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Firearms Report Review Paper 1998-2001

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INTRODUCTION

This report covers advances in scientific methods applied to firearms issues (ballistics, chemistry and wound ballistics) reported since the 12th Interpol Forensic Science Symposium in 1998. Forensic laboratories and Interpol agencies from around the world were requested to provide information on both published articles and unpublished reports in this area. A literature review was also conducted covering articles published in the principal forensic journals since 1998.

The following list describes the data source and major forensic journals, which we used in order to create the Review Paper:

4# **FORC DATABASE**
4# **ASSOCIATION OF FIREARM AND TOOL MARK EXAMINERS (AFTE)**
4# **JOURNAL OF FORENSIC SCIENCES**
4# **JOURNAL CANADIAN SOCIETY OF FORENSIC SCIENCE**
4# **FORENSIC SCIENCE INTERNATIONAL**
4# **SCIENCE & JUSTICE HARROGATE**
4# **WOUND BALLISTICS REVIEW**

We would like to thank all the forensic science laboratories and Interpol agencies that provided us with their articles. In addition, we would like to apologize to all the labs and authors whose articles are not mentioned in this report and in the Speaking Report. Please also excuse any typo mistakes.

ABSTRACTS:
FIREARMS – BALLISTICS

Firearms Toolmarks Identification

Criteria for Identification of Toolmarks Part II. Single Land Impression Comparisons
By: Miller-J
ABSTRACT: The first part of this paper dealt with the criteria for the identification of striations using data collected from .38 calibre bullets in two-dimensional (2D) and three-dimensional (3D) images from single land impressions, comparing known matches with known non-matches. The data were used for the assessment of the criteria for an identification within single land impressions based on total matching lines, the percentage of matching lines, and consecutive groups of striations. In this second part, more data from .25 ACP, .380 ACP, and 9 mm calibers are used for the assessment of the consecutive group of striations concept as a criterion for identification. The results are compared with previous results obtained for the .38 special.

The Application of Numerical Criteria for identification in Casework Involving Magazine Marks and Land Impressions

By: Moran-B

ABSTRACT: This paper addresses the evaluation of magazine marks and the magazine surfaces that produce them with regard to potential for subclass and individualizing characteristics. It also describes the practical use of numerical criteria in the evaluation of striated toolmarks in routine casework (magazine marks and rifling impressions) and it's significance in providing objective criteria for examining striated toolmarks having limited information such as magazine marks on fired cartridge cases.

An Examination of Two Consecutively Rifled Barrels and a Review of the Literature

By: Miller-J

ABSTRACT: It is more likely that possible "carry-over", or the reproduction of sub-class characteristics will occur in consecutively manufactured barrels. In this study, two barrels, which were consecutively manufactured by the gang broach method, were studied for sub-class characteristics. Fired bullets were compared and assessed to determine the presence of sub-class characteristics, and according to the conservative criteria for the identification of striations. This paper also includes a review of previous studies dealing with the examination of bullets fired from consecutively manufactured barrels.

The Identification of Consecutively Rifled Gun Barrels

By: Brundage-D-J

ABSTRACT: Test firings were conducted with ten consecutively rifled Ruger P-85 pistol barrels in order to obtain standards and unknowns for comparison by a group of 30 firearms examiners from nationally accredited forensic laboratories. In order to ensure true consecutiveness, the manufacturing process was monitored. A group of fifteen unknowns was supplied to each firearms examiner. At least one bullet was fired from each barrel, but some barrels could have had two, three, or four bullets fired from them. It was demonstrated that correct associations were made in all cases and that consecutively rifled gun barrels could be identified successfully.

Consecutively Machined Ruger Bolt Faces

By: Lopez-L-L; Grew-S

ABSTRACT: In this study, six consecutively machined Ruger rifle bolts were examined for characteristic marks due to the end mill machining process. Comparisons showed a surprisingly high degree of correspondence between the microscopic characteristics among the bolt faces. This high degree of correspondence brings to mind previous cautions regarding sub-class microscopic "matching." Closer examination of the rifle bolts showed slight irregularities, including abrasions and chatter marks, which differ between consecutively machined bolts, therefore they may be of use for the identification of the bolt faces if they are transferred to a cartridge case.

Consecutive Matching Striation Criteria: A General Critique
By: Bunch-S-G
ABSTRACT: Traditionally, firearms and toolmark examiners have drawn conclusions of identity from subjective criteria. This paper discusses the general validity of one proposed objective-criteria regime - the counting of consecutive matching striations on fired bullets. Both practical and theoretical considerations are discussed from the perspective of Bayesian logic. Although this objective-criteria regime does have its drawbacks, research and logical analysis should be continued.

The Influence of Manufacturing Processes on the Identification of Bullets and Cartridge Cases- A Review of the Literature
By: Bonfanti-M-S; De-Kinder-J
ABSTRACT: It is a fundamental principle of firearms identification that striations and marks left on fired bullets and cartridge cases, respectively, are unique. This paper presents a review of the relevant literature, applied to consecutively (or closely) manufactured parts of a firearm. A correct firearm identification, which starts from the striations on a bullet, can be made if certain rules which are independent of the specific rifling technique applied to the barrel are considered. If the identification process starts from a cartridge case, however, care has to be taken to exploit as many marks as possible.

Striae Matching and Angle of Incident; A Study of the Foreshortening Effect
By: Lopez-L-L
ABSTRACT: Many factors are involved in the process of toolmark identification. Some of the variables which have to be considered when making standards for comparison with a questioned toolmark are the type of tool used, the manner of use, the angle of incidence, the contacting part of the tool, and the surface character and nature of the marked material. As a great deal of firearms and toolmarks examination involves the analysis of marks on curved surfaces and at varying angles, it would be useful to determine the effect of such variables on the process of making an identification with a known standard. Here, a study was carried out in order to determine the effect of striae foreshortening on the identification process. Foreshortening can be caused either by the mark being angled in the viewer's line of sight or by the tool being used in such a manner as to leave striae at an angle less than that at which the could possibly be the furtherest apart. Unless the foreshortening effect is too great for identification purposes, the signature pattern of a scraped toolmark can be recognized and matched with a standard mark made by the same tool. All else being equal, two marks varying in progression angle by more than 20 degrees could not be matched without tilting the standard in the line of sight of the viewer in order to compensate for the foreshortening effect. Even when such a simulation is performed, however, matches rarely occur with angles, which differ by more than 45 degrees.

Identification of Cartridge Cases Fired in Different Firearms: "Pre-Identified Cartridges"

By: Kennington-R-H

ABSTRACT: The fact that firearms possess many microscopic toolmarks aids the firearms examiner in determining which weapon fired certain questioned evidence. The most important machined-in toolmarks for identification purposes are breechface, firing pin impression, ejector, and extractor toolmarks. In this paper, it is stressed that the examiner must positively recognize firearm class characteristics. Such knowledge enables the firearms examiner to discriminate between toolmarks produced by the firearm and toolmarks produced during the manufacture of the ammunition.

Making Use of and Interpreting Marks on Bullets and Cartridge Cases

By: Bonfanti-M

ABSTRACT: This paper presents a review of the various markings, which may be left on cartridge cases or bullets as a result of firing. Consideration is also given to the marks resulting from the manufacturing process and also to the identification possibilities based on other cartridge components such as the over-powder card wad. Certain matters relating to firearms identification are also discussed.

