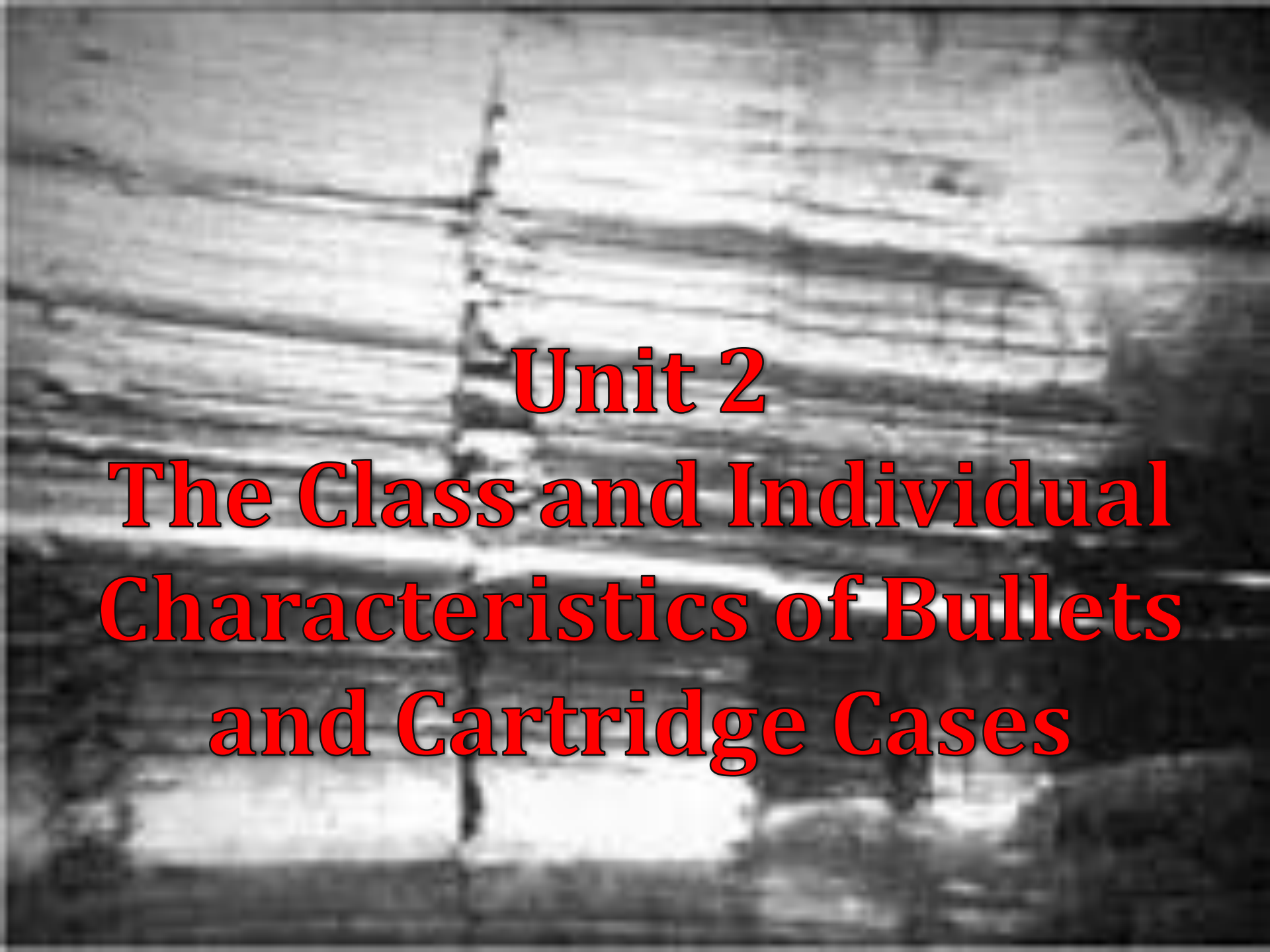
Module 5B

Bullets, Cartridge Cases, & NIBIN

Forensic Science Teacher Professional Development


Unit 2
The Class and Individual Characteristics of Bullets and Cartridge Cases

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A cartridge consists of a primer, cartridge case, powder or propellant, and bullet. The following identify the process of firearm discharge.

