Case Files
Sacco and Vanzetti

In 1920, two security guards were gunned down by unidentified assailants. The security guards were transporting shoe factory payroll, nearly $16,000 in cash at the time of the robbery-murder. Witnesses described the assailants as "Italian-looking", one with a full handlebar mustache. The robbers had used two firearms, leaving behind three different brands of shells.

The two suspects were identified as Nicola Sacco and his friend Bartolomeo Vanzetti. A .32 caliber was found in their possession and 23 bullets of the same brand found in the crime scene were found in Vanzetti's pocket.

Red Scare, WWI, put to death 1927
Gunpowder Residues

When the crime deals with gunshot wounds, it is often necessary to determine the distance from which the weapon was fired. If the suspect claims self defense or if the victim seems to have committed suicide, it is important to determine the distance of the weapon.

Distance Determination

Modern ammunition is propelled toward a target by the expanding gases created by the ignition of smokeless powder or nitrocellulose in a cartridge. The powder is never completely burned. When a firearm is discharged, unburned and partially burned particles of gunpowder in addition to smoke are propelled out of the barrel along with the bullet toward the target. The distribution of gunpowder particles allows an investigator to determine the distance.

The accuracy of a distance determination increases when the investigator has a suspect's weapon and knowledge of the type of ammunition.
Handguns and Rifles

If the investigator has the suspect's weapon and the same type of ammunition, he can determine the distance that the weapon was fired based on the spread and density of the residue pattern.
Some considerations:
When a weapon is held in contact with or less than 1 inch from the target, a heavy concentration of smokelike vapors usually surround the bullet hole.
Loose fibers surrounding a contact hole show scorch marks from the flame discharge of the weapon.
Also, the blowback of muzzle gases may produce a star-shaped tear pattern around the hole.

A halo of vaporous lead(smoke) deposited around a bullet hole normally indicates a discharge 12 to 18 inches or less from the target.

The presence of scattered specks of unburned and partially burned powder grains without soot can be observed up to 25 inches. However, with ball powder ammunition, this distance can extend to 6 to 8 ft.
Finally, a weapon that has been fired more than 3 ft from a target usually does not deposit any powder residues onto the target's surface. In these cases, the only visual indication that the hole was made by a bullet is a dark ring known as bullet wipe around the perimeter of the entrance wound.
A bullet wipe consists of a mixture of carbon, dirt, lubricant, primer residue, and lead wiped off the bullet's surface as it passes through the target. In the absence of a suspect's weapon, these observations are general guidelines for estimating target distances.

Factors:
- type of ammunition
- caliber
- type and condition of the weapon fired
- barrel length

Influence:
- influence the amount of gunpowder residue

Bullet wipe image
Shotguns

If the weapon is missing, the muzzle to target distance can be estimated by measuring the spread of the discharged shot. With close-range shots varying in distances up to 4 to 5 ft, the shot charge enters the target as concentrated mass, producing a hole larger than the bore of the barrel.

as the distances increases, the pellets progressively separate and spread out.

rule of thumb- 12 gauge shotgun increases 1 inch for each yard of distance: so, 10 inch pattern would be produced at approximately 10 yd.

Barrel length factors that affect:

size and quantity of pellets quantity of powder charge

choke of the gun
Choke

degree of constricted placed at the muzzle end of the barrel

The greater the choke, the narrower the shotgun pattern and the faster and farther the pellets will travel.

Powder Residues of Garments

when garments relevant to a shooting ar sent to the lab, the first type of examination is done using a microscope and checking for color change. sometimes an IR picture is taken in order to check for vaporous lead and powder particles around the bullet hole.
When nitrocellulose powder doesn't combust completely, nitrates are left behind. A procedure to detect nitrates from nitrocellulose is called the Griess test.

The examiner presses the photographic paper onto the target with a hot iron; once the nitrate particles are on the paper they are made visible by chemical treatment.

The nitrate patterns can be compared to test firings at known distance in order to determine the shooting distance from the target.
How is GSR detected?
GSR Chemical Tests

The Griess Test
A second chemical test is then performed to detect any trace of lead residue around the bullet hole. The questioned surface is sprayed with a solution of sodium rhodizonate, followed by a series of oversprays with acid solutions. This causes lead particles to exhibit a pink color, followed by a blue-violet color.

Primer Residues on the Hands

Firing a weapon not only propels residues toward the target but also blows gunpowder and residues back toward the shooter. This can be used to see whether an individual has recently fired a weapon.

Detecting Primer Residues

With the exception of the .22-caliber ammunition, primers contain a blend of lead styphnate, barium nitrate, and antimony sulfide. Residues from these materials are most likely to be deposited on the thumb web and the back of the firing hand of the shooter. Individuals who handle a gun without firing it may have primer residues on the palm.
Tests for Primer Residues

Swabbing

An approach to remove any residues present is by swabbing both the firing and nonfiring hands with cotton that has been moistened with 5% nitric acid. The front and back of each hand are swabbed separately. The 4 swabs along with the moistened control are then sent to the lab.

The test checks for large amounts of barium and antimony. Unfortunately, the primer residue stay on the hands for a short time. The residues are removed by intentional or unintentional washing, rubbing, or wiping of hands. Studies have shown that most residue comes off after two hours after firing the weapon.

In cases involving suicide victims, there is a higher chance of finding GSR on the hands.
SEM Testing

Most labs also use a Scanning Electron Microscope (SEM) to detect gunpowder particles. These particles have a characteristic size and shape that readily distinguish them from other contaminants present on the hands.