

The background is a dark blue gradient. A thin, light blue curved line starts from the upper left and arcs across the middle. A larger, lighter blue curved shape is positioned in the lower right quadrant, partially overlapping the main text area.

The Art of Firearm-Related Toolmark Identification

The goal of FATM analysis

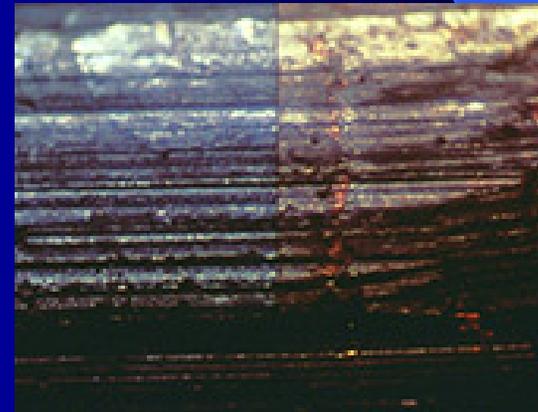
To determine whether a particular firearm produced the markings on a bullet or cartridge case associated with a crime

How?

Generally:

- Markings on bullets and cartridge cases believed to be associated with a crime are compared against
- Markings on bullets and cartridge cases test fired from a firearm believed to be associated with a crime
- Evidentiary “show up”

Tools

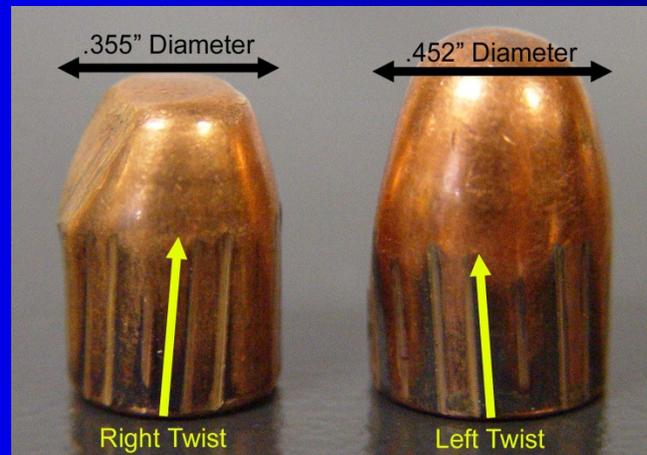


What markings are used for comparison?

- Scratches (“striae”) and impressions left by the interior surface of the firearm
- Markings fall into three categories:
 - Class
 - Individual
 - Subclass

Class Characteristics

- Characteristics that are shared by bullets and cartridge cases fired from the same make and model of firearm
- E.g. Direction of rifling, number of lands and grooves, shape of firing pin impression



Individual Characteristics

- Characteristics that firearms examiners believe are unique to a firearm, resulting from some combination of irregularities in the machining process and imperfections that emerge during the subsequent use of a firearm
- No definition of what makes a mark unique – subjective decision by the examiner

Subclass characteristics were not recognized until 1989

Until 1989, there was a binary system. All marks were deemed either:

- Class characteristics shared by all firearms of a given make and model, or
- Individual characteristics unique to a single firearm.

Misidentifications ensued

- Misidentifications resulted even though so-called “individual” marks lined up
- Historical note: the first time a FATM identification was introduced into evidence in a criminal trial – resulting in a death sentence for the defendant – the examiner’s declared match between several bullets and a revolver *turned out to be wrong*.

Courts rejected the testimony of firearms examiners

“We are being viewed less and less as Hi [sic] Priests. . . . We are putting the courts in an increasingly difficult position. We ask that they believe us when we testify about individualizations. They ask us to tell them why they should. We respond with the usual subjective and Art [sic] form answers. They reject them.”

-- Letter, John Murdock and Al Biasotti to
Lucien Haag, AFTE President
July 22, 1985

A committee is convened to address the problem

Murdock & Biasotti:

- “Is there a way that we can provide answers more acceptable to both our members and the courts?”
- “Many people are turned off by the need for th[e] sophisticated research [required to establish objective criteria]. Many of our members, including myself, don’t understand all of it.”

Haag:

- “[T]he problems are real. . . . Transcripts of diverse and confusing explanations of our ‘science’ (trade, skill, art – which is it?) will emerge.”

Four years later...