1. When a firearm is fired, the firing pin strikes the primer of the cartridge.
2. This action ignites the propellant and produces an extreme amount of high-pressure gas within the cartridge.
3. This pressure causes the cartridge to swell and occupy the diameter of the firearm's chamber.
4. This obturation effectively seals the resulting gasses behind the bullet and in front of the cartridge case.
5. As the gasses expand at an incredibly rapid rate, the cartridge case slams back into the breech face of the firearm, and the bullet is rapidly projected down the barrel of the firearm and out of its muzzle.

Unit 2 The Class and Individual Characteristics of Bullets and Cartridge Cases

- The fired cartridge case will bear striation and impression marks as a result of contact with the breech face and the firing pin.
- The fired bullet will bear striations on land engraved areas (LEAs) as a result of traveling down the barrel of the firearm, as shown in Figure 6.
- Fired bullets and cartridge cases can be linked to the firearm from which they were fired by matching individual characteristics found in these striated and impressed marks.

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Class characteristics of fired bullets

- The number of lands and grooves in a firearm barrel
- The widths of the lands and grooves
- The direction in which the lands and grooves spiral (the “twist”), either right or left
- The caliber, or the distance between two opposing lands in hundredths of an inch (US) or in millimeters

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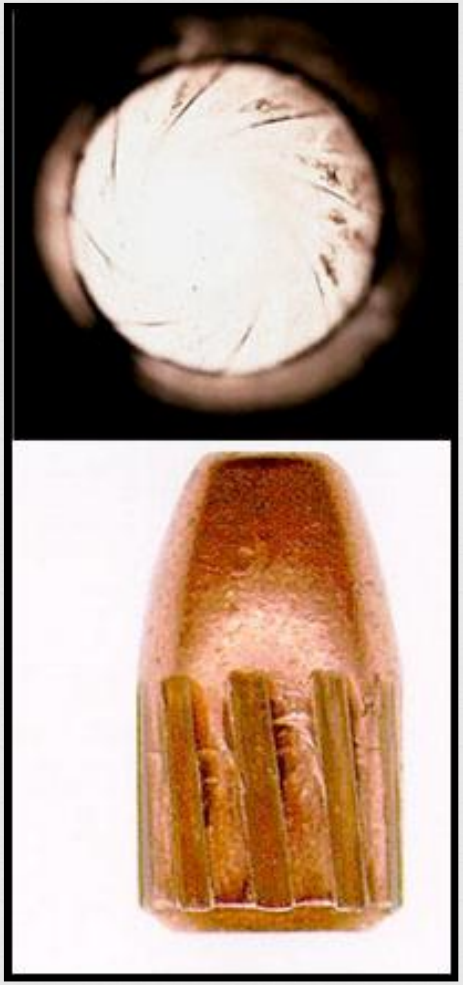

Figure 6

Rifling in this barrel has eight lands and grooves that twist to the left (*top photo*).

This discharged bullet exhibits eight land and groove impressions with a left twist (*bottom photo*).

Visit the following website to find out more on how a bullet can be traced to a particular gun.

http://www.scientificamerican.com/article.cfm?id=how-can-a-bullet-be-trace

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Computer Databases

- The FBI maintains a central computerized firearm file called the General Rifling Characteristic file (GRC).
- Firearm examiners can search the file with the caliber, number of lands and grooves, and the widths and direction of twist. This may help to determine the make and model of the firearm that could have fired the crime scene bullet.

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Individual Characteristics

- Striations found on bullets have individual characteristics that can be identified back to a particular firearm because of microscopic imperfections within the barrels of firearms.
- Firearm barrels are machined to have lands and grooves in order to improve their accuracy by imparting a stabilizing spin to the bullet.
- Machining methods that create these lands and grooves, such as cutting, button swaging, and hammer forging, leave different microscopic imperfections within barrels.

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Individual Characteristics, continued

- Previous research has shown that even consecutively manufactured barrels will have such random imperfections that bullets fired through these barrels can be successfully linked with the correct barrel.
- Firearms examiners are tasked with locating the microscopic individual characteristics found on fired bullets and cartridge cases. They then determine if the bullets or cartridge cases came from a particular firearm.

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Individual Characteristics, continued

- Imperfections in the lands during manufacture or ones caused by wear, nicks, scratches etc., will be mirrored on the surface of the fired bullets.
- These rifling imperfections are unique to each barrel and form the basis for a projectile-to-barrel identification.

