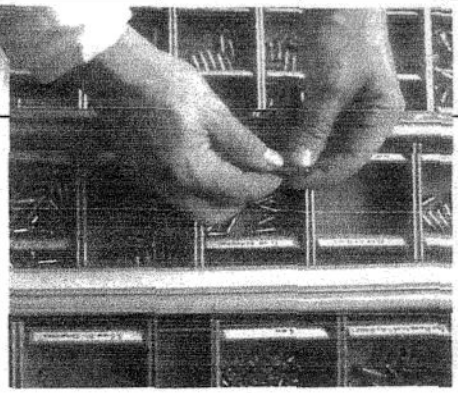
Firearms in the lab



BULLET DATABASE ▲
In addition to computer databases of ammunition, most firearms sections also maintain a collection of the real thing, for comparison and test firing.

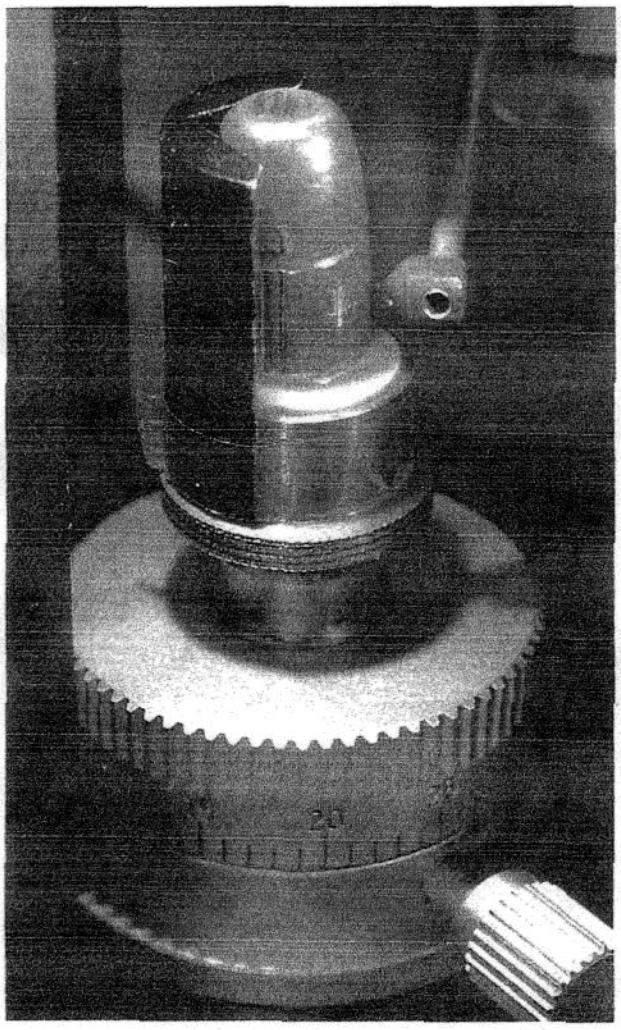
In the firearms section of a crime lab, the smell of gun oil and burned powder and the sound of gunfire are never far away. For a firearms examiner needs to be part sleuth and part marksman: it is necessary to have a feeling for guns and ammo that is impossible to acquire without spending time on a firing range.

Though often mistakenly called "ballistics," the forensic department that specializes in guns and ammunition is more correctly described as "firearms identification." For ballistics—literally the flight of projectiles—is peripheral to the job. Instead, firearms examiners spend most of their time studying and comparing the subtle dents, scratches, and marks found on ammunition (see box on cartridge and bullet markings). The testing and firing of suspect weapons to reproduce these marks for comparison, and for other purposes, is also a necessary part of the work.

Comparing ammunition

When investigators find a bullet, a careful study of the marks on it can reveal what kind of gun fired it. But once a suspect weapon has been found, the firearms examiner can go much further. Loading the gun with the appropriate ammunition, and firing it—into a water tank or a box of gel—marks the test bullet with striation marks that are as unique as a human fingerprint. To compare these scratches and grooves with those on the bullet recovered from the crime scene, or body of a victim, the examiner uses a comparison microscope (see p. 89). A match is positive proof that the same gun fired both bullets.

Microscopic examination of spent cartridge cases can tell a similar story, revealing at least the class of weapon that ejected the case. And as with bullets, if a suspect weapon is recovered, a test firing produces a comparison cartridge case that can verify whether the same gun was involved.



◀ GROOVE FOLLOWER
This instrument uses a stylus to measure the rifling grooves on a spent bullet for comparison with one used in the suspect weapon.

Computerized matching

Bullets found at a scene can also be compared with similar evidence from previous investigations. Using microscopic methods would be impossibly slow, but it is practical to compare hundreds of thousands using computer databases.