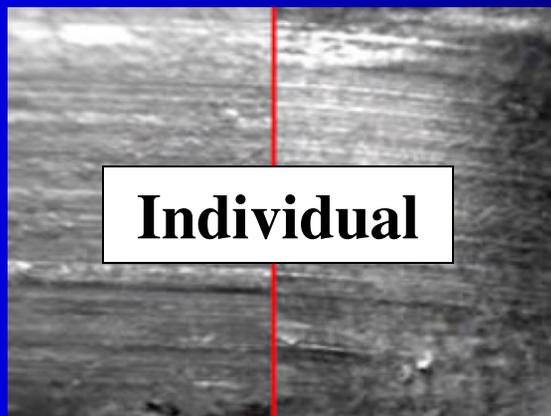
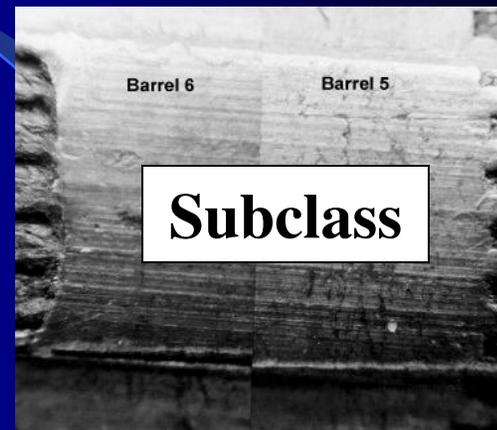
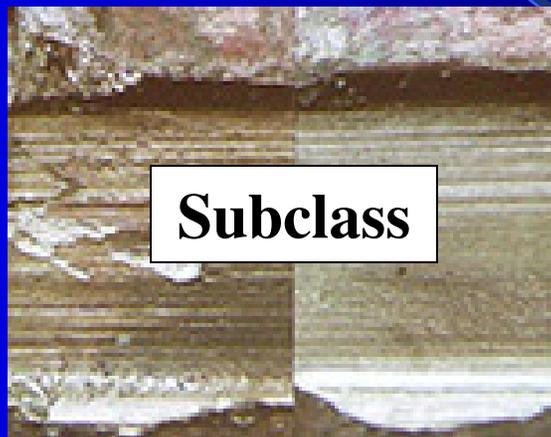
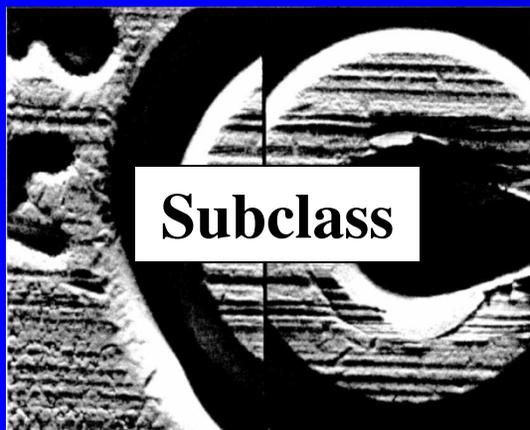
The results of the Criteria for Identification Committee's work are produced in 1989:

- Recognition of subclass marks
- AFTE Theory of Identification
- Range of conclusions

Subclass characteristics

- Marks shared by a subset of firearms of the same make and model
- Like “individual” marks, produced by irregularities in the machining process
- Nothing distinctive about subclass marks that allow them to be readily distinguished from “individual” marks

Subclass v. Individual



In other words...

Subclass marks are by all appearances “individual” marks that turn out not to be individual after all

Changes in manufacturing are decreasing “individual” marks while increasing subclass marks

- “[M]ass production of guns has replaced hand-manufacturing” *US v. Mouzone*
- Manufacture under “precisely controlled” conditions imparts “recurring patterns” of marks. D. Baldwin, *Statistical Tools*
- Tools have become more durable, enabling their use in ever-larger production runs. P. Kirk, *Crime Investigation*

Even FATM examiners recognize a potential problem

“As techniques of firearms manufacture have evolved, following mostly commercial rather than forensic arguments, this hypothesis [of uniqueness] needs to be verified on a regular basis.” M.S. Bonfanti & J. De Kinder

Warning signs that the problem is real

- Studies show that bullets and cartridge cases fired from **different weapons** can and sometimes do have **more matching marks** than bullets fired from the same weapon.
- As federal databases have grown, known non-matches have appeared **closer** to the top of the candidate list than known matches

