Summer 2005 memo from FBI Lab Director Dwight Adams to FBI Director Robert Mueller explaining why the bullet lead science was being ended and stating that prosecutors should no longer rely on past bullet matches made by the FBI.

I have decided, as of yesterday, to discontinue the use of the technique known as bullet lead analysis.

Background: The FBI Laboratory independently sought an impartial scientific assessment of bullet lead analysis as early as 2000 through a contract with the Department of Energy, Ames Laboratory and again in 2002 through a contract with the National Research Council (NRC). The NRC issued their report on February 9, 2004. I specifically asked the committee chair if the FBI Laboratory should discontinue the use of bullet lead analysis while we make the recommended improvements and they replied "You should not discontinue this technique, only enhance it." Nevertheless, we did discontinue the test pending the outcome of our review of all NRC recommendations.

The NRC was asked three questions: (1) was the analytical method currently used sound? (2) were the statistics for comparison sound? and (3) were the conclusions reached with the analytical method and statistical comparisons valid?

ANALYTICAL METHOD - In short, the NRC stated that the "current analytical instrumentation used by the FBI is appropriate and is the best available technology. . . . the elements selected by the FBI for analysis are appropriate . . ."

STATISTICS FOR COMPARISON - The NRC recommended that the FBI use a different statistic than the one previously used. Much of the past year has been devoted to reviewing the different statistical approaches recommended by the NRC.

INTERPRETATION ISSUES - To have value as evidence in court, the interpretation of results depends on the quality of the chemical analysis, the statistical comparison, and the determination of the significance of the comparison. It is this last point which leads me to discontinue the technique. The following excerpts from the NRC report speak directly to the underlined portion:

"Variations among and within lead bullet manufacturers make any modeling of the general manufacturing process unreliable and potentially misleading in (bullet lead) comparisons."

" . . .distribution information on bullets . . . either does not exist or is considered proprietary, and the committee was unable to assess regional distribution patterns. For these reasons, unlike the situation with some forms of evidence such as DNA . ., it is not possible to obtain accurate and easily understood probability estimates that are directly applicable."

BOTTOM LINE - our techniques are suitable and reliable. The recommended changes in statistical procedures would enhance our existing comparisons and provide a sound basis for declaring two samples as indistinguisable. However, the probative value of these findings and how that probative value is conveyed to a jury "remains a critical issue." In the end, it did not matter that we were using the best available technology. What mattered was our inability to determine the significance of our comparisons. We cannot afford to be misleading to a jury or state that two samples are indistinquishable, but not be able to state the significance of that fact or what it means.

FOLLOWUP ACTION - We plan to send a letter to all prosecutors that utilized this technology and provide them with the above information and direct them to the NRC report. We plan to simultaneously issue a press release confirming the above. We plan to discourage prosecutors from using our previous results in future prosecutions.

2004 FBI e-mails in which lab employees acknowledge that prior bullet lead matches would be reversed if the lab used new statistical methods recommended by the National Academy of Sciences.

methods that have been used are valid, and all should have been noted in the report that was prepared at the time. In essence, it is merely a choice of valid statistical methods, and defense experts were and still are free to present their own findings under a different statistical method.

b6
b7C -----Original Message-----
From: [redacted] (LD) (FBI)
Sent: Tuesday, August 03, 2004 2:42 PM
To: ADAMS, DWIGHT E. (LD) (FBI)
Subject: FW: updated bullet lead memo
Importance: High

UNCLASSIFIED
NON-RECORD

FYI
-----Original Message-----
From: [redacted] (LD) (FBI)
b6 **Sent:** Tuesday, August 03, 2004 1:10 PM
b7C **To:** [redacted] (OGC) (FBI); [redacted] (OGC) (FBI)
Cc: DIZINNO, JOSEPH A. (LD) (FBI)
Subject: FW: updated bullet lead memo
Importance: High

UNCLASSIFIED
NON-RECORD

I was unable to attend the meeting referred to below, but this closes part of the loop on the bullet lead issue. I touched base with Joe on this issue yesterday.

Basically, National Academy of Sciences (NAS) recommended using a different statistical model in doing certain calculations in the bullet lead analysis - it deals with the statistical interpretation of the data to help determine whether there is a match. The Laboratory had some reservations about adopting their proposed model, and so the Chemistry Unit conducted a study with 100 randomly selected cases, utilizing a variety of statistical models for each one. The results of the study show that a different statistical model actually leads to more conservative results in the large majority of the cases.