One of the best known of these is the FBI's Drugfire system. It works in a way similar to other databases. Firearms examiners mount a recovered bullet or cartridge case on a microscope stage, enter some initial data—such as a case number—into a linked computer, and start a database search. A scanner then automatically creates a digital image of the evidence, and the system looks for similar records for visual comparison.

Like computerized fingerprint searching, this powerful technology saves a lot of time. It also enables firearms examiners to deduce links between otherwise unconnected crimes, and perhaps solve them "cold."

Testing weapons

Firearms examiners may test a weapon to discover whether it can be discharged accidentally, if this forms part of a defense in a shooting case. And they may dismantle weapons—to find out how a semiautomatic was illegally converted for automatic fire, for example.

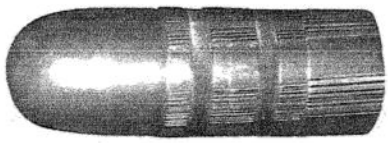
Range firing of shotguns reveals the shot spread. The cloud of pellets that a shotgun fires fans out from a tight clump at short range to a scattered cloud farther away. In the past, investigators used rough

CARTRIDGE AND BULLET MARKINGS

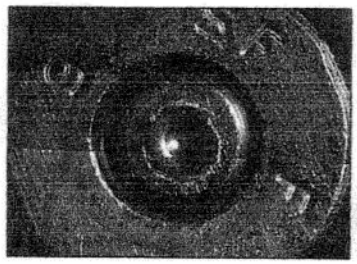
Loading and firing a gun engraves its ammunition with a wealth of marks.

Several different parts of the weapon mark the cartridge case. The magazine scratches it. The impact of the firing pin puts a distinctive dent in the metal cover that retains the primer. The explosion that follows stamps the cartridge case with a mirror image of marks on the breech—the solid block that holds it in the barrel. Finally, the mechanism that ejects the spent cartridge case also scratches it.

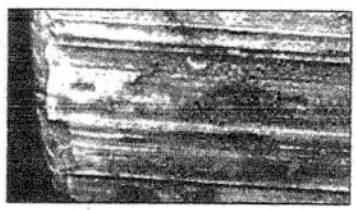
Marks on the bullet come from rifling—spiraling grooves inside the barrel that spin the bullet to stabilize it. Scratches on the bullet duplicate the spacing, size, direction (clockwise or counterclockwise), and angle of the grooves. In combination with the caliber (size) of the bullet, this information enables a firearms examiner to identify the class of weapon that fired the bullet, or to match a recovered bullet to a suspect gun.



◀ RIFLING
Firearms examiners use computer databases to match a weapon from the rifling marks it makes on the bullet.



◀ FIRING PIN
The comparison microscope presents two cartridge cases as one, in a divided image. This makes it easy to see whether the same firing pin dented the soft metal primer cover of each.



◀ STRIATIONS
Unique to each weapon, striation marks are created from tiny imperfections in the gun's barrel. A close look at two bullets may show an unmistakable match.

rules of thumb to determine range from the spread of pellets, but research has shown that spread is not easy to predict. It varies between apparently similar weapons, and is affected by the type and batch of cartridges, even by temperature and humidity.

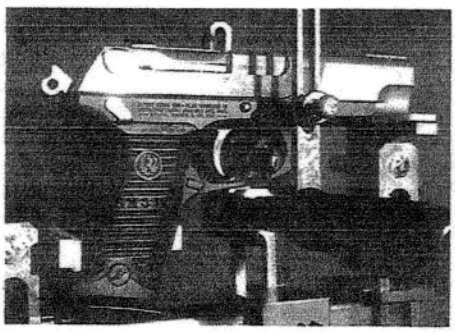
Range firing also has a role in testing the spread of primer gunshot residues (P-GSR) from weapons as they are shot. The area of skin covered by tattooing and soot deposits from a pistol, for example, can corroborate or refute a shooting suspect's statement. Shooting someone at incredibly short range has the hallmarks of a gangland execution, but self-preservation might be a legitimate defense if the victim was slightly farther from the gun, and may drop the charge from murder to manslaughter.

Who pulled the trigger?

More often it is not the pattern of P-GSR that's incriminating, but its presence or absence. For example, absence of P-GSR on the hands of someone who has apparently shot themselves suggests homicide rather than suicide.

Instrumental testing and microscopy are used to authenticate P-GSR. The atomic absorption spectrophotometer is the most commonly used analytical instrument. It identifies traces of barium, lead, and antimony that are used in primer. Under the scanning electron microscope, particles of primer are easy to spot by their characteristic shape. Energy dispersion X-ray analysis confirms their composition.

TRIGGER TEST ▼
The trigger pressure needed to fire a gun may be a crucial factor in cases where a suspect claims that a shooting was accidental.



GUN RACK ▶
Revolvers—plain and fancy—form part of the reference collection in the firearms division of the FBI forensic laboratory.