claim that the skill

[13] Faigman, D.L., Saks, M.J., *et al*., *Modern Scientific Evidence: Forensics*, 5:10 at 426: Thomson-West (2008), ISBN 978-0-314-18415-3.

derives from ‘training and experience’ and that it cannot be explained. Such an explanation raises the question as to how toolmark trainers communicate behind closed doors with trainees to recognize the difference between subclass and individual characteristics if instructors cannot articulate such differences in published articles.

34. In my reviews of underlying benchnotes of firearms/toolmarks examiners, I most frequently see no discussion or reference to subclass characteristics or “subclass carryover” but, rather, observe a direct leap from class characteristics to claimed “individual” characteristics. For example, in the case *sub judice,* toolmarks examiner Heather McClellan makes reference to “ind char’s”, no reference to subclass characteristics, and summarily declares an “ID” with the purported “ind char’s”. Such direct reference to, and use of, “ind char’s” for declaring a match strongly suggests that the examiner assumes that any characteristics beyond class characteristics *must be* “individual.” Such a leap of faith is not unexpected in view of the fervent belief in the unproven premise of uniqueness by practice advocates.

35. An easily overlooked, subtle consideration rendering the practice of toolmark associations even more subjective than it has been characterized thus far is the issue of line quality. Notwithstanding efforts to reduce subjectivity in toolmark associations by introducing an element of quantifiability, such as line

counting as promoted by the practice known as consecutive matching striae (CMS), the issue of line quality is significant, unquantifiable and inherently subjective. A claim that six lines matched is deceptive in that it is perceived as specific, objective, unambiguous and inarguable, but whether each line is of sufficient quality to be included in the count of matching striae remains a subjective determination.

36. In the case at bar, it is noted that the purported individualization was based on firing pin and breech face characteristics. Comparisons based on firing pin and breech face characteristics are known within the community of toolmark examiners to be generally the least reliable upon which to base an inference of individualization because of subclass carryover, as will be discussed below. A noted toolmark author observed, "The difficulty of addressing subclass characteristics is not in debate."[14]

37. Reasons why firing pin and breech face characteristics are tenuous bases upon which to render conclusions of individualization include: that characteristics transferred during fabrication to the very small surface area of a firing pin are extremely limited; compressive forces involved in cartridge head/breech face interactions are generally the most favorable for preservation and persistence of characteristic transfer through the life of the weapon; there are few

[14] Nichols, Ronald G., Nichols, Ronald G., "Defending the Scientific Foundations of the Firearms and Tool Mark Identification Discipline: Responding to Recent Challenges", *J.For.Sci*, May 2007, Vol. 52 No. 3, at. 587.

techniques generally used to manufacture firing pins and breech faces; and the techniques used are more amenable for persistent subclass transfer than other components such as barrels. One article by a leading proponent notes that, "It was observed that the circumferential tool marks on the surface of the firing pins, caused by a lathe-turning process, *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"[15] [emphasis mine].

38. With regard to use of breech face characteristics as a basis for individualization, the same author states, "Breech face marks can be cut, milled, or stamped. In each instance, subclass characteristics may be produced [*See* Lardizabal, P., "Cartridge case study of the Heckler and Koch USP", AFTE J. 1995;27(1):49-51. *Cf.*, Lopez, L, Grew, S., "Consecutively machined Ruger bolt faces", AFTE J. 2000:32(1):19-24]. As a result of such studies, firearm and tool mark examiners are aware that such processes can result in subclass characteristics. When suspicion of subclass is high and cannot be resolved, conscientious examiners will routinely look to other marks…"[16]

39. Subclass influence in breech face-cartridge associations has been a serious concern to toolmark examiners. One author notes,

[15] *Ibid*, at. 588.
[16] *Ibid*.

> "A number of articles regarding the presence of subclass characteristics on various parts of a firearm have been published over the years, including those that specifically dealt with tool marks produced as a result of the manufacturing process on breech or bolt face surfaces. In a 1995 article by Lardizabal [cite at fn 17, *infra*], two consecutively manufactured Heckler & Koch USP pistols were found to exhibit similarities in breech face marks, the "quality and quantity" of which, according to the author was "excellent." As a result of further testing, Lardizabal was able to establish that these subclass characteristics persisted even after numerous firings. Bill Matty authored a 1999 article that described similar correspondence in tool marks on the steel breech face inserts of Lorcin L9mm pistols [cite at fn 17, *infra*]…Lopez and Grew also found carryover of subclass characteristics among six consecutively machined Ruger rifle bolts [cite at fn 17, *infra*]…the correspondence of the circular machining marks was compelling. These examples of subclass carryover of breech/bolt face manufacturing marks, and the example to be discussed in this article, raise a concern for firearm and tool mark examiners when solely relying on these marks for identification purposes."[17]
>
> When the known non-match tests from the two pistols were compared there was a startling similarity among the impressed breech face marks.[18]
>
> The obvious and alarming similarities in the breech face marks of these two different pistols led to the search for information regarding their manufacturing process…Smith & Wesson [indicated that] "[b]oth pistols were shipped to the same local retailer on the same date."[19]