Note that in a very few cases, the model the Lab now prefers to use leads to a less conservative finding than that which was reported out at the time. Joe asked me to consider whether those cases would need to be contacted. In my opinion, they would not. All of the statistical methods that have been used are valid, and all should have been noted in the report that was prepared at the time. In essence, it is merely a choice of valid statistical methods, and defense experts were and still are free to present their own findings under a different statistical method. Please let me know if you wish to discuss.

The Lab plans to do a presentation on this study at the next American Forensic Society meeting, and is preparing two publications on the issue for forensic journals. Additionally, Joe would like to reach out to the two DOJ attorneys he and [redacted] met with on the bullet lead issue earlier, in order to update them on the study findings. If either of you would like to attend that meeting, please let me know. Otherwise, I'll try and set something up for [redacted]
b6 and myself fairly soon.
b7C

Thanks -

[redacted]

[redacted] (LD) (FBI)

From: [redacted] (LD) (FBI) b6 b7C
Sent: Wednesday, March 09, 2005 4:02 PM
To: ADAMS, DWIGHT E. (LD) (FBI)
Subject: RE: Bullet Lead Update

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UNCLASSIFIED
NON-RECORD

Dwight,

I hear what you're saying and understand your concern. I would add, however, that this is a very tight examination now. There will be no such thing as an inconclusive, provided we could do the examination. Either they'll match or they won't using our revised statistical protocol. The exception may be with fragments where we can at least rule out a common source of the lead, but the new technique will not allow us to use a single measurement to claim that we have a match.

The only reason that we had issues in the past was because we allowed for a subjective variable...namely "experience"....to somehow figure into whether a call was made or not. Now it is all done behind the scenes with our statistical program. Looking at all the cases that we reported since 1996, only 1.4% of the cases resulted in a different report being issued. To the best of our ability, we have identified why those 7 cases have a different result today and it is mainly due to the use of "chaining"... some of it used quite liberally.

I think some of your concern may be due to discussions that were held last year when we were looking at the use of the "equivalence test". If we had continued with that method of assessing the data, we would have been making a lot more false exclusions. As you will recall, we switched horses at that point and did the false positive probability study that will allow us to use a very traditional statistical technique...namely the student t test. I can't imagine anyone really questioning the use of this statistical technique in the scientific community.

As far as peer-review of the method, I hope that you will also consider the NRC's report as part of the peer-review. We have done our best to meet their comments and recommendations.

I am also encouraged that since you aren't yet convinced about whether we should proceed or not until the process is finished, that I still have a chance to win you over on this.

Thanks for hearing me out. I greatly appreciate it!

[redacted]
Chief
Chemistry Unit
Laboratory Division
Quantico, VA 22135
[redacted]
FAX [redacted]

b2 b6 b7C

2005 FBI e-mail stating the lab scientists should no longer use its 1.3 million estimate of the total number of bullets made in a single batch of lead because it could be misleading.

Message

possessing bullets from the same CIVL.

You are right that the database has limitations, but it is what the NRC recommended we use to estimate false positive matches. In the end, that is all we can ever do when we are determining uncertainties....give it our best estimate based on what we have available to work with.

In the end, you are right, in that we can't give an exact number for anything related to bullet lead with 100% certainty, but that is why it is circumstantial evidence. We can make well-educated estimates, however, that help the judge and jury weigh in their own mind how probative (and unique) the information is.

Thanks,

Marc LeBeau
Chief
Chemistry Unit
Laboratory Division
Quantico, VA 22135
(703) 632-7408
FAX: (703) 632-7411
Cell: (202) 439-4408

-----Original Message-----
From: DIZINNO, JOSEPH A. (LD) (FBI)
Sent: Thursday, May 12, 2005 9:15 AM
To: LEBEAU, MARC A. (LD) (FBI)
Cc: CHOI, AMANDA ELLER (LD) (FBI); FRAM, ROBERT (LD) (FBI)
Subject: RE: Bullet Lead