Pushed Bullet Comparison

By: Hornsby-B-J

ABSTRACT: This paper describes a case, which involved the analysis and identification of questioned bullets to the suspect weapon (a 380 Auto calibre Model DA380 semi-automatic pistol) by having the test bullets pushed through the barrel of the gun. This was necessary as the weapon had been disassembled before it was recovered, several days after the shooting incident, therefore the weapon could not be test fired in the usual way. This case illustrates how a bullet does not have to be fired from a weapon to show that a suspect bullet was fired from that weapon.

The Effect of Powder Load and Bullet Material on an Identification

By: Lindsay-D-C

ABSTRACT: It is increasingly the case that, during the course of a firearms examiner's work, striations are found where only part of a firearm is recovered or when a bullet is recovered but cannot be traced back to a manufacturer. Also, the development is taking place of new jackets constructed from unconventional materials such as aluminum and steel, thereby affecting the marks left on fired bullets. These issues were addressed in order to establish documentation that may be of use to forensic firearm examiners. The ammunition studied comprised bullets covered (jacketed) with aluminum, brass, steel; and copper, with factory load and half-load. The different loads and ammunition were test-fired into a Water Recovery Tank. Also, the bullets were removed using an Inertia Bullet Puller and pushed through the barrel using a brass punch and a hammer. Comparison of the bullets revealed that identifications could be made consistently, regardless of the material or method of test firing used.

Toolmarks Which May Lead to False Conclusions
By: Ball-P-D
ABSTRACT: Investigation of a crime scene resulted in the recovery of seven discharged .380 Auto cartridge cases and a single bullet. These items were submitted for matching to a firearm recovered from another crime scene. Of the seven cartridge cases recovered, preliminary examination showed that five had been fired by one firearm, but the remaining two had been fired from a different firearm. Test firings were carried out using a Davis pistol recovered from the second crime scene and laboratory stock. The test-fired cases could only be phased using chamber marks. Of the six cartridges submitted with the pistol, one bore the AP headstamp. Microscopic examination of the AP cartridge revealed marks on the primer surface, which were similar to those, present on the AP cartridge cases. The examiner then realized that the markings were, in fact, manufacturing marks, which could easily be mistaken for breech face markings. The two AP cartridge cases were subsequently compared with the single AP cartridge, which had been submitted with the pistol. There were sufficient grounds for concluding that the primers of all three had been in contact with the same tool, and not the same firearm.

Identification of Bullets to a Portion of a Sawn Off Barrel
By: Dutton-G
ABSTRACT: This paper describes a case where the firearms evidence proved vital to its solution. The suspect admitted to the shooting when bullets recovered from the victim's head were matched to part of the barrel of the firearm used. The weapon had been disassembled by the killer and the barrel had been cut into two pieces after the commission of the crime. Particular attention is paid to the method used to obtain test-fired bullets as this involved the construction of a firing device and the modification of the relevant segment of barrel prior to testing.

Individual Characteristics Criteria
By: Thompson-E
ABSTRACT: It is a feature of firearm/toolmark identification that individual characteristics produced by a particular firearm/tool are unique to that item. This paper is aimed specifically at those new to the examination of such marks and discusses what constitutes individual characteristics and how such characteristics are produced.

Sub-Class Characteristics of Sequentially Rifled 38 Special S&W Revolver Barrels
By: Tulleners-F-A; Hamiel-J-S
ABSTRACT: This paper describes subclass characteristics found in groove impressions on lead bullets fired from ten sequentially rifled 38 Special, Smith & Wesson revolver barrels. The subclass characteristics were found on some, but not all, of the barrels and in some, but not all, of the groove impressions. The step cutting broach-manufacturing process was used in the rifling of these barrels. The subclass characteristics were not present on the land impressions of the fired bullets or on the land or groove impressions of fired copper-jacketed bullets.

Automated Comparison Systems
IBIS

Automated Firearms Evidence Comparison; A Forensic Tool for Firearms Identification - An Update
By: Tontarski-R-E; Thompson-R-M
ABSTRACT: Computerized image analysis has been used by the Bureau of Alcohol, Tobacco and Firearms to identify bullets and cartridge casings recovered during investigations. This technology has also been applied to a database of test fired weapons. Comparisons can be performed in minutes using the Integrated Ballistic Identification System (IBIS) - a task which would take weeks using conventional microscopical techniques. A regional firearms evidence database can be built up by the networking of remote Data Acquisition Stations (DAS), making the IBIS a powerful tool for the investigation of firearms offences from many jurisdictions. This paper provides a technical overview of the IBIS image acquisition hardware, image storage, case data input, "surface signature" analysis, and correlation scoring to an image database.

Automated Firearms Evidence Comparison Using the Integrated Ballistic Identification System (IBIS)
By: Thompson-R-M
ABSTRACT: Computerized image analysis is being applied by the ATF to the identification of bullets and cartridge cases recovered in open cases, and to a database of test-fired weapons. Unlike traditional microscopic techniques, comparisons can be carried out in minutes using the Integrated Ballistic Identification System (IBIS). A network of remote Data Acquisition Stations (DAS) could be used to establish a regional firearms evidence database, making the IBIS a powerful tool for the investigation of firearms-related crimes from multiple jurisdictions. In this work, performance studies were carried out on the hardware and software components of IBIS. The correlation of breech face and firing pin impressions on used cartridge cases uses the BRASSCATCHER component of IBIS. In one study, a comparison was made of pairs of cases from more than 200 pistols. The correct "twin" case was found in the first position of ranked scores in 73-87% of cases, and 90-93% of the time in the top five positions. The IBIS component BULLETPROOF was used to compare ten pairs of used 9mm Luger copper jacketed bullets which had been fired from 10 consecutively rifled Ruger pistol barrels. Comparison of the resulting images of bullet land impressions resulted in the correct matching "twin" being selected in the top ranked score position in 17 out of 20 correlations. When these bullets were subsequently correlated to a database containing more than 3700 other bullets, the correct "twin" bullet was selected in the first position ranked score in 12 out of 20 correlations performed. This paper presents a technical overview of the IBIS technology. Trial assessments by law enforcement agencies, the effect of this technology in actual laboratory use, and the future use of this technology as a portable field instrument are discussed.

Examiners Make Explosive Gains in the Ballistic Labs. Productivity Rockets to Levels Unheard of Before

By: McLean-D

ABSTRACT: This paper describes the Integrated Ballistics Identification System (IBIS), which is an automated method for identifying the unique bullet markings caused by gun barrel rifling, and cartridge case markings caused by the breech face, firing pin, ejectors, etc. As most bullets deform or fragment after impact, IBIS has been designed to work with such evidence as its correlation algorithm can establish a match from markings on a small portion of one "land engraved area" (LEA). This system is capable of saving much time and effort in firearms-related investigations.

