

Evidence cartridge case (l.) from scene of crime and test reveal similar parallel ridges caused by contact with breech face (r.) in firing. (Reproduced from John E. Davis' "An Introduction to Tool Marks, Firearms and the Striagraph," courtesy Charles C. Thomas, Springfield, Ill.)

## CARTRIDGE CASES AS CRIME EVIDENCE

Fired case can yield clues helpful in law enforcement

By STANTON O. BERG

*(Often, a fired cartridge case is the principal clue in a crime involving use of firearms. The bullet may have whistled off into the night. The gun and criminal may have disappeared. An ejected case or cases left behind can be the starting point of the solution to the crime.)*

*The scientific approach to linking a bullet to a given firearm was fully discussed in THE AMERICAN RIFLEMAN of October, 1968, pages 37-47. Here Stanton O. Berg, of Minneapolis, Minn., a professional firearms examiner and expert witness, gives a general view of the theory, methods, and some problems involved in cartridge case identification. —The Editor*

CARTRIDGE case identification has played a distinct role in firearms identification in the United States for well over half a century.

One complex instance occurred in 1907 when U.S. infantrymen engaged in a riot at Brownsville, Texas. Shots were fired. The question naturally arose: Who fired them?

Following the riot, 39 expended cal. .30 rifle cartridge cases were recovered

at the scene along with some bullets and a number of suspected rifles. The accumulated evidence was sent to the Ordnance staff at Frankford Arsenal, Philadelphia, for examination.

The staff devised a means of identifying under a microscope which empty cartridges were fired in which rifles, by distinctive markings left on the cartridge cases. They were able to report that most of the gunfire came from 4 rifles of one company which were used to discharge 11, 11, 8 and 3 of the recovered cases respectively. The 6 remaining cartridge cases could not be linked with any of the suspected rifles. As no conclusions could be drawn concerning the identity of the fired bullets, the solution rested upon cartridge case identification.

Cartridge case identification also figured in the famous Sacco-Vanzetti case in 1920. (Commonwealth vs. Sacco 125 Mass. 309). One of the recovered cal. .32 cartridge cases was identified with Sacco's .32 Colt pocket model automatic pistol. The identification was effected by an examination and comparison of tool markings found on the primers of the evidence cartridge case and test cartridge cases fired in Sacco's pistol.

Finally the adaptation of the comparison microscope to both cartridge case and bullet identification in 1925 put the study of cartridge identification on a firm footing from which it has continued to be developed and refined.

From careful examination of a fired cartridge case, useful facts and items of information frequently can be ascertained. The caliber and type of cartridge, as well as its manufacturer, usually can be determined by examination of the shape and size of the case as well as the manufacturer's stampings on the case head. By examination of the markings left on the cartridge head and primer by the firing pin, extractor, ejector, magazine and breech face, and comparison of these to known standards of reference, it is sometimes possible to determine the make and model of gun in which the case was fired.

### Several possibilities

In many instances, this identification involves several possibilities. Frequently, the markings are common to a great many guns and no useful determinations are possible. Where 2 fired cartridge cases are available, it is usually possible by examination of their markings to determine if they were fired in the same gun. Where one or more evidence cartridge cases and an evidence gun are available, it can usually be determined if the evidence cartridge cases were fired in the evidence gun. This is decided by test firing the evidence gun and comparing the markings found on the test-fired cartridge cases with those on the evidence cartridge cases.