UNCLASSIFIED
NON-RECORD

Marc,
I'd like to try to answer your questions and reiterate why I believe that we should leave 2 of these statements in the letter.
1) Saying that the examiner cannot testify to such facts as to how many bullets may have come from the same melt, I believe is true. You have indicated that the NRC said we should make a reasonable estimate, for example they suggested we say a billion .22LR could be produced from one CIVL. Where did the NRC come up with this number? I'm sure that it varies from manufacturer to manufacturer, from caliber to caliber or simply by chance of the process. Therefore, I don't believe that we can testify about how many bullets may have come from the same melt and our estimate may be totally misleading because we simply do not know for that particular bullet fragment in that case.
2) Saying how many bullets from a different melt may have a similar composition, I also believe is true. You indicate that the NRC said we should state that there was less chance of a bullet matching a different melt than one from the same melt. That, to me, however, is different from saying how many bullets from a different melt may have a similar composition. Also, you state that our own studies have shown that the chances of a false positive match are better than 1 in 5000. First, our database, compared to the huge world of bullets, is very small. Therefore, a good argument could be made that our database does not reflect the much larger world of bullets. I believe that we cannot say how many bullets from a different melt may have a similar composition because again we simply do not know for that particular bullet fragment in that case.
3) Your last point about geographic distribution of bullets being known by the manufacturer is well taken and I believe that we should modify this language.
If you have any other questions, please do not hesitate to give me a call.

2006 FBI affidavit which uses the 1.3 million estimate for the total number of bullets made in a single batch of lead despite prior warning that it could be misleading.

CIRCUIT COURT for BALTIMORE COUNTY

James Allen Kulbicki

Plaintiff,

v.

State of Maryland

Defendant.

CRIMINAL NO. 93CR0530

AFFIDAVIT OF DIANA M. WRIGHT, Ph.D.

I, Diana M. Wright, state for the record:

BACKGROUND AND EXPERIENCE IN COMPARATIVE BULLET LEAD ANALYSIS

1. I am employed as a Forensic Examiner by the Federal Bureau of Investigation (FBI), and I am currently assigned to the FBI Laboratory, Scientific Analysis Section, Chemistry Unit, in Quantico, Virginia.

2. I obtained a Bachelor of Science degree in Chemistry from the College of Saint Elizabeth, Morristown, New Jersey and a Doctor of Philosophy degree in Chemistry from the University of Maryland, in College Park, Maryland.

3. I have been employed by the FBI Laboratory since August 3, 1997 where I was assigned to the Materials and Devices Unit (MDU). This unit later changed its name to the Materials

Analysis Unit (MAU). The subunit that was responsible for the analysis of bullet lead was incorporated into the Chemistry Unit (CU) in February, 2002, where the exam was performed until it was discontinued in September, 2005.

4. Comparative bullet lead analysis involves the physical and chemical examination of the lead portion of expended bullets, fragments of bullets, and bullets loaded into cartridge cases which are considered to be "live" or functional rounds of ammunition. Evidence of this type is submitted to the FBI Laboratory in support of investigations involving criminal cases from law enforcement agencies throughout the United States. The majority of this evidence is submitted by city, county and state agencies. This evidence is subjected to processes which include physical examination and comparison of the fired bullets to the bullets loaded in the live ammunition. These examinations include physical measurements, weight comparisons, removal of surface contamination or effect coating (e.g. copper plating or jacketing material), and sectioning of the lead portion of the bullet in order to take replicate measurements of the evidence. The chemical examination requires digestion of the lead in an acid solution, along with appropriate commercially-available standard reference materials, followed by analysis using instrumental methods.

5. During my career with the FBI Laboratory, my areas of expertise as a Forensic Examiner have included comparative bullet lead analysis, gunshot residue analysis, and the analysis and comparison of paints, tapes, and polymeric materials. I have supervised laboratory chemists and am responsible for the analysis and interpretation of the data obtained during examination of items of evidence. Upon a complete and thorough technical and administrative review of all data generated in a case, I prepare a laboratory report stating the conclusions I derived from the work performed. I also testify to my results and conclusions upon request.

6. As a Forensic Examiner, I have been responsible for the analysis of over 250 cases during my tenure with the FBI Laboratory. I have issued reports regarding the results of my

analyses in each case, and have been responsible for the review and verification of the results and conclusions of other forensic examiners.

7. In my position with the FBI Laboratory, I have testified to the results of my analyses eleven times, both in trial and admissibility hearings, across the United States, including one testimony provided at the request of the defense.

8. In the nine years that I have been involved in the field of comparative bullet lead analysis, I have had the opportunity to present the findings of research in this area in the form of scientific posters, oral presentations, and/or publications. The citations for this work are as follow:

Wright, Diana M. and LeBeau, Marc A. "An Analytical Approach to Comparative Bullet Lead Analysis: Physical and Chemical Aspects of Discrimination." Poster presented at the 57th American Academy of Forensic Sciences meeting, New Orleans, Louisiana, February 2005.