IBIS Correlation Results - Improvements

By: Silverwater-H, Koffman-A

ABSTRACT: IBIS (Integrated Ballistics Identification System) is an automated method for the comparison and analysis of fired cartridges. In this report, two methods are recommended for the improvement of the chances of a potential match (hit) and two methods for the reduction of operator analysis time of the correlation results. The first method involves the assessment of the top five correlation results regardless of the correlation score differential. This resulted in an improvement of around 35% when 40 correlations were performed. The second method involves the input of two cartridges instead of the usual one. Using this method, 10 case studies showed that there were no missed hits and, therefore, 100% success. The first method of reducing operator analysis time involves the rearrangement of the correlation marks using mathematical intersection and union functions. Ten case studies revealed that, in 60% of the cases (containing a hit), the hit was moved into the number one position, thereby reducing the Signature Analysis Station (SAS) operator analysis time significantly. The second method involves the rearrangement of the "failed intersection and union list" using neural networks, giving reduced SAS operator analysis time in all cases.

The Relationship between Acquisition Positions of Cartridge Cases and Discrepancy in Correlation Scores on IBIS™

By: Chan-R

ABSTRACT: The Hong Kong Police Force acquired its IBIS™ in November 1997. After installation and initial evaluation, the system was subsequently loaded with the outstanding crime evidence maintained by the Bureau. The most predominate caliber involved in local crime incidents is the Chinese version of the Russian 7.62X25 mm cartridges of which there are six hundred odd candidates in the Bureau outstanding crime List. During operation, it has been noted that the SAS regularly returns widely fluctuating scores for cartridges known to have been fired in the same gun. Attempts have been made to analyze and eliminate factors that contribute to this phenomenon. This lead to the discovery that the positioning of a cartridge case on the BRASSCATCHERTM stage has a significant impact on the score attained. A research project was commenced to ascertain the interrelationship between angular positioning of cartridge cases on the BRASSCATCHERTM stage and the resulting scores generated by the SAS.

IBIS Correlation Results - Analyzing Methodology and Reliability Factor
By: Koffman-A, Silverwater-H
ABSTRACT: This research suggests an improved methodology for analyzing the Integrated Ballistics Identification System (IBIS)™ Correlation Results and for setting up a "Reliability Factor" of the IBIS™ Correlation results. The motivation for developing the methodology was mainly a result from the desire of the Israeli Division of Identification and Forensic Science (DIFS) upper-management to reduce the labor-intensive manual searches in the open crimes file collection and to base the search more and more on the IBIS™. The new methodology is based upon entry of two cartridge cases into the IBIS™-DAS and at a later stage a third and fourth cartridge case may be required to be entered. It has three phases: Partner Test Procedure, Operator Error Checking Procedure and Identical Twin (ID-TW) Test Procedure. The "Reliability Factor", based on the results of each phase, places at the discretion of the firearms examiner the extent (if any) manual examination of the open crimes file collection is required. Results: We feel that this new method and reliability factor has indeed produced more effective use of IBIS™ with a minimum of additional DAS and SAS operator time.
Note: The article has not been published yet.

An Average Phase Scoring for Bullets, in the IBIS™ Correlation Results
By: Giverts-P, Argaman-U, Shoshani-E
ABSTRACT: This report presents a new way, which the authors believe is the optimal way, of achieving proper candidate ranking by calculating the Phase score as an average Phase score using the existing LEA-to-LEA correlation scores received from the Signature Analysis Station (SAS). This average Phase scoring can help re-order the Max Phase and Peak Phase correlation results lists; thus the best potential candidate bullets that have already been found by the system will be ranked in higher positions within the two lists.
Note: The article has not been published yet.

Drugfire

Drugfire
By: Demino-D
ABSTRACT: The FBI developed and is developing a computer system that is capable of capturing images of fired cartridge cases and bullets. The system will correlate the capture images with a database of similar images enabling an examiner to search for related images and solve serial type shooting crimes.

Others

Feature Extraction of Optical Projectiles Images
By: Pirlot-M; Chabottier-A; Celens-E; De-Kinder-J; Van-Ham-P
ABSTRACT: Where large collections of cartridge cases or bullets are involved, the comparison of a new piece of evidence with this collection is time-consuming. As a possible solution to this problem, different manufacturers have used specific hardware and software. Marks left on bullets and cartridge cases by firearms are recorded by CCD camera. The resulting images are then compared using algorithms appropriate to the manufacturer. Despite their promise, these methods could prove too costly for many laboratories and nothing is known about the internal algorithms, which are used to make the comparisons. It is argued that this latter problem removes interpretation by the firearms examiner using the automated method. This paper, therefore, presents a system based on the selection of a region of interest (ROI) by a firearms examiner. The comparison is partly automatic and partly the work of the firearms examiner, who is presented with a list of different candidates for subsequent manipulation and comparison.

Pattern Recognition in a Database of Cartridge Cases
By: Geradts-Z; Bijhold-J; Hermsen-R
ABSTRACT: A number of databases exist for the forensic comparison of spent ammunition. These databases store images of cartridge cases and any marks present on them. This study concentrates on the different methods of feature selection and pattern recognition used in the comparison process. For the images to be compared automatically, the first step is to extract the useful parts of the images. A number of different preprocessing steps were tested and compared on databases containing 3800 images, and the results are presented. Tests have also been carried out on the correlation methods based on gray values of all relevant image data, and the results showed that they were useful in the database. Implementation has also taken place of further invariant image descriptors and the a trous wavelet transform. Although these methods are promising, further tests are required prior to their use.

Automated Comparisons of Bullet Striations Based on 3D Topography
By: De-Kinder-J; Bonfanti-M
ABSTRACT: This paper presents a system, which can compare bullet striations for firearms identification purposes. The system is on recording the topography of the bullet in question using laser profilometry. A method for the derivation of a one-dimensional array of characteristics from the recorded data is presented. A comparison can then be made between these so-called feature vectors and similar quantities from other bullets using a correlation procedure. Using this method, good results were obtained for firearms, which left well-defined characteristics.

Correlation Algorithms in a Database of Cartridge Cases
By: Geradts-Z; Bijhold-J; Hermsen-R
ABSTRACT: Several systems are commercially available for the collection of spent ammunition for forensic examination. These databases store images of cartridge cases and any marks found on them. This paper concentrates on the various methods of feature selection and pattern recognition used in the comparison procedure. For the images to be compared automatically, the useful parts of the images must be extracted. Here, a comparison was made of several preprocessing steps on databases comprising 2000 images. The results of this study and the methods, which have been implemented, are presented.

Automated Systems of Ballistic Identification
By: Rosiak-J
ABSTRACT: Currently, many countries are experiencing a rapid growth in the number of firearms offences. The basic measure for the assessment of performance of ballistic analysis systems is the defined time required for a "hit" to be obtained, i.e. the linking of a firearm to a crime. These hits may be obtained more quickly if a uniform evaluation scale is used to determine properties and identification possibilities of examined material. Human decision-making may be accelerated by the application of computer-based technology, such as image and information processing, to this process. In any case, however, the results obtained using such an automated ballistic identification system must still be confirmed by a firearms examiner using a comparison microscope.

"FireBall" Firearm Identification System
By: Lawrence-P
ABSTRACT: The Ballistic Sections of Australian police forces required a cost-effective image database for the management of cartridge cases and projectiles from unsolved firearms cases, and which would also facilitate the exchange of images between jurisdictions. In order to satisfy these requirements, the computer-based "Fireball" Firearm Identification System was developed using off-the-shelf hardware and Microsoft Access database software together with custom image capture software. This system allows users to search suspect firearms against images of cartridge cases and projectiles contained in the database, and has established a standard for image capture and exchange between police forces in Australia.