Figure 7
Striations on the surface of a fired bullet

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Collection & Preservation of Firearms Evidence

- A firearm must be rendered safe before it is removed and packaged.
- A record must be kept of the cylinder position that is lined up with the barrel of a revolver.
- Bullets and cases recovered from the scene must be carefully marked for identification or sealed in containers that are marked.

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Collection & Preservation of Firearms Evidence, continued

- Firearms evidence should always be sent to the laboratory for analysis so that connections can be made to other cases using the firearms database.
- To prevent the disturbance of latent fingerprints on a firearm, the weapon should be lifted by the edge of the trigger guard or by the checkered portion of the grip.
- When a gun is recovered from an underwater location, it should be transported to the crime laboratory in a container with enough of the same water necessary to keep it submerged.

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Examination for Safety & Physical Condition

- There are two key parts of the initial physical examination.
  - Ensuring that no cartridges are left in the firearm
  - Sighting down the barrel to verify that it is not obstructed
- The weapon is then “dry fired” (no cartridge) to ensure that all the component parts are working.
- The basic class characteristics are noted along with the make, model, and serial number.

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Functionality of Firearms and Obtaining Control Bullets and Cases

- Firearms are test fired to determine functionality and proper working of the safety features and to obtain known specimens.
- Functionality is the ability of a firearm to fire a projectile when the trigger is pulled.
- Two or three test firings are done into water-filled bullet recovery tanks, as shown in Figure 8.

Unit 2 The Class and Individual Characteristics of Bullets and Cartridge Cases

Figure 8
Demonstration of a test fire in a water-filled tank
The test fired bullet can then be recovered with no damage to its surface.

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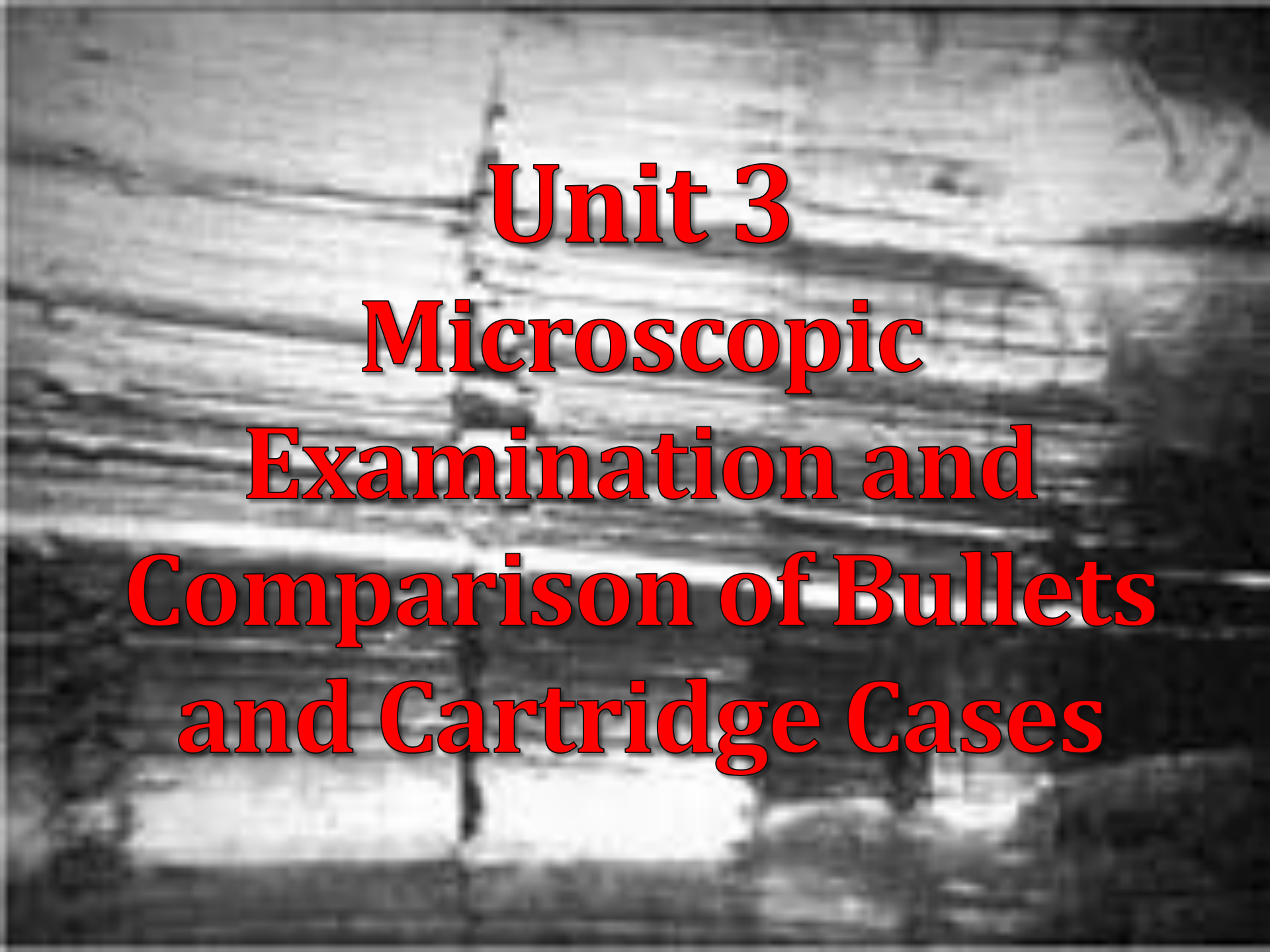
Recovered Firearm and Fired Evidence in Reconstructions