40. As indicated in paragraph 3, above, the NRC report on *Ballistic Imaging* noted that the critical underlying assumption of uniqueness had not been scientifically established. The report further indicates that, "…even with more

[17] Rivera, Gene C., "Subclass Characteristics in Smith & Wesson SW 40VE Sigma Pistols", *AFTE J.*, Vol. 39 No. 3 (Summer 2007) at 247.
[18] *Ibid* at 249.
[19] *Ibid* at 250.

training and experience using newer techniques, the decision of the toolmark examiner remains a subjective decision based on unarticulated standards and no statistical foundation for estimation of error rates", that "[a]lthough they are subject to numerous sources of variability, firearms-related toolmarks are not completely random and volatile; one can find similar marks on bullets and cartridge cases from the same gun", and that "[a] significant amount of research would be needed to scientifically determine the degree to which firearms-related toolmarks are unique or even to quantitatively characterize the probability of uniqueness."[20] Even if the assumption of uniqueness were to be scientifically established or otherwise accepted, however, the next step for assessment of the probative significance of any source attribution should be to estimate the statistical probabilities of a coincidental "match." Two metrics are required for such an assessment: (1) the likelihood that the observed results could occur if the samples had a common source (repeatability), and (2) the likelihood that the observed results could occur if the samples *did not* have a common source (uniqueness). Without valid answers to both questions, there is no way to assess probative value of the evidence for an unequivocal source attribution. However, the literature does not answer either of these questions, and firearm examiners continue to make absolute identification claims without any proof of "match" significance.

[20] All quotes from *Ballistic Imaging*, *supra* at footnote 1.

41. A major determinant of probative value of claimed "matches" is the issue of product density and distribution. Firearms products are likely not uniformly dispersed throughout the U.S. Instead, there may be some clustering effects similar to those found by bullet lead researchers, where groups of firearms produced at the same time and in the same manufacturing process cluster in one particular area or region. *See* "A Retail Sampling Approach to Assess Impact of Geographic Concentrations on Probative Value of Comparative Bullet Lead Analysis", S.A. Cole, W.A. Tobin, L. Burgess, H. Stern, *Law, Probability & Risk*, Vol. 4, No. 4 (2005), Oxford University Press (probabilities of 1 were found in some geographic areas for some product lines, meaning that consumers had no choice but to purchase the same packing coded (composition) bullets even if they wanted others). In assessing probative value of the significance of matching characteristics on a bullet or casing, one should take into account the density and distribution patterns of the particular type of firearm and, indeed, even the prevalence of other similar caliber firearm types, in a particular region. Firearm and toolmark examiners do not currently use any data on the density and distribution patterns of firearms in rendering their conclusions of probative value due, in largest part, to the unvalidated premise upon which they rely - - that no two firearms can exhibit confusing, virtually "similar", matching toolmarks. It should be noted that proponents of comparative bullet lead analysis (CBLA) maintained

the same position for almost 40 years with regard to the similar underlying premise of uniqueness and also of probative value until relatively recent research proved CBLA invalid as proffered and without probative value. *See* "Comparative Bullet Lead Evidence (CBLA): Valid Evidence or *Ipse Dixit*?", E.J. Imwinkelried & W.A. Tobin, *Okla. City Univ. LR*, Vol. 28 No. 1 (2003). *Cf.*, "A Retail Sampling Approach to Assess Impact of Geographic Concentrations on Probative Value of Comparative Bullet Lead Analysis", S.A. Cole, W.A. Tobin, L. Burgess, H. Stern, *Law, Probability & Risk*, Vol. 4, No. 4 (2005), Oxford University Press, and FBI Press Release (where FBI concedes lack of probative value) dated Sept. 1, 2005, available at http://www.fbi.gov/pressrel/pressrel05/bullet_lead_analysis.htm.