New Systems & Equipment & Techniques

Methods Review

Review of the Methods Used for Comparing Tool Marks on Cartridge Cases and Bullets

By: Bonfanti-M; De-Kinder-J

ABSTRACT: This paper presents a review of the various methods used to compare bullets and cartridge cases. Optical methods are mainly based on the use of the comparison microscope. Striae on bullets and cartridges cases may be transferred to other materials by rolling the bullets or cases on sheets of soft materials or by casting. An improvement in the surface properties of the materials being compared can be achieved by damping metallic powders on it. New technologies have been developed which depend on the digitalization of optical images or on recording surface topology, using methods such as laser scanning, interferometry, and scanning electron microscopy.

Surface Topology

Surface Topology of Bullet Striations; An Innovating Technique

By: De-Kinder-J; Prevot-P; Pirlot-M; Nys-B

ABSTRACT: One method of obtaining characteristic information of the striation marks on bullets is laser topography. For this purpose, a profilometer equipped with a translational and rotational stage is used. Using the translational stage, the system parameters were optimized and a study was carried out into the one groove on a 9mm Para bullet. A comparison is made between the results obtained and those obtained using light microscopy. The first results of measurements of the whole bullet circumference using the rotational stage are promising for their application to firearm and toolmark identification.

TriggerScan System

The Trigger Scan System - Microprocessor Technology Applied to Precision Trigger Pull Analyses

By: Dillon-J-H

ABSTRACT: Traditional methods used for trigger pull analysis have included the use of dead weights, as used in shooting competitions and by gunsmiths for trigger pull modifications or testing. Modified spring-type scales have also been used for this purpose. Both of these traditional methods have given bracketed trigger pull values with a range of 1/4 or 1/2 pound, according to the technical protocols of the particular laboratory. This paper describes the use of microprocessor technology and integral program logic, in the form of the Trigger Scan system, to trigger pull analysis, which is routinely accurate to the nearest 0.1 pound, up to 20 pounds, for handguns and long arm weapons. The Trigger Scan system connects to a computer running Windows 3.1, 95, or NT and above via a standard serial port for visualization and convenient analysis of the test results. The software outputs results via a multi-color screen, can accommodate a database of trigger pull "profiles" and is capable of printing color copies if required.

TriggerScan Computerized Trigger Pull System
By: Koffman-A; Argaman-U; Silverwater-H; Hocherman-G; Shoshani-E
ABSTRACT: The TriggerScan system is a trigger pull measuring device, which has been developed by Dvorak Instruments. This paper describes the TriggerScan system for the benefit of firearms examiners, paying particular attention to the advantages of this system for forensic laboratories. The TriggerScan system can supersede traditional methods of trigger pull measurement, some of which are subjective. Test results may be stored, analyzed, documented, reproduced, retrieved and presented in court, due to the computerized nature of the test. The examiners have the ability to analyze the characteristics of firearm triggers and to compare them wit test results from stored profiles of firearms of the same, or different, model. Also discussed are the advantages and drawbacks of the more traditional trigger pull measurement methods used in the authors' laboratory. The main aim is the establishment of a global database of trigger pull characteristics, which will be accessible via the Internet.

Accuracy Testing on Dvorak Instruments' Trigger-Scan System
By: Cunningham-J

Frangible Bullets

Frangible Bullets; A Firearms Examiner's Nightmare
By: Balash-D-E
ABSTRACT: Advice is provided for firearms examiners concerning the introduction of a new product on the market. This new, frangible bullet is made by DFA of Stafford, Virginia, and used by Winchester in their Ranger brand of law enforcement ammunition. Concerned that this type of bullet could prove difficult to identify, the author test-fired a number of rounds. The results indicated that, in the author's opinion, the bullets were impossible to identify with the firearm from which they were fired, making them an attractive proposition to those wishing to use them illegally.

Centerfire Frangible Ammunition: Wounding Potential and Other Forensic Concerns
By: Kaplan-J; Klose-R; Fossum-R; Di-Maio-V-J-M
ABSTRACT: Newly developed frangible ammunition of copper particulate construction in a variety of calibers (.38, 9 mm, and .223) was assessed for wounding performance by test firing the ammunition into pigs' heads. Also investigated was the matching of fired bullets with the corresponding weapon. The results obtained demonstrated that wounds resulting from 9-mm and .38 caliber frangible bullets were similar in terms of severity to wounds caused by regular service ammunition of the same calibre. Although the recovered bullets of these calibers demonstrated class characteristics, they lacked the individual rifling marks necessary for bullet-to-gun matching. Severe wounds, caused by extensive fragmentation of the bullets in target tissue, were noted with the high-velocity .223 calibre rifle bullets. Examination of radiographs of the resulting wounds showed images, which were very similar to the lead "snowstorm" images caused by high-velocity hunting ammunition.

Federal's New Frangible Ammunition

By: McConaghy-J-L

ABSTRACT: Federal, the ammunition manufacturer, has introduced a new line of frangible ammunition, called BallistiClean, for sale to law enforcement agencies. The "Close Quarter Training" cartridge described in this paper is lead-free and is composed of copper alloy jacketed zinc. The core of the ammunition consists of zinc cabled arranged in a spiral fashion. These cables break apart upon entering a target. Another feature of this ammunition is the fact that the copper alloy jacket retains the gun's rifling marks, thereby permitting identification.

The Design, Composition, Exterior Ballistic-, Terminal Ballistic- and Wound Ballistic Properties of Contemporary Frangible Ammunition

By: Haag-L

ABSTRACT: A new generation of lead-free, frangible ammunition is becoming popular on indoor shooting ranges and in police "shoot-houses". This type of ammunition is also being considered for use in entry (raid) situations due to its reduced range and frangible nature when striking hard objects. This type of ammunition may also be used in prisons, banks and other commercial institutions, which use armed security personnel. At least four manufacturers currently supply this type of frangible ammunition in various popular calibers, each with their own characteristic compositional and design features. As such ammunition gains in popularity, it is expected that it will appear in casework. In such cases, the firearms examiner should be aware that these products cannot be associated with the weapon that fired them in the conventional manner. Also, these bullets may not necessarily be frangible. These features, and several others associated with the forensic examination of this ammunition, are discussed.

U.S. Military "Green Bullet"

By: Mikko-D

ABSTRACT: The aim of this paper is to inform firearms examiners of a new, non-toxic, frangible ammunition, which has been developed by the Oak Ridge National Laboratory for the United States military. This ammunition, called the "Green Bullet", is a new, lead-free projectile that remains as lethal as the standard 5.56mm but with fewer adverse environmental effects. This ammunition has been developed using powder metallurgy techniques for the production of metal matrix composite simulants for lead. The characteristics of this type of ammunition are discussed.

Tungsten Frangible Bullet Wounds in Pig: Exam by Autopsy and X-Rays

By: Fackler-M-L

ABSTRACT: Recently, there has been an increase in demand for the assessment of the tissue disruption potential of tungsten frangible ammunition. When examining the spread of the tungsten after firing into ordnance gelatin, one must correlate it with that seen using more conventional lead core bullets. The aim of this study was to attempt to correlate the fragmentation pattern of the tungsten frangible bullets with the tissue disruption caused. Tests shots were fired from an M16 M4 Carbine from a distance of 10 feet. The targets were ordnance gelatin and a freshly killed pig. Tissue damage was assessed by postmortem examination and X-rays.