Anecdotes about “troubling” subclass marks abound

See, e.g., Patrick D. Ball, *Toolmarks Which May Lead to False Conclusions*, 32(3) AFTE J. 292 (2000); Robert H. Kennington, *'Ejector' Type Marks on Unfired Cartridges*, 19(4) AFTE J. 452 (1987); Evan Thompson & Rick Wyant, *9mm Smith & Wesson Ejectors*, 34(4) AFTE J. 406 (2002); Tsuneo Uchiyama, *Similarity among Breech Face Marks Fired from Guns with Close Serial Numbers*, 18(3) AFTE J. 15 (1986); Peter P. Lardizabal, *Cartridge Case Study of the Heckler & Koch USP*, 27(1) AFTE J. 49 (1995); Evan Thompson, *False Breech Face ID'S*, 28(2) AFTE J. 95 (1996); Vincent J. Lomoro, *32 SWL Caliber F.I.E. Corporation Titanic Revolver*, 6(2) AFTE J. 18 (1974); Laura L. López & Sally Grew, *Consecutively Machined Ruger Bolt Faces*, 32(1) AFTE J. 19 (2000); Richard K. Maruoka, *Guilty Before the Crime? The Potential for a Possible Misidentification or Elimination*, 26(3) AFTE J. 206 (1994); Richard K. Maruoka, *Guilty Before the Crime II?*, 27(1) AFTE J. 20 (1995); Chi King (Beta) Tam, *Overview of Manufacturing Marks on Center Fire Cartridges*, 33(2) AFTE J. 112 (2001); William Matty & Torrey Johnson, *A Comparison of Manufacturing Marks on Smith & Wesson Firing Pins*, 16(3) AFTE J. 51 (1984); Ronald Nies, *Anvil Marks of the Ruger MKII Target Pistol -- An Example of Subclass Characteristics*, 35(1) AFTE J. 75 (2003); *see also* M.S. Bonfanti & J. De Kinder, *The Influence of Manufacturing Processes on the Identification of Bullets and Cartridge Cases - A Review of the Literature*, 39 Sci. & Justice 3, 5 (1999) (reporting that for some handguns “a correct identification of the firearm on the basis of the breech face and firing pin impression, turned out to be hardly possible” and for different guns “it was impossible to identify the tool which generated the subclass characteristics”).

AFTE Theory of Identification

- Identification opinions can be rendered when there is “sufficient agreement” between toolmarks.
- “Agreement is sufficient when it exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with agreement demonstrated by toolmarks known to have been produced by the same tool.”
- When agreement is “sufficient”, the likelihood of a coincidental match is “so remote as to be considered a practical impossibility.”
- Whether agreement is “sufficient” is left entirely to the examiner’s subjective judgment

In other words...

The examiner is told to think back to the best matching non-match she can remember. If she can't remember a better match than what she is seeing now, then it's practically impossible the match is coincidental.

Think back to the comments
by the committee head . . .

Murdock:

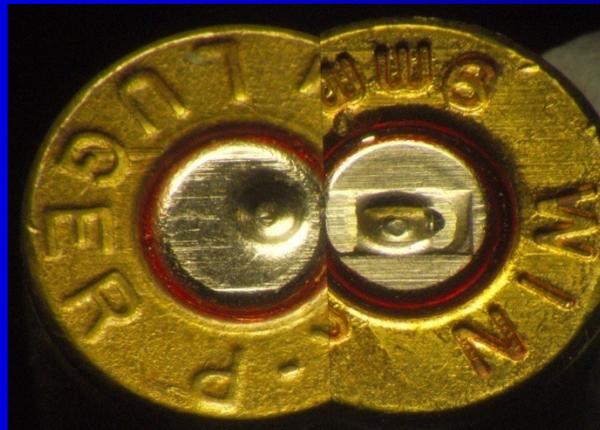
Is there some way we can come up with
answers without doing research?