42. As the forensic system is presently structured, examiners are particularly vulnerable to various forms of observer bias. In the overwhelming majority of cases involving requested toolmark comparisons of suspect cartridge cases and/or bullets with a firearm, only one firearm is submitted. Once the examiner declares a "match", the examiner typically conducts no more examinations to see if any other firearms could have produced toolmarks as good as, or possibly even better than, the evidentiary specimens. This procedure is equivalent to a line-up with only one suspect present.[21] Examiners' expectations are that the investigating officers "got it right," with a subtle influence of "we want

[21] See Schwartz, Adina, "Challenging Firearms and Toolmark Identification—Part One", *The Champion*, Oct. 2008, p. 11, citing Judge Gertner in *United States v. Green*, 405 F.Supp 2d, 104 (D. Mass. 2005).

you to confirm what we already know."[22] The procedures for submission and acceptance of forensic evidence instill confirmation and expectation biases.

43. The vulnerability of forensic examiners to another form of observer bias, namely contextual bias, was vividly demonstrated in a study by Dror, Charlton & Peron. Experienced fingerprint examiners were naively re-presented fingerprint specimens in a blind re-test of fingerprints on which they had rendered previous identification decisions. In the new exposure, the examiners were presented with contextually biasing information in an effort to contaminate their objectivity. Although the experts were instructed to ignore all the contextual information and to focus solely on the actual prints, 80% were affected by the context and made decisions inconsistent with their original decisions. *See* "Why Experts Make Errors", Itiel E. Dror, David Charlton, *J.For.Sci.* 600 / 56 (4), 2006, at 605.

44. In another aspect of the study, only one-third of the participants remained entirely consistent across the trials. From a pattern recognition standpoint, fingerprint ridge characteristics, of which there are only seven,[23] are varied in geometry and should be easier to recall than combinations of non-unique linear striae patterns used by toolmarks examiners for comparisons. Researchers in

[22] Phrasing from Steele, *supra.*
[23] See "Psychological Aspects of Forensic Identification Evidence", William C. Thompson & Simon Cole, in *Expert Psychological Testimony for the Courts*, Lawrence Erlbaum Assoc. Publishers (2007), at 36.

the Dror study were most alarmed with the data points of inconsistent decisions made *even in the context-free* controls. They reasoned that the data suggest the possibility, at least for subjective evaluations (such as toolmarks and fingerprint comparisons), that expert decisions are inconsistent across time *regardless of contextual biasing contamination*. Dror, *ibid* at 613.[24]

45. It is impractical to assess reliability of toolmarks examiners' ultimate inferences of individualization (specific source attribution) because of subjectivity of the methodology, the lack of scientific basis for examiners' claims of specific source attribution (exclusive firearm individualization) in general, and because of the absence of an effective feedback loop. Typically, examiners conduct their examinations, render subjective conclusions without comprehensive and meaningful underlying research and data, compile a report, and frequently testify as to their conclusions. They then proceed with casework in their respective laboratories. Except in very rare circumstances (such as the Brandon Mayfield matter discussed below), there is no effective mechanism to determine the "ground

[24] In view of the obvious pattern recognition difficulties demonstrated by subjects in the Dror study, it is even more apparent that the AFTE Theory of Identification cannot be reliably applied in practice to establish the statistical certainty required of exclusive source attributions. As noted by Risinger, *et al*, "…reliability cannot be judged "as drafted," but must be judged only specifically "as applied" for the task at hand." Risinger, *et al*, *supra*, at 6. I have not found any database, statistics, data, research, or studies that have scientifically established the boundary conditions of the AFTE Theory, or even any metric by which they could be assessed. Further, in my opinion, pattern recognition of linear striae is a perishable skill with limited cognitive shelf life. I have found no research or studies confirming, or even establishing, the extent of human capacity for cognitive pattern retention of individual linear striae or impressions over spans of hours, days, months or years between observations.

truth" of their opinions and testimonies and, thus, rate of error, as to false positives, as discussed in further detail in the next several paragraphs.