Wright, Diana M. and LeBeau, Marc A. "Choosing a Statistical Method for the Data Assessment of the Compositional Analysis of Bullet Lead." Poster presented at the 57th American Academy of Forensic Sciences meeting, New Orleans, Louisiana, February 2005.

Wright, Diana M. and LeBeau, Marc A. "The FBI Laboratory's Response to Recommendations Regarding Comparative Bullet Lead Analysis." Oral presentation at the 57th American Academy of Forensic Sciences meeting, New Orleans, Louisiana, February 2005.

Koons, R.D. and Grant D.M. "Compositional Variation in Bullet Lead Manufacture." *Journal of Forensic Science*. **47(5)**, Sep 2002.

9. I have also attended meetings, symposia and conventions to remain current with the field. I have had continuing education in the specialized instrumentation used to perform elemental examinations, toured ammunition manufacturing plants and smelters that refine recycled battery lead into alloys used to manufacture bullets, and routinely read scientific journals and publications that contain research articles and papers in the areas of forensic analysis of metals, advances in methods and instrumentation used to analyze elements, and general analytical chemistry.

10. See attachment A for a copy of my curriculum vitae.

The Basis of Comparative Bullet Lead Analysis

Examination of Physical Characteristics

11. As with many mass-produced commodities, lead bullets are readily available in many shapes, sizes, and designs. Bullets may be commonly found in retail outlets for a wide variety of firearms and end uses. The caliber of the firearm determines the bullet size and shape is often a function of its utility. However, styles that include full or partial jacketing, or ridges referred to as cannelures, are often influenced by marketing trends or ease of recognition in the production setting. Each of these features can be used to discriminate bullets and bullet fragments from bullets loaded as components of functional ammunition.

12. As an example, just as a truck fender would not be concluded to have come from a compact car, a bullet fragment that weighs more than an intact bullet would indicate that these two specimens were not manufactured in the same product line. Therefore, the fragment and the bullet in the live cartridge would be considered forensically unrelated with respect to the bullet evidence. In the same manner, a bullet fragment that contained a copper jacket would be readily

discriminated from live ammunition that was produced as unjacketed. Other discriminating features may be more subtle, such as the shape of a rounded bullet nose. However, even these distinctions are readily apparent to an analyst trained to observe the physical characteristics of manufactured products.

13. Visual, microscopic, and physical examinations such as these comprise the first steps in the comparison of expended bullets to the bullet components of functional ammunition.

Examination of Chemical Characteristics

14. Once physically different ammunition has been excluded from the comparison and documented as such, specimens that cannot be differentiated through appearance or mass are assessed and compared. Further examination requires physical alteration of the evidence. Therefore, detailed notes and photographs are used to document the appearance and any markings on the specimens chosen for chemical analysis. Using a microscope to capture surface details, a scalpel is employed to remove external contamination from the lead portion of unjacketed bullets. Jacketing material is removed through the use of a hand-held drill. The lead is then sectioned into three discrete samples in order to perform replicate measurements on each bullet.

15. The three lead samples from each bullet or bullet fragment are individually weighed on an analytical balance before they are digested in a solution of mineral acids which breaks down the lead matrix, leaving behind a clear, colorless solution. These solutions are then analyzed using an instrument known as a spectrophotometer. A spectrophotometer measures the amount of light that is emitted from a solution when it is subjected to conditions (e.g. heat or light energy) that cause a response of this type. The technique used to analyze bullet lead in this manner is referred to as inductively coupled plasma – optical emission spectroscopy (ICP-OES). Literature from the early days of this technique also referred to the technique as ICP-AES, where the "a" referred to "atomic" emission as opposed to "optical". The latter term is more general, and therefore, a better

descriptor for the number of processes that occur in this technique.

16. ICP technology was developed and first reported in the early 1960s by researchers in both the United States and England. Many laboratories were also at work on applications involving neutron activation analysis (NAA) during this time period. NAA is the technique that preceded ICP-OES as the common method of analysis for many types of materials including bullet lead in forensic applications. Though NAA can only be performed at facilities that are licensed to operate a nuclear reactor, such as the National Institutes of Standards and Technology (NIST), both techniques share widespread acceptance in the relevant scientific community and may be found in the scientific literature for many forensic materials such as paint, metals, archaeological ceramics, and bullet lead. In order to ensure chain of custody integrity and minimize radiological waste, the FBI Laboratory ceased all NAA operations at NIST in favor of ICP-OES exclusively in 1995.