No research; no protocols to limit subclass influence

- **NO** organized study of subclass marks associated with different firearms
- **NO** requirement that FATM examiner have familiarity with subclass marks created by the suspect firearm
- **NO** organized study of subclass marks associated with different manufacturing methods
- **NO** requirement that FATM examiner understand manufacturing processes used
- **NO** requirement that FATM examiner test fire other firearms of same make and model

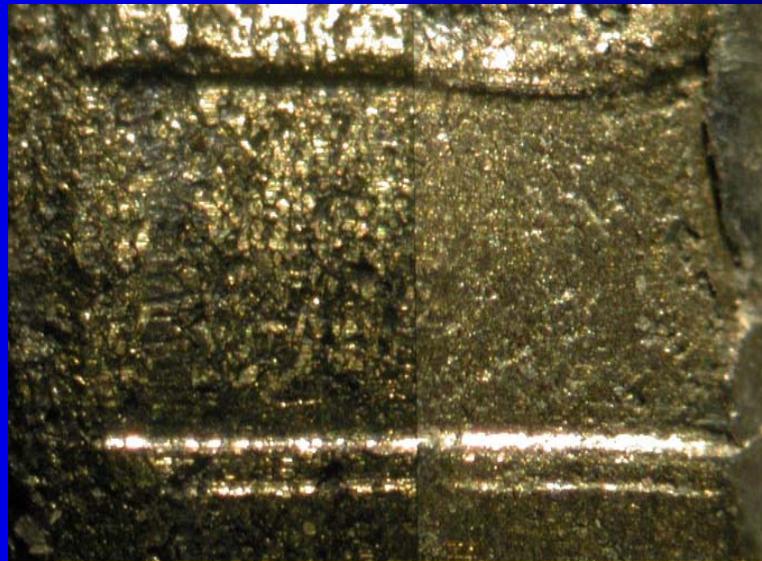
Range of conclusions

- Identification: “sufficient agreement” of individual characteristics; all class characteristics match
- Elimination: examiners are strongly encouraged to reserve for situations where it is evident the bullet or cartridge case was fired by a firearm of **different make and model** than the suspect firearm

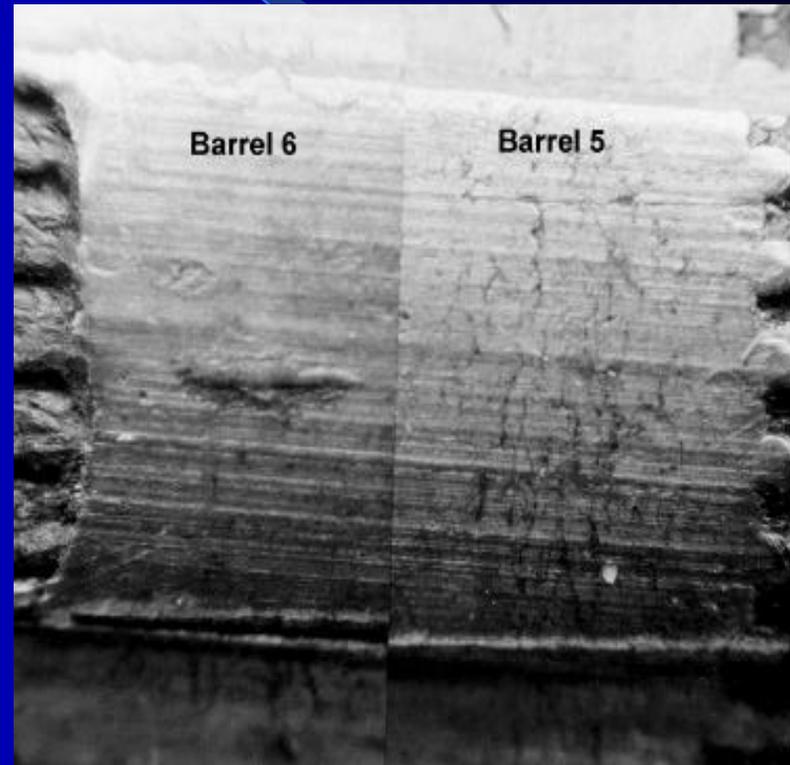
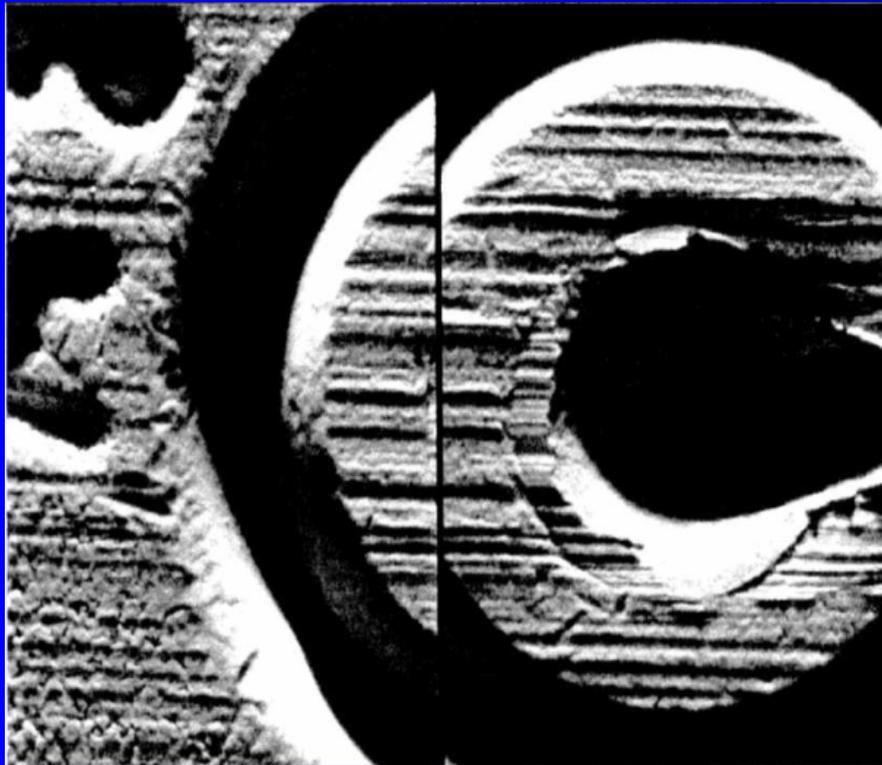