- Trigger pull tests are frequently done with recovered firearms to evaluate the sensitivity of the trigger and evaluate the accidental discharge possibility.
- Safety mechanisms are evaluated to test if the weapon would fire if accidentally dropped.
- Bullets may have trace evidence that will provide information about the objects encountered during its travel.
- Discharged evidence bullets must be carefully handled to avoid damage to the striation markings.



Unit 3
Microscopic Examination and Comparison of Bullets and Cartridge Cases

Unit 3 Microscopic Examination and Comparison of Bullets and Cartridge Cases

Bullet and Cartridge Case Comparisons

- A comparison microscope is used for the examination of bullets and casings.
- With bullets, fine striations on the interior of the land impressions are examined and compared.
- The examiner looks for areas of consistency between the striations of a known specimen and the evidence.
- Evidence bullets are often distorted on impact and only small areas are found with intact markings.
- The presence of grit and rust can, to some degree, alter the marking on bullets fired through the same barrel.
- Lands and grooves are subject to wear and tear; hence, striation markings are susceptible to continuing change.

Unit 3 Microscopic Examination and Comparison of Bullets and Cartridge Cases

Figure 9

A comparison microscope

Unit 3 Microscopic Examination and Comparison of Bullets and Cartridge Cases

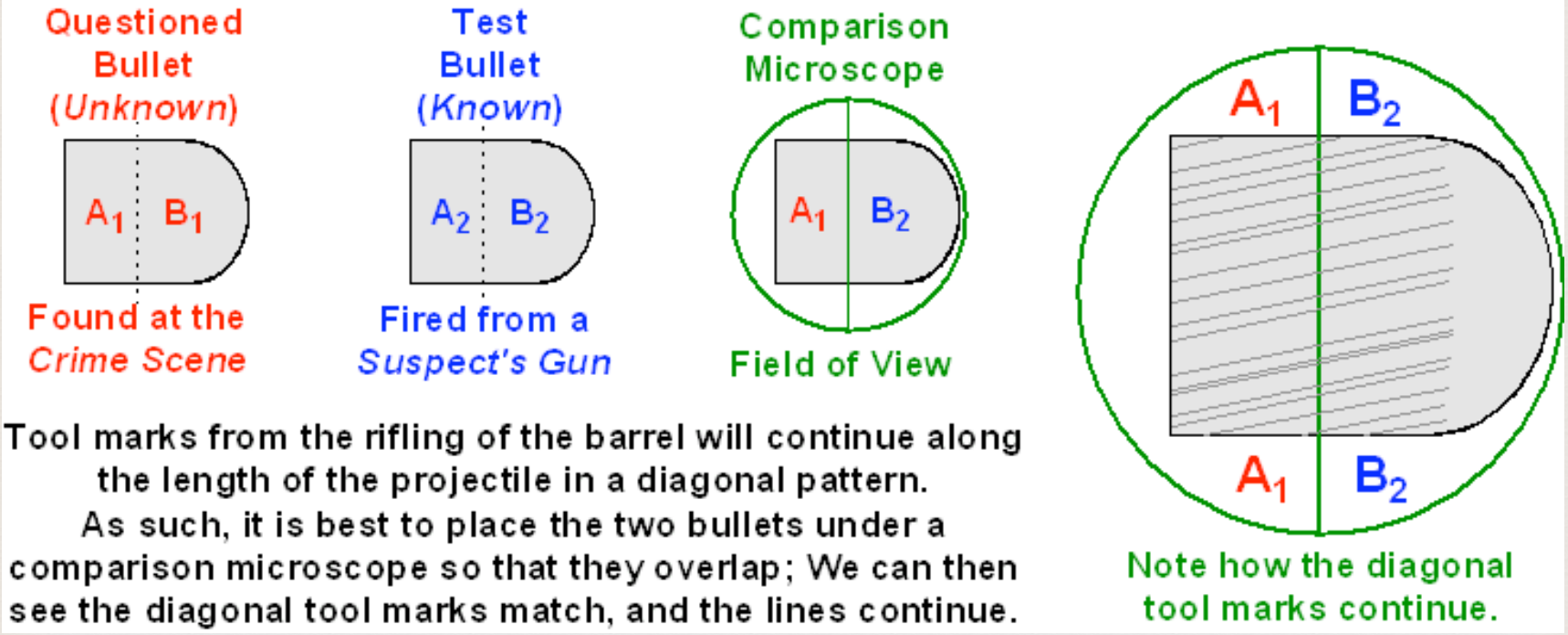


Figure 10

A diagram showing the arrangement of specimen under a comparison microscope

Unit 3 Microscopic Examination and Comparison of Bullets and Cartridge Cases

Figure 11

A comparison of bullets using a comparison microscope

Unit 3 Microscopic Examination and Comparison of Bullets and Cartridge Cases

With cartridges, the firing pin impressions left by the firing pin on the primer cup portion of the cartridge can often be linked to a particular firearm.

Cartridge cases can often be associated with a particular weapon by breech face markings left on the primer cup.