17. See attachment B for a list of articles related to ammunition manufacturing and forensic uses of NAA and ICP-OES.

18. ICP-OES is an instrumental technique whereby a sample, most commonly a solution, is drawn up into a gaseous environment that is partially ionized through the use of a radiofrequency generator. This environment contains so much energy that the gas is actually converted to a plasma state where electrons roam freely. The solution absorbs this energy which evaporates the liquid and allows for interaction of the electrons with metals in the solution. The metals become excited by the amount of energy they absorb, which creates an unstable state. In order to regain stability, the metals release the excess energy in the form of light. The wavelength at which the light is emitted is characteristic of the metal releasing the energy.

19. Through the use of standards that were specifically selected to contain the elements of interest in bullet lead, the amount of each element in the bullet lead solution can be determined by recording the amount of energy that is released at a given wavelength.

20. The presence and amount of these elements in each specimen is recorded and compared in order to determine if differences exist. Most bullet lead is specified by the manufacturer to contain a general amount of the chemical element, antimony (Sb), in order to harden the lead matrix. Gross disparity in the amount of antimony present in two specimens is a clear point of chemical differentiation between two bullets that could not be separated based upon physical characteristics. More subtle differences in composition between specimens require an assessment of how well the replicate measurements agree for each specimen.

Interpreting the Significance of a Match

21. There are only two likely explanations for obtaining a positive association between lead bullets. Either the bullets originated from a common origin of molten lead or the association is coincidental. It is important, therefore, to consider and determine the likelihood of a coincidental match.

22. When considering the significance of a positive association, an analyst might testify in a qualitative sense regarding the meaning of the results. With respect to bullet lead, some of the information used to determine if an association existed would be based on quantitative evaluation of the amounts of each element of interest that are present in trace quantities in the lead. However, the assessment would be made with the knowledge that many thousands of physically and chemically consistent bullets are produced virtually simultaneously within a given manufacturing plant.

23. Testimony would routinely describe how common a particular brand of ammunition is, how much of the style and caliber of interest is made per annum, and how much may be theoretically manufactured within a given batch before the properties are subtly altered by lead added to continue the process. This type of information is commonly discussed in other areas of

forensic science where manufactured products are submitted for examination. The particular characteristics of evidence examined within a given case may allow for a limited number of potential sources to be developed (i.e. limited to a manufacturer, style, or batch of molten lead). However, with the exception of fracture matches, examination of the manufactured physical and chemical properties of a mass produced entity can never be used to identify or classify comparable specimens to the exclusion of all others items of similar origin that may exist in the marketplace.

24. The FBI has maintained a searchable database of all lead standards and bullet lead specimens analyzed in its laboratory by ICP-OES. This file was kept in order to plot trends in the analysis of the standards used for quality control purposes. It was also compiled to determine if enough data could be collected to assess the likelihood of a coincidental match between chemically indistinguishable specimens. It was realized early on in the establishment of this file that the specimen content was only representative of the specimens received by the FBI Laboratory in casework. It was not representative of the number or type of ammunition products available in the world at any given point in time.

25. Legal challenges to the probative value of comparative bullet lead analysis have made reference to this data file of bullet lead specimens analyzed by the FBI Laboratory in an attempt to require a statistical assessment of the likelihood of a random or coincidental match between otherwise unrelated lead bullet specimens. In response to arguments in favor of establishment of some basis for the likelihood of coincidental matching, the FBI Laboratory reported in 2004 that the likelihood of coincidentally matching two unrelated bullets in this data file was 1:2500, a number corroborated by independent researchers who were granted access to the FBI bullet lead file.

26. Refer to attachments C and D for the publications that document the statistical work performed to establish a coincidental match rate for bullet lead using the FBI bullet lead data file.

RESEARCH REGARDING THE FBI LABORATORY'S COMPARATIVE BULLET LEAD EXAMINATION

27. The FBI Laboratory established the comparative bullet lead program in response to requests for examination of the bullet fragments recovered from the body of President John F. Kennedy and the ammunition recovered from the firearm believed to have been used in his assassination. Establishment of the examination for routine casework followed from those initial efforts to determine if an association could be made between fragmented bullets and functional ammunition.

28. Two papers written by Gallagher and Haney were published in the mid 1970s regarding the FBI Laboratory's attempts to identify elements of interest in bullet lead specimens. From this work and that reported by others studying the potential for this examination, it was determined that three elements were best suited for chemical discrimination of bullet lead specimens: antimony, arsenic, and copper. These three elements were easily measured using NAA, thereby establishing the technique of choice for this examination.