AFTE Issues

30th Anniversary

The AFTE Journal, Volume 31, No. 3, Summer 1999 was dedicated to the 30th Anniversary of the AFTE (1969-1999). The extended issue contained a special session called "An Historical Review".

Academy

AFT National Firearm Examiner Academy
By: Ethridge-M-W
ABSTRACT: A shortage of qualified firearm and toolmark examiners is a well-known fact in the forensic firearm world, as it is shortage of format training opportunities. As a result it takes a forensic laboratory years to provide the type of training necessary to prepare an examiner trainee for doing actual casework. To address this critical need the Bureau of Alcohol, Tobacco and Firearms (AFT) established the national Firearm Examiner Academy. The "pilot" class was scheduled for August 1999.

Certificate

Summary Report on the Development of Certification Examinations for Practicing Firearm and Toolmark Examiners
By: Kowalski-K-F
ABSTRACT: The goal of this project was to develop certification examinations for practicing Firearm and Toolmark Examiners. Certification examinations have been developed for three subject areas within the field of Forensic Firearm and Toolmark Identification. The three subject areas covered by these examinations are: 1) Firearm Evidence Examination and Identification, 2) Toolmark Evidence Examination and Identification, and 3) Gunshot Residue Evidence Examination and Identification. The certification examination for each subject area consists of a written examination and a practical examination. An applicant must pass both examinations to be certified in that subject area. The written examination must be passed before the applicant is allowed to take the practical examination in each subject area. Written examinations are offered at a cost of fifty dollars ($50.00) per subject area and a practical examination will be offered to eligible applicants at a cost of two hundred dollars ($200.00) per subject area. Two separate but equivalent versions of each certification examination have been prepared in each subject area in order to give some longevity to the program. These certification examinations are available to members of the Association of Firearm and Toolmark examiners (AFTE) at the Annual Training Seminars and their local workplaces.

Historical Review

Report on the Formation of the Association of Firearm and Tool Mark Examiners
By: Howe-W-J

Roster of Participants, May 15th, 1969
A Map of AFTE Membership, Then and Now – Written by Steve Molnar and Jerry Miller. Previous Location of AFTE Conferences.

History of Firearms Identification to 1930
By: Goddard-C-H

Fingerprinting Bullets
By: Stout-W-W; Hamby-J

The History of Firearm and Toolmark Identification
By: Hamby-J-E; Thorpe-J-W

Firearms Identification
By: Hamby-W-J; Mathew-H

A Historical Perspective of Firearms Reference Collections
By: Hamby-J

The End of a Formative Year – A Brief Review
By: Hamby-W-J

Law Enforcement On-Line (LEO)

Law Enforcement On-Line
By: Denio-D; Gardner-G
ABSTRACT: The FBI developed a free, secure, nationwide computer intranet to assist law enforcement. The system is intended to be an information resource and communication vehicle to provide easy access to exchange ideas, information, assistance and cooperation among law enforcement professionals the country.

Publications

Scientific Reliability - Publication, Peer Review, and the AFTE Journal
By: Collins-J
ABSTRACT: This paper discusses the modern aspects of peer review and its associated misconceptions. Also, an underlying philosophical approach to literature review is presented to facilitate the assessment of the pros and cons of contemporary pre-publication review. The opinions of the United States Supreme Court and published literature regarding peer review were examined, and relevant themes and points are presented. In the event of future updates to AFTE's editorial guidelines ever being implemented, the research in this paper should aid the AFTE editor, the AFTE Board of Directors, submitting authors, and readers of the journal. This subject is vital as our work is dependent on the publication of our peer's work and experiments.

FIREARMS – CHEMISTRY

Primer gunshot residues (GSR)

Compositions and Classification

Gunshot Residue-Similar Particles Produced by Fireworks
By: Mosher-P-V; McVicar-M-J; Randall-E-D; Sild-E-H
ABSTRACT: Fireworks manufacturers use compounds containing lead, barium and antimony in a variety of pyrotechnic devices, with all of these elements occasionally found in the same firework. As lead, barium and antimony are used in the identification of gunshot residue (GSR), it is possible that some of these fireworks could produce particles similar to GSR. In this study, fireworks did produced such GSR-type particles, depositing them on the hands of professional fireworks technicians, and in the combustion plume of consumer-grade fireworks. Further studies are required to investigate the effect of such fireworks on GSR analysis and interpretation.

Gunshot Residue - Further Studies on Particles of Environmental and Occupational Origin

By: Garofano-L; Capra-M; Ferrari-F; Bizzaro-G-P; Di-Tullio-D; Dell-Olio-M; Ghitti-A

ABSTRACT: This paper presents the results of studies into gunshot residue particles of environmental and occupational origin, which were carried out at the authors' laboratory. Experimental data were obtained from 175 samples collected from the hands of individuals who were employed in relevant occupations. Samples were also collected from vehicle interiors, from the hands of motorists who had worked on the motor, battery, and tyres, from the hands of those who had fired cartridge-operated industrial tools (stud guns), children's cap guns, and had handled and set off fireworks. Apart from confirming that, in most cases, occupational samples cannot be erroneously identified as gunshot residue, this study shows that people working in the vehicle industry may be exposed to particles of barium and antimony, which, in some cases, may be mistaken for gunshot residue. There is an especially high risk of "false-positive" results when automatic research systems and tape lift collection are used without particle morphology-based investigation. It is proposed, therefore, that a slight change is required in the classification system. This study also confirms the results of previous studies, which have suggested that Italian cartridge-operated industrial tools produce barium, lead and antimony particles, which may be mistaken for particles of gunshot residue.

A Survey of titanium and zinc particles in samples collected from suspects

By: Levin-N, Tsach-T, Bergman-P,Springer-E

ABSTRACT: The analyses of gunshot residue (GSR) particles in samples collected from suspects, using SEM/EDX, are based on the empirical findings that particles having certain elemental compositions (e.g. Pb, Sb and Ba, or Pb, Ba, Si, Ca and Sn) were found so far only in percussion primers discharge residues. Such particles are referred to as gunshot residue (or primer discharge residue) particles. Other particles, originating from primer discharge, have compositions similar to those found also in other sources unrelated to firearms' discharge. Such particles are referred to as consistent with gunshot residue particles. In recent years, new lead-free primer types have been developed, in order to lower the amount of lead emitted to the environment. One such primer type is the Dynamite-Nobel Geco Sintox®. The Sintox® primer composition is Dinol (diazodinitrophenol), zinc peroxide, titanium powder and nitrocellulose, and its discharge residue particles are composed mainly of Ti and Zn. In order to assess the evidential value of Ti+ Zn particles, found in samples collected from suspects, the present survey was conducted. Particles containing Ti and/or Zn, found in 128 samples analyzed during routine casework in the laboratory, were studied using SEM/EDX. Out of 963 particles, defined by the software as "titanium" or "zinc", only 16 particles (found in 6 of the samples) contained both Ti and Zn and none had the characteristic features of Sintox® GSR particles. Based on these findings it is suggested to regard spherical Ti + Zn particles as being consistent with Sintox® GSR particles.