Range of conclusions (cont'd)

- Inconclusive: “quality and character of the toolmark are lacking”



Identification, Elimination or Inconclusive?



Hamby and Brundage Ten Gun Study

- FATM examiners and the government frequently cite this study as evidence that FATM examiners can accurately match bullet/cartridge case to gun under the worst possible conditions
- The worst possible conditions are approximated by bullets fired from consecutively manufactured firearms

Many problems have been identified with this study

- Number of guns studied (10) is too small to be meaningful
- Only one type of firearm was studied, and one type of ammunition – and that one firearm was manufactured in 1985, before updates to the manufacturing process.
- Bullets were fired into a water tank, so they were not damaged as they often are in casework
- The study is a “subjective evaluation” without documentation, such as photography, and thus is “only of value to the examiner who conducted the study.” Biasotti and Murdock
- The study’s author – James Hamby – is a far cry from the objective scientist, having been fired from his role as director of a forensic laboratory for influencing forensic technicians to withhold information regarding testing irregularities and for concealing improper testing protocol.

More problems with 10 gun study

- Most importantly, testing was unblind, meaning that test takers knew the exact nature of the test – a consecutive barrel study with no “extra” non-matching bullets.
- Adding participants to the study – the original study included 67 participants, and now the number of participants exceeds 600 – does nothing to fix the problems with its validity

Two NAS Reports

Ballistic Imaging

ABOUT US ORDERING INFO CONTACT US SPECIAL OFFERS

Subscribe E-mail This Podcasts RSS

THE NATIONAL ACADEMIES PRESS

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

SEARCH [input] QUESTIONS? CALL 888-624-8373

Items in cart [0]



Ballistic Imaging (2008)
Committee on Law and Justice (CLJ)
Committee on National Statistics (CNSTAT)
National Materials Advisory Board (NMAB)

- [Web Search Builder](#)
Use this book's key terms to search within this book, across our collection, or across the Web.
- [Skim This Chapter](#)
Skim this chapter and use this chapter's key terms to search within this book.
- [Reference Finder](#)
Paste in your own text to find books that relate to your topic.

