BALLISTICS

Scratch Match

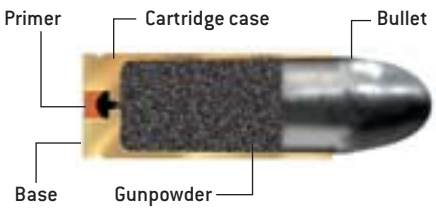
Solving a case like the October sniper shootings around Washington, D.C., hinges heavily on firearms identification. How do examiners match evidence to a gun? If a gun is recovered, a forensic scientist test-fires it to determine the markings it leaves on bullets and cartridge casings. The examiner then compares these under a microscope with the caliber (diameter), rifling pattern (series of grooves), and impressions and striations (microscopic marks left by unique imperfections in a gun's firing pin and barrel) on the bullets and casings found at the crime scene.

If test-fires don't match, or if no gun is found, the examiner will measure the rifling patterns on the recovered ammunition and compare them with the General Rifling Characteristics database to see which gun models might match. The problem in some cases, however, is that "20 to 150 brands of firearms could leave the same rifling pattern," says Scott Doyle, forensic specialist for the Kentucky State Police in Louisville.

If the examiner needs to go to the next level, he can take photographs of the impressions and striations and send them online to the National Integrated Ballistic Information Network (NIBIN), overseen by the Federal Bureau of Alcohol, Tobacco, and Firearms (ATF) and the FBI. Every day local forensic scientists from across the country upload the images of test-fires and crime scene evidence, which NIBIN stores. For each case, it will send back 10 or so of the closest matches, if found, indicating specific guns that might have fired the ammunition. The examiner must then manually contrast the images against his own.

The sniper shootings have raised debate over whether the ATF should turn NIBIN into a national ballistic-fingerprint system. Firearms manufacturers would be required to test-fire every new gun and enter images into NIBIN. The system would help but would not be a panacea. The marks from a gun can change if the barrel rusts over time; criminals can tamper with the barrel, too, says Robert Shem, chief examiner for the Alaska Crime Lab in Anchorage. "You will always need a human expert, comparing evidence under a microscope, to say 'Yes, this bullet came from that gun.'" —*Mark Fischetti*

DIFFERENT GUN BARRELS
have different rifling patterns. Common templates include 4/right (four lands and grooves, twisting to the right) (*far right*), 8/left, and so on. Each pattern cuts a distinct, inverse image in a bullet propelled through the barrel (*second photograph at right*). Each land and groove also leaves unique microscopic striations on the bullet (*third photograph at right*).



PULLING A GUN'S TRIGGER
slams a firing pin into a bullet's primer, which ignites gunpowder. The explosion drives the cartridge case backward into the breech face and out of the gun, leaving telltale scars, and propels the bullet forward. A spiral of raised lands and shallow grooves along the barrel spins the speeding bullet like a thrown football, improving its flight accuracy.