Antimony Enrichment on the Bullets' Surfaces and the Possibility of Finding It in Gunshot Residue (GSR) of the Ammunition Having Antimony-Free Primers
By: Zeichner-A; Schecter-B; Brener-R
ABSTRACT: Scanning electron microscopy/energy dispersive X-ray spectroscopy (SEM/EDX) was used to examine projectiles of twenty brands of ammunition. In all of the projectiles, antimony enrichment was present on the surface (around 10 um depth or less) of the lead alloy as compared with the bulk. Some of the projectiles had high enrichment - as much as tens of times the bulk concentration. Auger electron spectroscopy was also used to study the concentration depth profiles in a number of the projectiles, and it was found that there were much higher concentrations of antimony on the surface than in the bulk, even when such an effect could hardly be detected by SEM/EDX. Shooting tests were performed using ammunition with antimony-free primers and in which the highest content of antimony on the projectiles' surface was found. In all of these tests, a very small percentage of antimony-containing gunshot residue particles was found.

The Contribution of Trace Elements from Smokeless Powder to Post Firing Residues
By: Miyauchi-H; Kumihashi-M; Shibayama-T
ABSTRACT: Scanning electron microscopy-energy dispersive X-ray microanalysis (SEM/EDX) was used to analyze the smokeless powders in 22 types of ammunition seized from a Japanese gang. Copper (Cu), sulphur (S), potassium (K), silicon (Si), aluminium (Al), calcium (Ca), iron (Fe), chlorine (Cl), and barium (Ba) could all be detected. All samples contained Cu. A single sample contained a high amount of Ba. One of the burnt smokeless powder contained Cu, K, Ca, Fe and S, whilst the other part contained Cu, Fe, and zinc (Zn). It has previously been reported that the elements in gunshot residue come from a bullet and/or a primer. This data, however, shows that some of the elements detected could originate from smokeless powder.

Instrumentation

Analysis of Gunshot Residue Using Variable Pressure Scanning Electron Microscopy on Samples Collected from Skin, Clothing, and Vehicle Interiors
By: Schwoeble-A-J; Lentz-H-P; Lee-K-R
ABSTRACT: The use of variable-pressure scanning electron microscopy (SEM) for the analysis of gunshot residue (GSR) eliminates the need for sample preparation techniques, which may lead to contamination or particle loss. This paper describes the use of variable-pressure SEM on GSR samples from case studies and test firings, using a variety of sampling techniques employed by law enforcement agencies. The samples analyzed originated from skin, clothing, and vehicle interiors.

Evaluation of X-Ray Microfluorescence Spectrometry for the Elemental Analysis of Firearm Discharge Residues

By: Flynn-J; Stoilovic-M; Lennard-C; Prior-I; Kobus-H

ABSTRACT: Firearm Discharge Residues (FDRs) are conventionally analyzed by pressing an adhesive-coated SEM stub a number of times onto the area of interest. The sample is subsequently analyzed by scanning electron microscopy/energy dispersive X-ray spectroscopy (SEM/EDX). Although this method has excellent spatial resolution, other techniques have much greater elemental sensitivity. The aim of this work was the evaluation of X-ray microfluorescence (micro-XRF) for the analysis of FDRs, the comparison of this method with SEM/EDX analysis, and the evaluation of the ability of micro-XRF to carry out on-target FDR analysis. Micro-XRF uses a non-destructive method capable of locating and analyzing individual FDR particles with a diameter of 10 um or more. The micro-XRF analysis can use X-ray mapping to produce elemental maps directly from the target substrates, giving an indication of the elemental distribution across a sample. The study used different types of ammunition to include different primer and bullet compositions. Experimental shots were fired into different target substrates from close range and the residues were analyzed by micro-XRF. This method was also used to analyze SEM stubs, which contained FDR particles. The results obtained suggest that micro-XRF is effective at detecting and analyzing FDR particles greater than 10 um in diameter. It was shown that micro-XRF is useful for on-target analysis of residues caused by close-range gunshots (<30 cm). Information concerning bullet composition can also be obtained from the micro-XRF analysis of the bullet wipe area.

Analysis of Primer Residue From Lead Free Ammunition by X-Ray Microfluorescence

By: Charpentier-B; Desrochers-C

ABSTRACT: Traditionally, the forensic analysis of gunshot residues has involved the detection of lead (Pb), antimony (Sb) and barium (Ba) usually present in the primer. Recently developed lead-free ammunition, however, presents a new challenge to the forensic firearms examiner. An analysis was made of the gunshot residues in the area surrounding bullet holes, which is very important when attempting to determine shooting distance. The ammunition used was lead-free (9mm Luger and .38 spl + p calibers), where the lead in the primer was replaced by strontium (Sr) and where the lead bullet was copper-plated (Total Metal Jacket). The analysis was performed using energy dispersive X-ray microfluorescence spectrometry, allowing the qualitative and quantitative determination of Sr residues on the target up to a distance of 45 cm.

Analysis of Gunshot Primer Residue Collection Swabs by Inductively Coupled Plasma-Mass Spectrometry
By: Koons-R-D
ABSTRACT: Inductively coupled plasma-mass spectrometry was used to determine levels of antimony, barium, and lead in gunshot residue collection swab extract solutions. The advantages of this method are a lack of interference, low limits of detection, wide linear dynamic ranges, short analysis times, and good accuracy and precision. This method can be applied to both hand blank and shooter-associated concentrations of antimony, barium, and lead in gunshot residue swab extracts.

Applications of Focused Ion Beam Systems in Gunshot Residue Investigation
By: Niewohner-L; Wenz-H-W
ABSTRACT: The introduction of scanning ion microscopy has enabled gunshot residue (GSR) examiners to investigate a particle's core. Using this method, a focused ion beam allows the cross sectioning of particles, revealing the interior structure and character of the particle that can prove useful for identifying the manufacturer of the ammunition of interest.

Raman Microscopic Identification of Gunshot Residues
By: Stich-S; Bard-D; Gros-L; Wenz-H-W; Yarwood-J; Williams-K
ABSTRACT: In this study, Raman microscopy was used for the unambiguous identification of lead and barium anions in gunshot residues (around 5 um in size) deposited on cellulosic materials. Most of the particles comprised mixtures of oxides, sulphate and carbonate (along with carbon). There was particularly strong evidence for the formation of mixed oxides of iron, but little evidence was found for antimony oxides. Raman microscopy is capable of identifying individual or mixed components and confirming the presence of microcrystalline particles with a particular crystal structure.

Sampling

Is There a Real Danger of Concealing Gunshot Residue (GSR) Particles by Skin Debris Using the Tape-lift Method for Sampling GSR from Hands?
By: Zeichner-A
ABSTRACT: Experiments were carried out to assess the danger of concealing GSR particles by skin debris using the tape-lift method for sampling GSR from hands. Thirty discrete spherical particles (from GSR and from the debris of oxygen cutting of steel) sized from 8 to 30 microns were mounted on double-side adhesive coated stubs in known locations using a stereomicroscope. These stubs were then used for dabbing hands 50 times. Some of the particles or parts thereof were covered by skin flakes, however all particles could be detected using the backscattered electron image (BEI) in the scanning electron microscope (SEM). Also, all could be identified by the energy dispersive X-ray spectroscopy (EDX).