29. The decision to incorporate ICP-OES technology into the examination of bullet lead was based on research reported in the scientific literature by manufacturers of battery lead as well as others. These studies described the ability to readily obtain chemical information on a greater number of elements that might serve to better discriminate lead specimens. For this reason, the FBI Laboratory began research into the use of ICP-OES methodology in concert with the existing NAA protocol. Through the simultaneous use of both techniques, the FBI Laboratory could obtain ICP-OES data for the three elements analyzed by NAA in addition to other elements that were not easily determined with the standardized NAA procedure. As a result of the improved discriminating capability, both techniques were used to gather comparative bullet lead for a number of years. In 1995, the reactor used to perform the NAA examination was scheduled for a

lengthy shutdown for upgrade and repair. At this time, the FBI Laboratory made the decision to switch exclusively to the use of ICP-OES for bullet lead chemical comparisons.

30. Refer to attachments E and F for the original research article that described the use of ICP-OES for battery lead and the FBI Laboratory's 1988 article describing its bullet lead protocol.

31. The analytical ability to discriminate between bullet lead specimens was well established in the scientific literature by the late 1980s. However, the FBI Laboratory knew experientially that bullets contained in a partial box of cartridges could have slight, yet distinct, differences in concentration of the elements of interest. In other words, most of the elements might agree to a reasonable degree of scientific certainty, but one element might differ to the extent that specimens could be excluded from a common source. For this reason, a box of ammunition cannot be considered to be a single unit of chemically identical samples. It is more appropriately compared to a carton of eggs, where some of the eggs may be from the same hen, some from a close relative of that hen, and still others from a more distant relative. All of the eggs in the described carton would be physically indistinguishable, but subtle chemical differences might be used to separate out "sister" eggs from first or second cousins. Experiential knowledge of the existence of subtle differences between bullets loaded into the same box paved the way for a research project conducted by the FBI Laboratory in the early 1990s. This project involved the analysis of multiple boxes of cartridges from the four major North American producers of ammunition.

32. The goal of the multiple boxes study was to determine if a minimum number of cartridges would need to be analyzed from a partial box of ammunition in order to best represent the number of distinct compositions that could be found in an intact box. The study was designed to determine the variability within a manufacturer's product as well as between the four major manufacturers of domestically produced ammunition. The study was presented to the forensic community at a symposium sponsored by the FBI Laboratory in June, 1991. Manuscripts for each of the presented topics were also submitted to a peer review committee and later published as

proceedings from the symposium.

33. The 1991 publication of the multiple box study describes the results obtained from the analyses performed on triplicate samples of over 800 bullets. The number of bullet lead compositions that could be found in a box of 50 cartridges ranged from two to thirteen, indicating that not all manufacturers employed the same level of quality control to the lead used for bullet manufacturing. It was later determined that the manufacturer with the fewest number of compositions in a box obtains their lead from a single supplier, thereby greatly decreasing the variability that might exist between batches. The manufacturer with the greatest variability used at least two different lead suppliers and would internally recycle or non-compliant bullets back into their molten lead supply pot in order to eliminate waste. Those recycled bullets could be of any caliber or contain a copper effect coating prior to being recycled back into the main supply pot. Therefore, chemical compositions of antimony (as the alloying element) or copper could vary widely in a batch containing the recycled lead as opposed to the normal conditions used for a given product. The paper concluded that the determination of multiple compositions of lead associated with a victim or crime scene which could not be differentiated from multiple compositions within a partial box of cartridges would be forensically significant because each of the compositions would be an independent association between the crime and the recovered box of ammunition. On the other hand, if bullets from a victim were close in composition to compositions represented in a box of ammunition, but could still be distinguished based on subtle differences, no association of probative value could be reported.

34. In recent years, increasing requests for admissibility hearings and Daubert rulings have dictated that bullet lead analysts provide a more thorough introduction to the history and protocol of comparative lead analysis. In order to provide background information in laymen's terms, the FBI Laboratory published a peer-reviewed paper in Forensic Science Communications in July, 2002, which described the basis for the examination, how bullets are manufactured, and what factors would need to be addressed in attempting to assess the significance of a match.