PAPERBACK + PDF
your price: \$69.50
[add to cart](#)

PAPERBACK
list: \$59.00
Web: \$53.10
[add to cart](#)

Search This Book [input] [GO] [Navigation icons] Page 1 [Navigation icons] Print Page

Strengthening Forensic Science in the United States: A Path Forward

ABOUT US ORDERING INFO CONTACT US SPECIAL OFFERS

Subscribe E-mail This Podcasts RSS

THE NATIONAL ACADEMIES PRESS

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

SEARCH [input] QUESTIONS? CALL 888-624-8373

Items in cart [0]



Strengthening Forensic Science in the United States: A Path Forward (2009)
 Committee on Science, Technology, and Law (CSTL)
 Committee on Applied and Theoretical Statistics (CATS)

RESEARCH TOOLS

- [Web Search Builder](#)
- [Skim This Chapter](#)
- [Reference Finder](#)

Search This Book [input] [GO] [Navigation icons] Page 1 [Navigation icons] Print Page

The following HTML text is provided to enhance online readability. Many aspects of typography translate only awkwardly to HTML. Please use the [page image](#) as the authoritative form to ensure accuracy.

Share E-mail Facebook Digg Stumble Twitter More

TABLE OF CONTENTS

- [Front Matter \(R1-R20\)](#)
- [Summary \(1-34\)](#)
- [1 Introduction \(35-54\)](#)
- [2 The Forensic Science Community and the Need for Integrated Governance \(55-84\)](#)
- [3 The Admission of Forensic Science Evidence in Litigation](#)

BEST VALUE!
 HARDBACK + PDF
your price: \$42.50
[add to cart](#)

HARDBACK
list: ~~\$55.95~~
Web: \$32.36
[add to cart](#)

BALLISTIC IMAGING (2008)

- “The validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks has not yet been fully demonstrated” (p. 3)
- “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.” (p. 3)
- Characterizing firearm/ toolmark identification as “part science and part art form” (p. 55)

Enter the NRC Forensic Science Report

- The court “must consider . . . the *current* state of generally-accepted scientific research” underpinning the proposed expert testimony. *Benn v. United States*, 978 A.2d 1257, 1278 (D.C. 2009)
- “[T]here is a *substantial debate* within the scientific community, as well as the Courts, regarding the degree to which firearms toolmark identification evidence passes muster,” and “in this debate . . . *the latest scientific consensus is as expressed in the NRC Forensic Science Report.*” *United States v. Mouzone*, Crim. No. WDQ-08-086, 2009 WL 3617748 at *17, *28 (D. Md. Oct. 29, 2009)(emphasis added).

What consensus is expressed by the NRC Forensic Science Report?

“The committee agree[d] that class characteristics are helpful in narrowing the pool of tools that may have left a distinctive mark,” but concluded that FATM has yet to establish “the capacity to consistently and with a high degree of certainty support conclusions about ‘individualization.’”

Report at 87; 154

NAS 2009

- “Because not enough is known about the variabilities among individual tools and guns, we are not able to specify how many points of similarity are necessary for a given level of confidence in the result. Sufficient studies have not been done to understand the reliability and repeatability of the methods.” (p. 154).

NAS 2009

- The lack of a specific protocol for toolmark analysis is a “fundamental problem,” and the toolmark analysis guidance provided by the AFTE lacks specificity because it allows an examiner to identify a match based on “sufficient agreement”. (p. 155)

Important FATM cases

- *Ramirez v. State*, 810 So. 2d. 2d 836 (Fla. 2001) (excluded knife-to-cartilage wound match b/c not generally accepted)
- *United States v. Glynn*, 578 F. Supp. 2d 567 (S.D.N.Y. 2008) (more likely than not)
- *United States v. Taylor*, 663 F.Supp.2d 1170 (D.N.M. 2009) (reasonable ballistic certainty)
- *United States v. Mouzone*, 2009 WL 3617748 (D.Md. 2009) AND *United States v. Willock*, 2010 WL 118371 (D.Md.2010) (no statement of certainty allowed)
- *United States v. Alls*, Case. No. 2:08-cr-00223-ALM-NMK (S.D. Ohio Dec. 7, 2009) (could testify to observations, not to match to the exclusion of all others)
- *United States v. Lape*, 2010 WL 909756 at *4 (S.D. Ohio Mar. 11, 2010) (not without critics; might not be admissible; orders pretrial release b/c lack of C&C evid.)

What they end up saying

- I matched this bullet to that gun. Period.
- I matched this bullet to that gun, based on corresponding marks, and to a reasonable degree of scientific certainty no other gun would produce the same marks (*Mouzone*)

What we want them to say

- No more than: I observed these class characteristics and based on that, I cannot exclude this firearm from firing this bullet/cartridge case. I cannot exclude other firearms with those class characteristics, either (all firearms of same make/model).