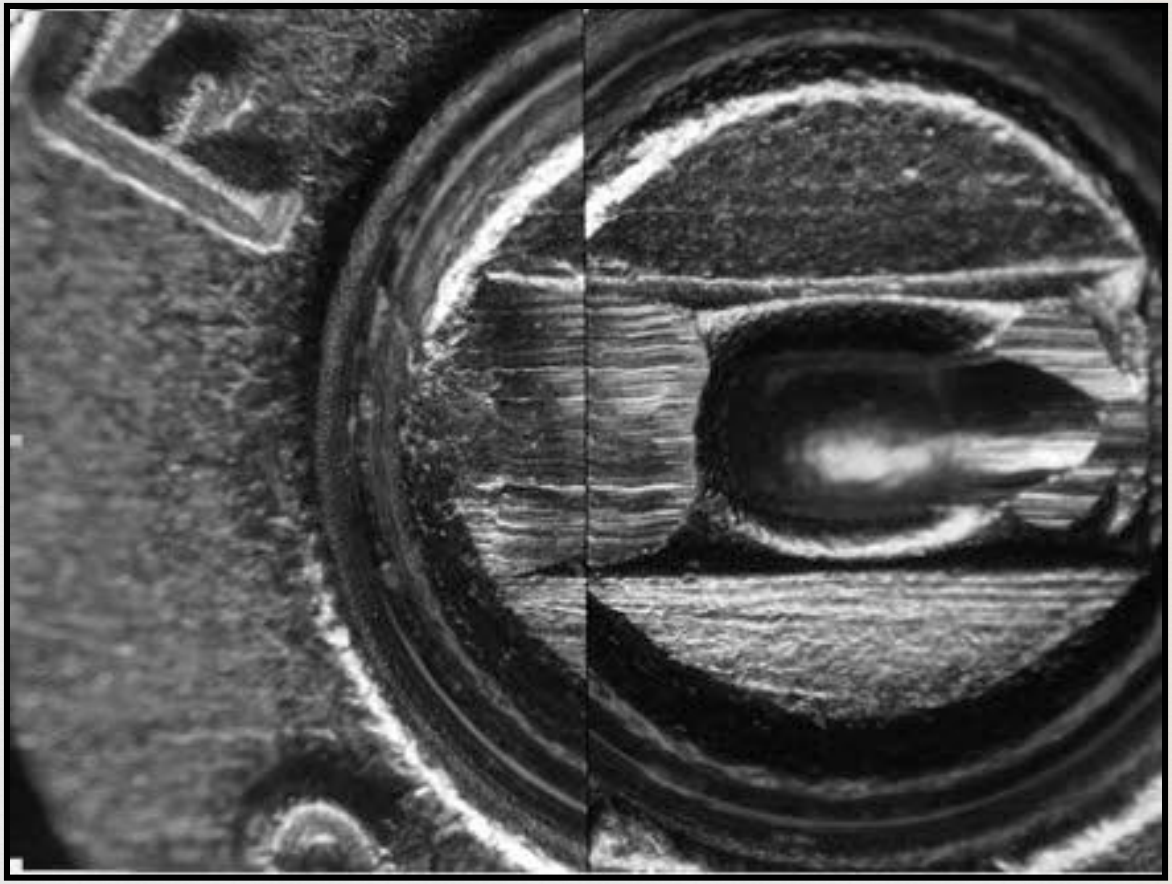


Figure 12

A comparison of cartridge cases under a comparison microscope

Unit 3 Microscopic Examination and Comparison of Bullets and Cartridge Cases

- Cases recovered from semi-automatic weapons may have extractor and/or ejector marks that provide enough information for individualization.
- For shotguns, shot shell cases can acquire firing pin impressions, breech face markings, and extractor/ejector marks.
- Shot shells can be linked to a shotgun, analogous to cartridges from a handgun or rifle.
- The components that can cause distinct markings include the firing pin, breech block, extractor and ejector mechanism, and the magazine.

Unit 4
The Implementation of NIBIN (National Integrated Ballistic Information Network) Database to Assist Crime Investigation

Unit 4 National Integrated Ballistic Information Network

- Automated correlations of possible matches, or “hits” as they are sometimes known, are achieved using the National Integrated Ballistics Information Network (NIBIN) via the Integrated Ballistics Identification System (IBIS) from Forensic Technology, Inc.
- In the field of firearm examination, NIBIN is known as the database for firearm evidence.
- BrassTRAX-3D™, which is the newest IBIS model, is capable of obtaining 2-D and 3-D images of fired cartridge cases.
- These images are then compared to other images in NIBIN, and a list of possible hits is generated.

Unit 4 National Integrated Ballistic Information Network

- While the possible match is generally found within the top ten correlations, IBIS hits are not used to make identifications.
- A firearms examiner must manually compare the hit in order to determine if both fired cartridge cases can be identified as having been fired from the same firearm.
- Thus, any technological enhancement that can help the firearms examiner when conducting these manual comparisons is invaluable in a crime laboratory.

Unit 4 National Integrated Ballistic Information Network

- Current technologies used to obtain images of fired evidence include scanning electron microscopy, 2D and 3D laser scanning, and thermal infrared (IR) imaging.
- The scanning electron microscope (SEM) has been used to observe fired evidence since the 1970s.