35. Also in 2002, the FBI Laboratory published the results of a second study that addressed the compositional variation that can exist within lead supplied to ammunition manufacturers and that which is produced in successive batches of lead by a single manufacturer. From this study, it was concluded that the maximum number of .22 caliber bullets that could be produced from a typical batch of lead would be approximately 1.3 million. In attempting to determine how significant this number is, one would also have to factor in that billions of bullets are produced per annum, half of which are .22 caliber in diameter. One would also need information as to the number of points of comparison that were available for assessment. A lesser number of physical or chemical features available for comparison would increase the chances of a coincidental match. However, there exists a greater risk of "coincidence" if two persons purchased ammunition from the same batch which could not be differentiated, than for two random specimens from separate batches to have completely indistinguishable properties. Other factors which are not readily available but could impact the significance of a bullet lead exam would include the number of bullets distributed as cartridges to a particular region of the country, the number of bullets from the original total produced that still existed in the marketplace at the time of interest, and the number of cartridges that were packaged together for individual sale (i.e. loose cartridges, 20 per box, 50 per box, or greater). Refer to attachment G for the referenced paper.

36. During this period of study, the FBI Laboratory determined that there was a limited ability to interact with a "peer community" given that it was the only laboratory that routinely offered and performed the comparative bullet lead examination. This limited interaction was compartmentalized into scientific discussions with instrumentation specialists and manufacturing discussions and trend assessments with ammunition producers and their lead suppliers. No peer group existed to discuss methods to best convey the significance of the examination either in written or oral form.

37. While bullet lead comparisons share many of the same characteristics and limitations

found in other trace element examinations, there are properties of this mass produced commodity that are specific to it. For example, the quality control processes utilized by the ammunition industry do not test the same parameters that are measured by the FBI Laboratory. This discrepancy has always been readily acknowledged by both parties as a difference in the information of interest. Nonetheless, the degree to which accuracy can be reported or challenged is hindered by this circumstance.

38. In the interest of developing a means to ensure quality and convey the probative value and limitations of comparative bullet lead analysis in the most effective manner, the FBI Laboratory requested an independent review of comparative bullet lead analysis from the National Research Council (NRC) of the National Academies in early 2003. The request was three-fold:

a) to examine the analytical protocol used for bullet lead comparisons via ICP-OES and provide suggestions as to ways to improve upon it as appropriate;

b) to examine the match criteria for the chemical data and provide suggestions as to ways to improve upon it as appropriate;

c) to assist in the development of language that would best interpret the scientific data for both a non-scientific audience. Also, it was requested that language be offered to assist in significance assessments as appropriate.

39. The NRC published their evaluation of comparative bullet lead analysis in early 2004. The committee issued their report in the form of findings and recommendations based on their review of the FBI protocol and ancillary resources.

a) Findings included the assessment that the current technology was appropriate and the best available for the exam.

b) It was also reported that the examination was sufficiently reliable to support testimony that bullets produced from the same molten source of lead were more likely to be indistinguishable than bullets produced from different sources. This finding also stated that an examiner could appropriately testify that two (or more) bullets which could not be differentiated

would have an increased probability of resulting from the same source as opposed to having no probative association.

c) The committee's review also provided the outer limits of a size of a source of molten lead and thus the number of .22 caliber bullets that could theoretically be produced from such a source. The number of bullets reported in the FBI Laboratory's 2002 peer-reviewed paper in the *Journal of Forensic Sciences* falls well within the range reported by the committee, as does the estimate of bullets produced annually.

d) The NRC also found that there is sufficient data to conclude that a large number of different sources of bullet lead exist and that bullets from different sources could coincidentally be associated based on chemical composition. The FBI Laboratory has also stated this limitation in testimony and publications, particularly for specimens with limited physical or chemical features available for comparison.

e) Another finding stated that compositional bullet lead data could not be used to state the date of manufacture for that product. The FBI Laboratory agrees that there are no time or date stamps associated with bullets.

f) The NRC also reported that detailed patterns of ammunition distribution are not readily available and that geographic distribution data for ammunition would be needed before probabilities of association between victims and subjects could be derived from bullet lead data. To the contrary, geographic distribution would not be specific enough to associate a box of ammunition back to an individual. The best information that could be obtained from such data would be that a given region or store received some number of boxes of like composition. The potential for more than one customer to purchase indistinguishable ammunition would still exist. Thus, geographic distribution data might serve to further narrow the number of subjects with access to physically and chemically associated ammunition, which would increase the potentially probative value of the information.