46. Errors in source attribution are unlikely to be discovered for a number of reasons. For one, the AFTE community is a very close and closed one. Peer reviews in such a closed community are vulnerable to another phenomenon in social psychology and research methodology known as "confirmation bias" which has been recognized by researchers at least as early as 1620 (*see* Francis Bacon, Novum Organum, Book I, 109, point 46 (1620), *reprinted in* 30 Great Books of the Western World 110 (Robert M. Hutchins ed., 1952)) and demonstrated by numerous researchers, "…especially in those forensic science practices utilizing subjective human judgment as their primary instrumentality and not based on techniques derived from normal scientific methodology." *See* Risinger, Saks, Thompson & Rosenthal, "The Daubert/Kumho Implications of Observer Effects In Forensic Science: Hidden Problems of Expectation and Suggestion", *Cal.L.R.* 90:1 (2002) at 6. Confirmation bias, one of a number of biases revealed by researchers (*see* Paul Giannelli, "The Abuse of Scientific Evidence in Criminal Cases: The Need for Independent Crime Laboratories", 4 *VA. J. SOC. POL'Y & L.* 439 (1997) for discussion of "pro-prosecution bias"), is a cognitive bias of selective thinking whereby one tends to notice and look for information that confirms one's existing beliefs while ignoring anything that contradicts those beliefs. It is of most concern

in practices involving subjective inference, such as in firearms/toolmarks examinations, and was most recently implicated in the high profile and sensational misattribution matter of Brandon Mayfield, an American attorney accused of a terrorist bombing a train in Spain, where multiple fingerprint examiners (including one of the defense experts), quite experienced and held in high esteem within their community, peer reviewed the original fingerprint source attribution and confirmed it.[25] As noted by Cole, "The fact that defense examiners have corroborated disputed identifications indicates that expectation bias may be even more powerful than the expert's bias toward the party retaining her." [emphasis mine] *See* Simon A. Cole, "More Than Zero: Accounting for Error in Latent Fingerprint Identification", *J.Crim.Law & Criminology,* 95:3 at 1061.[26] Realizing that the courtroom is not a laboratory, even the "test of time", also known as "implicit testing", as suggested by the lengthy admissibility of toolmarks testimony and conclusions, is not a valid measure of practice validity or rate of error because of

[25] As noted earlier, fingerprint comparisons are used as examples because of the similarities in pattern recognition practice. In reality, fingerprint comparisons should be less prone to error because of the accepted premise that fingerprints do not change over time, and because identifications are based on more varied geometric patterns (whorls, tented arches, *etc*.) than merely lines.

[26] Both practices of fingerprint comparisons and toolmarks comparisons are based on entirely subjective methodologies of pattern recognition. Additionally, both result in opinions of individualization: that the characteristics could only have derived from one source (person or firearm) in the world. Accordingly, the contextual, observer and confirmation biases, and inconsistency issues of fingerprint examiners, are relevant in reviewing the methodology of firearm and toolmark examiners. Indeed, there are 7 varied geometric patterns used for fingerprint comparisons, assuredly allowing easier discrimination of characteristics than comparing striations (lines) in toolmarks; yet dramatic misidentifications have been reported using even the 7 more complex fingerprint patterns.

the absence of effective feedback loop for expert witnesses testifying to exclusive source attributions.

47. One reason for the absence of effective feedback loop is that there has been virtually no comprehensive and meaningful research to establish the "ground truth" for determination of the accuracy of case-specific source attributions, or even valid generic rates of error. Secondly, as posited by Haber & Haber, "…the entire legal system conjoins to make erroneous identifications undiscoverable."[27] There are few avenues available for expert witnesses to learn of individualization or source attribution errors other than by pure accident. In the profession of toolmarks examinations, alternative reliable techniques for discovering misidentifications are rare. Because there is no scientifically reliable feedback loop for an examiner's individualization process, claims of low rates of error are without foundation. S*ee* "Simon A. Cole, "Implicit Testing": Can Casework Validate Forensic Techniques?, 46 Jurimetrics J. 117–128 (2006). *Cf.*, Saks & Koehler, *supra.*

48. Additionally, it is my experience and opinion that current proficiency tests are virtually worthless in establishing rates of error for forensic practices. Current proficiency testing is problematic, including: (a) that the tests are generally

[27] "Error Rates for Human Latent Fingerprint Examiners", Lyn Haber and Ralph Haber, in *Advances in Automatic Fingerprint Recognition*, Ch. 17, pp.337-358, edited by Nalini Ratha & R. Bolle; Springer-Verlag Publishers: (New York, 2004). Haber & Haber describe how defense attorneys, the defendant, police investigators, the profession itself (represented by professional organizations), jurors, and society contribute to making false positive source attributions undiscoverable.