The Persistence of Gunshot Residue on Shooters' Hands
By: Jalanti-T; Henchoz-P; Gallusser-A; Bonfanti-M-S
ABSTRACT: Evidence that a person has fired a gun can provide a link in the chain of proof in shooting investigations. Such evidence usually takes the form of gunshot residue (GSR) detection on the subject's hands. In cases where a suspect is not apprehended immediately, the persistence of GSR on the hands becomes an issue. This paper describes a study into the loss of GSR when a shooter's hands were sampled at different times after the gun was fired. The samples were analyzed by SEM-EDX and the sodium rhodizonate chromophoric test. The results showed that, from shot to shot, reproducibility in particle counts is poor. At t=0, the highest amount of GSR is found on the firing hand, with variations in the ratio of GSR on other parts of the hands. The largest loss of GSR occurred in the first 2-4 hours. It was also shown that particle retention was independent of their chemical nature. There is also a high influence of the weapon's memory effect on both the shooter's hands, and it is shown that the sodium rhodizonate test is meaningless after sampling for SEM-EDX.

Time since discharge

Time Since Discharge of Shotguns
By: Andrasko-J; Norberg-T; Stahling-S
ABSTRACT: This paper presents a solid-phase microextraction-based method for estimating the time since the last discharge of a shotgun. Samples are taken from the atmosphere inside the barrel of the weapon and analyzed by either GC/TEA or GC/FID(MS), both of which can detect a variety of combustion products. Estimation of time since last discharge is based on the escape rate of the volatile discharge residues from the shotgun barrel as a function of time. If the ammunition used is already known, the use of decay curves for the firearm and ammunition is quite straightforward. If the ammunition is unknown, sampling has to be repeated and the results must be fitted to decay curves obtained for other types of ammunition according to the proposed method. This procedure can indicate whether a weapon was discharged, e.g. 2-3 days, 1-2 weeks, or more than 3 weeks ago. A number of factors, which could affect data interpretation, were studied. These factors included cleaning of the barrel, number of shots fired, disturbance of SPME sampling, and the effect of storage temperature.

Time Since Discharge of Spent Cartridges

By: Andrasko-J; Stahling-S

ABSTRACT: A method is presented for the estimation of time since discharge of spent cartridges based on Solid-Phase Microextraction (SPME) sampling from the atmosphere inside the cartridges. Most of the cartridges analyzed contained traces of either naphthalene or an unidentified compound (designated TEA-2). Although these combustion products are the same as those measured in firearm barrels, the levels detected in cartridges are much lower. The estimation of time since discharge is based on the rate of escape of the volatile combustion products as a function of time. The three types of cartridge studied were: shotgun shells, sporting rifle cartridges, and handgun cartridges. In the case of shotgun shells, the decay of the naphthalene peak is measured. At room temperature, naphthalene can be detected in shotgun cartridges for two or three weeks after discharge. In sporting rifle cartridges, only the TEA-2 peak can be detected for around two weeks after discharge. No combustion products were detected in the handgun cartridges, with the exception of longer cartridges and small calibre cartridges (.22 calibre) where the TEA-2 peak was observed for a number of days after discharge. Although nitroglycerin (NG) could be detected in cartridges from certain manufacturers, the reproducibility of its detection was poor. Also, the NG rate of decay was too slow at temperatures below room temperature. The system was not disturbed by repetitive SPME sampling, but attempts to prevent the escape of the volatile compound from the cartridges proved unsuccessful.

Time Since Discharge of Rifles

By: Andrasko-J; Stahling-S

ABSTRACT: Solid-phase microextraction (SPME) and gas chromatography with TEA detection (GC-TEA) has been used for the estimation of time since discharge of rifles. An unidentified compound, termed TEA2, was found in all of the sampled rifles. TEA2 was also observed in shotguns and spent cartridges in a previous study. TEA2 escapes rapidly from the inside of rifle barrels, but remains detectable in the barrel for between one and two months after firing. The decrease of the TEA2 peak with time after discharge is not exponential, and the curve-fitting procedure suggested for the estimation of time since discharge of shotguns may also be applicable to rifles.

Shooting distance estimation

Improved Method for Shooting Distance Estimation. Part 1. Bullet Holes in Clothing Items

By: Glattstein-B; Vinokurov-A; Levin-N; Zeichner-A

ABSTRACT: This paper describes an improved method for the estimation of firing distance based on bullet holes in items of clothing. The novel part of this method involves the transfer of total nitrite (nitrite ions and smokeless powder residues) from a target to an adhesive lifter. After the transfer has been completed, deposits of lead and copper around the bullet hole can be visualized by rhodizonate and rubeanic acid, respectively. Following alkaline hydrolysis, the Modified Greiss Test is performed on the smokeless powder residues on the lifter.

Improved Method for Shooting Distance Determination. Part 2 - Bullet Holes in Objects that cannot be Processed in the Laboratory

By: Glattstein-B; Zeichner-A; Vinokurov-A; Shoshani-E

ABSTRACT: This paper describes an improved method for the determination of firing distance on exhibits such as cars, doors, windows, and furniture that cannot be processed in the laboratory. The novel feature of this method is the transfer of total nitrite (nitrite ions and smokeless powder residues) from the target to an adhesive lifter. After this has taken place, vaporous lead and copper deposits around the hole mad by the bullet can be visualized on the actual target by sodium rhodizonate and rubeanic acid, respectively. Following alkaline hydrolysis, the smokeless powder residues on the adhesive lifter are analyzed using the Modified Griess Test.

Improved Method for Shooting Distance Estimation. Part III. Bullet Holes in Cadavers

By: Glattstein-B; Zeichner-A; Vinokurov-A; Levin-N; Kugel-C; Hiss-J

ABSTRACT: This paper presents an improved method for the estimation of firing distance on human body surfaces. A chemical test is included in addition to the conventional visual and microscopic examinations of wounds. The chemical test used involves the transfer of gunpowder residues from the site of the wound to an adhesive lifter. The sample is then visualized as total nitrite, after alkaline hydrolysis, by the Modified Griess Test (MGT). In cases of advanced decomposition or when the wounds are surrounded by hair, the information obtained from this chemical test can prove vital for the determination of shooting distance. The chemical test may also improve the accuracy of the examination and, in certain cases, help to discriminate between entrance and exit wounds.

Scientific Examination and Comparison of Skin Simulants for Distance Determinations

By: Haag-M; Wolberg-G

ABSTRACT: Several simulant materials have been used for shooting distance determinations based on stippling and/or tattooing patterns on a victim's skin. These simulants range from pig skin to aluminium foil. This is the first direct, objective comparison of these patterns on live human skin with patterns on simulants. Objective, numerical density measurements were used to determine the simulants, which most closely simulated human skin (fresh pig skin, twill jean cloth, Whatman #1 blotter paper, and Whatman #10 BenchKote. The most accurate simulant of those tested was fresh pig skin, with the twill jean cloth and blotter paper being more accurate from 2-3 feet, and the BenchKote being more accurate at 3-4 feet. Other testing materials were also examined, but they were deemed unsuitable on the basis of numerical criteria. (The methods described in this paper are in violation of the fundamental rules of firearm safety and may result in serious injury if replicated. This paper is being published in its entirety at the request of the AFTE Board of Directors)

Machine Washing or Brushing of Clothing and the Influence on Shooting Distance Estimation

By: Vinokurov-A; Zeichner-A; Glattstein-B; Koffman-A; Levin-N; Rosengarten-A

ABSTRACT: Experiments were conducted to assess the effect of machine washing or brushing of clothing items on Gunshot Residue (GSR) patterns (gunpowder residues, lead and copper deposits) around bullet entrance holes. Results show that those treatments decrease considerably the amount and density of GSR. However, for close shooting distances not all of the GSR deposits are removed. Remaining patterns may be visualized by specific color reactions and used for shooting distance estimation.