g) The committee further reported that available data does not support a statement concerning the likelihood that an expended bullet originated from a particular box of ammunition and that references to boxes of ammunition should not be made in testimony. The objection to

such references appears to stem from the concern that such testimony might lead one to infer that there is a substantial probability that a given bullet originated from a specific box associated with the subject. The FBI Laboratory recognizes the limitations of comparative examinations that rely on mass produced characteristics or features in order to determine associative value. For this reason, it sought language suggestions from the NRC that would appropriately convey the circumstantial nature of bullet lead examinations without assigning classifications that would exceed the bounds of expert testimony. The probative value of examinations based on class characteristics is greater between specimens that can be disassociated as opposed to items that are concluded to be "alike". Assigning relevance to comparative specimens which cannot be distinguished is limited by the factors described in Paragraph 35, such as the number of features available for qualitative and quantitative comparison. A partial box of popular ammunition containing one bullet that is indistinguishable from an expended bullet may provide limited probative value. In contrast, a box containing multiple compositions of bullets that are also represented in bullets associated with a case provides more forensic significance because each of these associations is independently derived.

40. Though not recommended by the NRC, the FBI Laboratory chose to cease performing bullet lead examinations while reviewing the committee's report. The review encompassed all aspects of recommendations made by the NRC, including a voluntary re-validation of the chemical analysis and more thorough reporting of the physical examination in the protocol in order to best capture all aspects of the analytical process for publication. In considering bullet lead analysis in the context of other trace element examinations performed routinely in forensic laboratories, several facts were beyond dispute.

41. No clear methodology exists to independently test the accuracy of comparative bullet lead analyses. The FBI Laboratory annually requires proficiency testing of all analysts to determine accuracy; however, there is no way to independently corroborate the conclusions regarding significance without a peer group to also participate in the testing. With other trace

evidence examinations routinely conducted in the FBI Laboratory, there are other laboratories that exist within the forensic or manufacturing communities that perform the same examinations, and therefore, can be relied upon to judge the accuracy of the conclusions drawn in these disciplines. Bullet lead analysis is not required in cases where a firearm and bullet can be definitively associated. It is also an expensive technique to maintain if a laboratory's caseload does not warrant it. Comparative bullet lead analysis takes advantage of the use of loosely controlled quantities of trace elements that are present in the lead as impurities. Since manufacturing is not affected by the levels of these elements that exist in the lead, there is no industrial peer group available either. Each of these factors contributes to the classification of bullet lead analysis as non-routine.

42. Corroborating data has been published by research laboratories during the time that the FBI Laboratory has used bullet lead analysis in casework. However, the probative value of the examination is determined by the jury once an FBI examiner has explained the process, findings, and limitations with respect to the opinion that can be derived from the evidence submitted. Recent challenges to comparative bullet lead analysis have questioned its probative value due to the large number of indistinguishable bullets that are simultaneously produced and the inability to track them once they are separated from the molten source. In this context, the FBI Laboratory recognized that this issue would continue to be contentious within the courts. It was conceded that the probative value could often be evaluated on a case-by-case basis and that this variability in weighting the information could confuse the trier of fact, particularly when so much background information was necessary to explain the basis of the examination.

43. As a result of the extensive review of the NRC report and the realized difficulties that the absence of a peer group and limited sourcing information produced, the FBI Laboratory announced in September 2005 that it would cease comparative bullet lead examinations. It is evident that the science is sound and the analysts who performed this examination during its forty-year history were proficient and knowledgeable in its use and limitations. However, jury education was often lengthy and could be inconsistent with respect to the emphasis placed on

significance and limitations. Therefore, in order to best serve the needs of the organization and its contributors, the FBI has decided to tailor its resources toward examinations and research that are more closely aligned with its core mission and responsibilities. This decision is in no way meant to convey a lack of confidence in the integrity of the examination or the analysts who conducted these examinations. The FBI Laboratory stands behind its conclusions and believes that the research conducted in this area provides a sound basis for the findings that have been reported throughout the history of the examination. The NRC report generally supports this position as well, while acknowledging that the ability to confirm or challenge the accuracy of the opinions offered may be beyond the limitations of scientific certainty at the present time.

44. Based on my education, research, work experience, review of the scientific literature and contact with other scientists, I unequivocally state that comparative bullet lead analyses as conducted by the Chemistry Unit of the FBI Laboratory were valid and reliable to the extent that such assertions can be corroborated.

Signed under the pains and penalties of perjury this sixteenth day of November, 2006,

Diana M. Wright

Diana M. Wright, Ph.D.

COMMONWEALTH OF VIRGINIA
COUNTY/CITY of STAFFORD, to-wit:

The foregoing instrument was acknowledged before me this 16th day of November, 2006, by Diana M. Wright, Ph.D.

Sharon Faye Craige

Notary Public

My commission expires: May 31, 2008