not double-blind or even blind, likely resulting in reduced rates of error from extraordinary caution in declaring 'matches', particularly inasmuch as 'inconclusive' is permitted and is not counted as an incorrect response, or responses are not required, (b) samples are most frequently not "real-world" and are significantly easier than actual case circumstances, (c) examiners are sometimes familiar with the control samples such that complete analyses are not even necessary (if in-house control samples are used), (d) concerns over examiner credibility (damaging test results in personnel files can potentially destroy the career of an expert witness) resulting in lax administrative policies over reporting examiner failures, (e) bureaucratic concerns over agency image, (f) camaraderie, [with (d), (e) and (f) providing ample incentive to allow respondents to repeat tests until they "get it right"], (g) no direct control over who participates in the testing process (*e.g.*, possible 'group' effort not normally operative for casework), and (h) no retention of the incorrect result records. *See also* "The Individualization Fallacy in Forensic Science Evidence", Michael J. Saks & Jonathan J. Koehler, at 14, available at:

http://works.bepress.com/cgi/viewcontent.cgi?article=1000&context=michael_saks.

Notwithstanding that the two most appropriate disciplines for assessing experimental methodology and conclusions of toolmarks examiners are metallurgy/materials science and statistics, to my knowledge, understanding and

belief, there has been no significant cross-discipline input from materials scientists or statisticians ever sought by the Association of Firearm and Toolmark Examiners (AFTE) or SWGGUN (Scientific Working Group for Firearms & Toolmarks) for purposes of peer review or other scientific input into any major studies in the development or testing of the methodology used by firearm examiners for exclusive source attributions. In fact, several scientific validation study proposals have been rebuffed by potential participants.[28] It is my opinion, and that of various academicians, scholars, and scientists, that the AFTE community will likely not be motivated to participate in such studies for determination of realistic rates of error until the weight of court rulings influences it otherwise. Until only recently by distinguished scholars and the NRC/NAS, there was little extrajudicial interest in toolmarks comparisons. Decades of acceptance by a relatively small, closed community of toolmarks examiners does not constitute general acceptance within the scientific community, of the ultimate inference of individualization as typically rendered. Further, it is my opinion that the exclusive source attribution testimony in this matter is not based on scientifically accepted validation methodology and is, thus, without scientific foundation.

[28] For one, see Metropolitan Police Department (MPD), Wash., D.C., representative M. Anzallo e-mail to C. Spiegelman, Distinguished Prof. of Statistics, Texas A&M, dated April 2, 2009, wherein the MPD declined to participate in a National Institute of Justice (NIJ) study of rates of error in source attribution for toolmarks examiners (available from affiant or Spiegelman at cliff@stat.tamu.edu). The FBI Laboratory Firearms/Toolmarks Unit also declined a similar invitation.

49. According to the most recent committee of the NAS studying forensic science, "Among existing forensic methods, only nuclear DNA analysis has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between an evidentiary sample and a specific individual or source."[29]

50. Exclusive source attributions such as were rendered in the case at bar are without scientific foundation. Inferences, implications and assertions of "to the exclusion of all others", "reasonable scientific certainty", "zero error rate", "infallible methodology" and "were fired from [a particular] gun" are inherently probabilistic. An earlier NAS report concluded that, "Conclusions drawn in firearms identification should not be made to imply the presence of a firm statistical basis when none has been demonstrated."[30] In particular, the NAS report on Ballistic Imaging was concerned about testimony cast "in bold absolutes" such as that a match can be made to the exclusion of all other firearms in the world: "Such comments cloak an inherently subjective assessment of a match with an extreme probability statement that has no firm grounding and unrealistically implies an error rate of zero."[31]

[29] National Research Council, National Academy of Sciences, "Strengthening Forensic Science in the United States: A Path Forward", National Academies Press (2009) at 3-12.
[30] National Research Council, National Academy of Sciences, report on Ballistic Imaging 82 (2008).
[31] "The NAS Report And Its Implications for Criminal Litigation", Paul C. Giannelli, *Jurimetrics*, April 22, 2009 [May 6, 2009], citing NRC/NAS Report on Ballistic Imaging 82 (2008).