FIREARMS - WOUND BALLISTICS

Characteristics of Gunshot Wounds in the Skull

By: Quatrehomme-G; Iscan-M-Y

ABSTRACT: Although the analysis of skeletal trauma is important in forensic medicine, most pathology references do not give this topic sufficient attention. Therefore, this paper is devoted to describing a number of different aspects of gunshot wounds, such as entrance and exit patterns, angle and path, range of fire and velocity, and bullet calibre, based on observations of a number of known cases. The study material comprised the skeletal remains of 21 victims of fatal gunshot wounds. Each case was analyzed with regard to wound location, shape, size and exit/entry surface area ratio, beveling, and direction of shooting. Entry wounds to the skull were most frequently round or oval, whereas in bones such as the mandible and mastoid process, the shapes were either unusual, triangular, nearly rectangular or irregular. Tunneling was noted in the mastoid process. All but one skull showed evidence of the expected internal beveling, but external beveling of an entry wound was only observed in one case (parietal bone). Exit wounds tended to be fairly round, oval, square, and rectangular, but were always more irregular than entry wounds. Most vault bones showed signs of external beveling, but none was observed in the orbit, maxilla, greater wing of the sphenoid, temporal, or left occipital bone. Tangential gunshot wounds were evidence in a mastoid process, zygomatic process, mandibular ramus and condyle, and occipital condyle. The majority of the exit to entry surface area ratios ranged from 1.4 to 2.0. In four of the cases studied, the ratio suggested that the entrance wounds were larger than the exit wounds. Assessments such as these should prove useful for the reconstruction of events surrounding gunshot deaths.

Keyhole Defect Production in Tubular Bone
By: Berryman-H-E; Gunther-W-M
ABSTRACT: Fracture characteristics, which are mainly reported fro the skull, are useful indicators of bullet direction. A bullet which strikes the vault tangentially produced an irregular opening (keyhole defect). The circular part of this defect is the initial point of impact. The identification of such a feature in long bones can also indicate bullet direction and the position of the bone when the shot was fired. The case described involved a tangential shot to the humerus and showed similar fracture mechanics to those observed in the skull.

Incomplete Shored Exit Wounds - A Report of Three Cases
By: Druid-H; Ward-M-E
ABSTRACT: The forensic literature contains many examples of typical and atypical exit wounds. The descriptions of atypical exit wounds include perforating, "shored" exit wounds where the perforation of the skin is associated with an abrasion, whether or not the projectile fully exits the body. This paper describes an atypical, incomplete, shored exit wound where the skin was abraded by supporting material at the site of bullet recovery, although there was no associated perforation of the skin. Recognition of this pattern of injury may prove important when reconstructing crime scenes.

Wounding Characteristics of Glaser Safety Ammunition: A Report of Three Cases
By: De-Roux-S-J; Prendergast-N-C; Tamburri-R
ABSTRACT: There are two forms of handgun ammunition containing multiple pellets (birdshot). This paper describes the postmortem and radiographic finding in three individuals who suffered fatal wounds after being shot with Glaser safety ammunition. The findings are contrasted with those reported in cases of shot shell injury.

Fatal Neck Injuries Caused by Blank Cartridges
By: Rothschild-M-A; Vendura-K
ABSTRACT: Three cases are reported where blanks fired from starting pistols caused fatal neck injuries. In all three cases, discharge was at contact range. The gas pressure resulting from the discharge was responsible for the creation of extensive wound cavities in all cases. In one of these cases, the victim shot himself eight times with two different starting pistols, with the resulting wounds being matched to each weapon by muzzle imprints on the neck.

Multiple Entrance Wounds from One Bullet Due to the Use of a Silencer
By: Karger-B; Rand-S-P
ABSTRACT: If a bullet hits an interposed object before entering a body, the bullet may fragment, or pieces of the object may be accelerated. These secondary missiles may give rise to multiple entrance wounds if the body is in their line of flight. This paper reports an unusual case where the part of the interposed object was played by a silencer. The bullet which was being fired hit the central part of the silencer baffles, which were misaligned, and disintegrated completely. Some fragments of the bullet remained inside the silencer and some exited the silencer in the form similar to shotgun pellets. At a shooting distance of several meters, the bullet fragments wounded the victim at a number of different anatomical sites. This phenomenon should be considered in cases where bullet fragments are recovered from a scene or victim but where there are no appropriate interposed objects.

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Army noncombat munitions injuries.
By: Kopchinski-B, Lein-B.
ABSTRACT: Objective: The object of this study was to determine the types of noncombat injuries secondary to munitions sustained by U.S. Army soldiers. Methods: A retrospective review of all noncombat munitions injuries reported to the U.S. Army Safety Center from August 1989 to September 1996 was conducted. Results: There were 742 incidents reported, resulting in 894 injured soldiers. The most common types of injuries were thermal burns, puncture wounds, and lacerations. The extremities were the most common anatomical location injured. The most common activities associated with injuries were combat training exercises, munitions firing, and rendering munitions safe. Conclusion: This study demonstrates a distinctive injury pattern for each category of munitions. Military readiness will be improved if Ne train all personnel to be familiar with the injury patterns and the most common situations associated with injury. By informing unit commanders which activities are associated with increased risk of injury, they may better prepare preventive measures to decrease the number of noncombat injuries.

Wounds from civilian and military centerfire rifles.
By: Di Maio-V-J.
ABSTRACT: This article explores the differences between rimfire and centerfire rifles and the differences in ammunition used. Permanent and temporary cavity wound tracks are explained. Radiographs, intermediary targets, and assault rifles are also discussed.

Mortality associated with use of weapons in armed conflicts, wartime atrocities, and civilian mass shootings: literature review.

By: Coupland-R-M, Meddings-D-R.

ABSTRACT: Objective To determine the implications of variation in mortality associated with use of weapons in different contexts.

Design Literature review.

Setting Armed conflicts and civilian mass shootings, 1929-96.

Main outcome measure Mortality from wounds.

Results During the fighting of war the number of people wounded is at least twice the number killed and may be 13 times as high; this ratio of the number wounded to the number killed results from the impact of a weapon system on human beings in the particular context of war. When firearms are used against people who are immobilized, in a confined space, or unable to defend themselves the wounded to killed ratio has been lower than 1 or even 0.

Conclusions Mortality from firearms depends not only on the technology of die weapon or its ammunition but also on the context in which it is used. The increased mortality resulting from the use of firearms in situations other than war requires a complex interaction of factors explicable in terms of wound ballistics and the psychology of the user. Understanding these factors has implications for recognition of war crimes. In addition, the lethality of conventional weapons may be increased if combatants are disabled by the new non-lethal weapons beforehand; this possibility requires careful legal examination within the framework of the Geneva Conventions.

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56. Serial Number Restoration of Obliterated "Welded-On" Type Characters Finor-J-M; Rone-C AFTE; 1998; V30 (4); P649-651

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