DANIELS & DANIELS; BALLISTICS PHOTOGRAPHS BY SCOTT DOYLE, FROM WWW.FIREARMSID.COM

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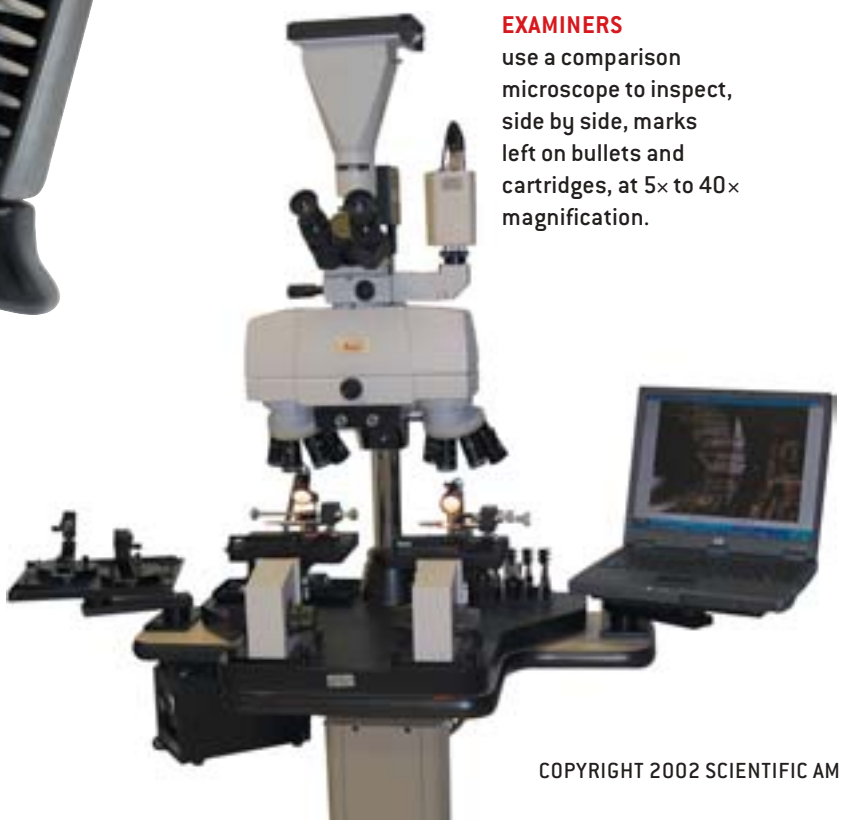
DID YOU KNOW . . .

➤ X CALIBER: A .22-caliber bullet has a diameter of roughly 0.22 inch. The designation on its cartridge typically includes the caliber, the manufacturer's name and adjectives describing variations; a .32 S&W Long indicates a .32-caliber Smith & Wesson bullet that is longer than the standard model. Casings found during the Beltway sniper shootings were .223; the "3" indicates not a measurement but an elongated .222 Remington cartridge that contains extra gunpowder to propel the bullet faster. More than 25 models of .223 rifles are sold in the U.S.

➤ MATCHMAKERS: The FBI is gradually expanding three nascent national databases to help forensic investigators. The Integrated Automated Fingerprint Identification System houses 40 million sets of fingerprints of prior suspects and convicted criminals. The Combined DNA Index System has 1.2 million DNA profiles. And the National Integrated Ballistic Information Network has half a million images of bullets and cartridges. In each case, local examiners upload data from crime scenes and search for matches from solved and unsolved cases. Civil liberties groups worry that the information could be misused.

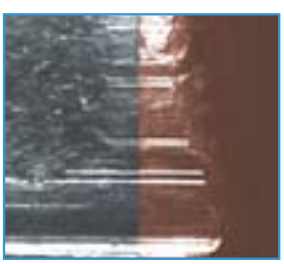
➤ TANKED: Firearms inspectors test-fire guns from one end of a rectangular water tank about three feet wide, three feet high and 10 feet long. The bullet from a revolver travels only about five feet before it drops to the bottom. "The friction is tremendous," says firearms specialist Scott Doyle, "and the projectile rapidly loses its energy."



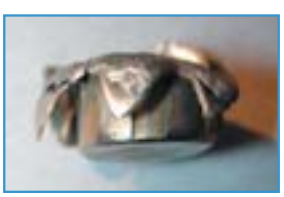
EXAMINERS use a comparison microscope to inspect, side by side, marks left on bullets and cartridges, at 5× to 40× magnification.

BREECH MARKS on the base of a cartridge found at a crime scene (*right*) match marks on a cartridge test-fired from a gun recovered at the scene (*left*).

TWO BULLETS each have six right-turning land and groove impressions, but their pitch differs, indicating that the bullets were fired from different guns.



STRIATIONS ON A BULLET found at a crime scene (*left*), caused by tiny imperfections unique to a gun's lands and grooves, match striations on a bullet test-fired from a recovered gun (*right*).



BADLY TORN FRAGMENT of a bullet still shows enough land and groove impressions and striations to help examiners solve a crime.