51. Reaction in the AFTE community to the NAS Report has been predictable. As noted by one forensic and legal scholar,

> "The intransigent response [from the AFTE community] has been to question the scientific authority of the NAS and to repeat, vociferously, various tired arguments that the NAS Report considered and rejected. Intransigent responders continue to argue, for example, that the pattern matching disciplines have *already* been validated (although they cannot cite relevant studies) and that their error rate is zero (although many errors have been exposed).
>
> Their biggest canard is an argument that Prof. Simon Cole has called "the fingerprint examiner's fallacy" (although the same argument is advanced by toolmark and bite mark analysts, among others). According to this argument, trained analysts can tell by looking whether particular marks (such as…toolmarks…) are "unique" and can therefore determine with absolute certainty whether two such marks had a common origin. As the NAS Report recognized, there is no proof that such marks are unique or that analysts could tell if they were, and hence no reason to believe that what an analyst decides to call a "match" between two marks is proof that the marks have a common origin. Nevertheless, forensic scientists keep arguing that because the marks they identify are "unique," their identifications must be infallible."[32]

52. Relating to the required premise of uniqueness upon which F/TM relies, and of the probabilistic reasoning involved in individualizations, one final observation relating to what has been termed "the individualization fallacy in forensic science evidence" is demonstrative. As has been observed by Saks & Koehler,

[32] Professor William C. Thompson, as quoted by Quintin Chatman, "How Scientific Is Forensic Science?", *The Champion*, NACDL, August 2009, at 40.

> "Although [characteristics] that rarely occur *might* be unique [emphasis in original], it is a fallacy to infer uniqueness from profile frequencies simply because they are smaller than the number of available objects. A simple analogy clarifies this point: Imagine a machine that prints lottery tickets with numbers 00 through 99. This machine can print 100 different tickets. Suppose that each of 10 customers purchases one ticket and that the machine generates ticket numbers at random, with replacement. The total number of unique tickets that could be sold (100) exceeds the population of customers (10) by a factor of ten. And yet there is no law of mathematics or nature that prevents two (or more) customers from being issued different tickets bearing the same number. Indeed, the probability of that happening is nearly 40%."[33]
>
> …The concept of "individualization," which lies at the core of numerous forensic science subfields, exists only in a metaphysical or rhetorical sense. It has no scientific validity, and is sustained largely by the faulty logic that equates infrequency with uniqueness.
>
> …Individualization implies uniqueness.[34] Individualization refers to "absolute specificity and absolute identification."[35]

53. My opinion that F/TM individualizations are scientifically unsupported and constitute intuition-based speculation is shared by prominent scholars and the National Academy of Sciences. In recommending a solution, Saks and Koehler suggest:

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[33] See Saks & Koehler, *supra*, at footnote 6, additionally explaining that "[t]his computation is similar to that used to solve the famous 'birthday problem' in which the probability that two people in a small gathering would have the same birth date is found to be far greater than human intuition would suggest."

[34] *Ibid*, at 3, citing John Thornton and Joseph Peterson, "The General Assumptions and Rationale of Forensic Identification*,"* in David Faigman, David H. Kaye, Michael J. Saks, and Joseph Sanders (eds.) 4 MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY ((2005-2006 ed., 2005) at 8.

[35] *Ibid*, at 3, citing David A. Stoney, "What Made Us Ever Think We Could Individualize Using Statistics?", 31 *J. FORENSIC SCI. SOC'Y* 197, 197 (1991).

> "For the present, when criminalists cannot distinguish a questioned pattern from a known pattern (*i.e.*, when they judge a questioned and a known pattern to be indistinguishable, consistent, or to "match"), they should report that finding with appropriate clarity and restraint. For example, they could explain that a conclusion that two patterns are consistent (or a match) does not require a conclusion that the patterns share a common source. Once they have explained this point, criminalists should resist the urge to draw a source conclusion -- or any other inference -- that is not supported by sound theory and hard data. (Judicial thinking can be found that approximately parallels this restraint.[36])
>
> Examiners could explain that, in finding that two patterns match, they have placed the suspect object or person in a pool of one or more objects that match the evidentiary marks. The strength of the likelihood that the known object or person shares a common source with the questioned object or person depends upon the size of the pool. No scientific justification exists for assuming that the size of the pool is 1. And, for most areas of criminalistics (other than DNA…), there are no empirically grounded estimates of how large such pools might be. Experts should not substitute their intuition or judgment in an effort to fill these knowledge gaps. The speculation of an examiner about the size of those pools is not scientific evidence. It is, simply, speculation."[37]

54. In summary, the forensic practice of firearms/toolmarks associations lacks the rigor of science and should not be permitted to render inferences implying an aura of infallibility generally associated with scientific endeavor.

[36] See *United States v. Hines*, 55 F. Supp. 2d 62 (D. Mass. 1999); *United States v. Llera-Plaza I*, 2002 WL 27305 (2002).
[37] Saks & Koehler, *supra*, at 11.

I DECLARE UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT.

Executed on: _____
(Date)

_____
(Signature) s/William Tobin