- Advantages of this technology include a large depth of field capable of imaging an entire firing pin impression and magnifications that range from 15x to multi-thousand times.
- However, the high cost of a SEM has prohibited its utilization in many crime labs.

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- Many companies, including Forensic Technology, have manufactured fired evidence imaging systems that use lasers to obtain 2D and 3D images of the fired evidence.
- The main advantage of these systems over traditional 2D imaging systems is a direct measurement of the surface topography and, thus, a reduction in subjectivity of firearms comparisons.
- However, many of these systems, specifically the popular IBIS BrassTRAX™ systems, are specifically designed for automated comparisons but not for manual comparisons.
- Another technology that has recently been used for automated comparisons of fired evidence is thermal infrared imaging.

Unit 4 National Integrated Ballistic Information Network

These images have been shown to be free of glare, reflection, and shadows because this technology uses the fired evidence's own emitted infrared wavelengths for imaging.

Figure 13

IBIS Trax-3D system

Unit 4 National Integrated Ballistic Information Network

Summary:

- NIBIN (National Integrated Ballistic Identification Network) contains images of bullets and cartridge cases recovered from scenes or test fired from seized weapons.
- The database can connect different cases through bullet and cartridge case evidence.
- When there is a fired bullet or cartridge case recovered from a crime scene, NIBIN is capable of generating a list of potential hits from its digital database. This allows the investigator to associate different shooting incidents or to associate a suspect from crime scene bullets or cartridge cases. When a suspect gun is recovered, it can also help in associating a gun with previous shooting incidents. However, it will require firearms examiners to manually confirm the match from the list of potential hits.

Unit 4 National Integrated Ballistic Information Network

Check NIBIN's website for successful stories and more information about the system.

http://www.nibin.gov/

End of Module 5B

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