The identification of cartridges is



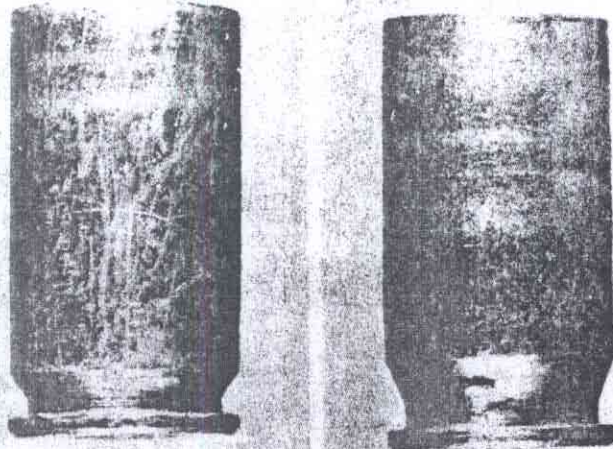
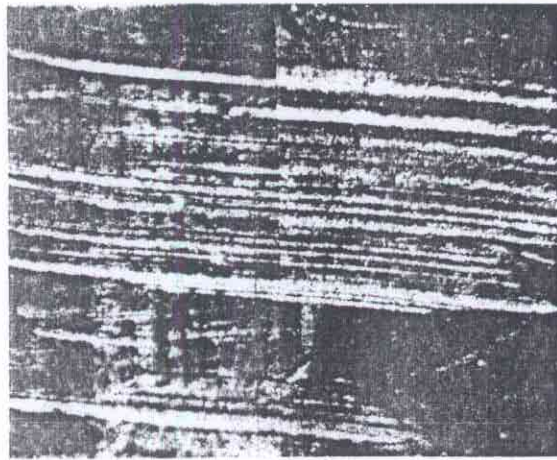
based on the examination, observation, and analysis of the class and individual characteristics to be found on the fired cases. The *class characteristics* (sometimes referred to as primary or gross characteristics) are those characteristics peculiar to all guns of a certain make and model or to all guns in a certain group or class. For example, semi-automatic arms will leave markings characteristic to that class or group of firearms. Revolvers also have their distinguishing characteristics as a group. *Individual characteristics*, on the other hand, (sometimes referred to as secondary or accidental characteristics) are those peculiar to *only one gun*. Whereas class characteristics are determined before manufacture of the gun, and result from manufacturing specifications, design, and dimensions, individual characteristics result accidentally during manufacturing processes, are usually microscopic in nature, and have random distribution. Individual characteristics may also be formed after manufacture of the gun through wear, abuse, and corrosion. Class characteristics are most useful in identifying the make and model of gun involved. Individual markings can serve to identify one specific gun to the exclusion of all others.

There are many examples of class and individual characteristics to be found on fired cartridge cases. The shape and size of a firing pin impression is a class characteristic. This is especially apparent in rimfire cartridges where a wide variety of shapes and sizes of firing pin impressions may be found. These may vary from rectangular, square, and wedge shaped, to circular and semi-circular, depending on design of the manufacturer.

In center-fire cartridges, the firing pin impression on the primer is almost always circular, but the diameter will vary. There are, however, a few center-fire guns with rectangular shaped firing pins. The microscopic tool markings found on the end of the firing pin striking surface are an individual characteristic.

#### Ejector and extractor markings

Examples of other class characteristics would be the location of the extractor and ejector markings. The extractor usually marks the rim of a cartridge case while withdrawing the cartridge from the chamber. Markings are also made as the extractor snaps over or slips over and engages the cartridge rim or at the time of disengaging the rim. The end of the extractor hook may bear against the case wall next to



A comparison microscope illustration (at top) of test and evidence cases shows a high quality match of the 2 sets of striae. (Reproduced from John E. Davis' "An Introduction to Tool Marks, Firearms and the Striagraph," courtesy Charles C Thomas, Springfield, Ill.)

the head and produce markings there. This may also produce microscopic markings that are usable as individual characteristics. The general location of the extractor marking, however, would be a class characteristic. Some manufacturers locate the extractor in the 3 o'clock position on the rim, others at a 2 o'clock or 5 o'clock position. Some makers design their guns with 2 extractors and both leave markings on the cartridge case.

The ejector strikes the rim or head of the cartridge sharply during ejection and usually leaves a mark. The location of the ejector mark is a class characteristic. Individual characteristics may also result. In certain model guns (notably rimfire), the firing pin does double duty by also acting as the ejector.

The magazine or clip may leave class and individual characteristics, as may the process of chambering the cartridge. In semi-automatic and repeating firearms the bolt face or breech face strikes the cartridge head while moving it into the chamber, necessarily marking it in the process. Lips of a magazine usually mark the rim edges of cartridges as

they are stripped from it and chambered.

Imperfections at the edge or mouth of the chamber will also mark the cartridge case as it is moved into and out of the chamber in loading and extraction. In automatic arms, the loading, extraction, and ejection may be quite violent, resulting in more pronounced markings than those found in other arms.

Many individual characteristics are imparted to a cartridge case by the internal pressure in firing. This acts in all directions, forcing the case hard against the breech face and sides of the barrel chamber. The breech or bolt faces and the chamber act as dies to impress their tool marks and manufacturing imperfections onto the cartridge case head and sides. Outlines of the firing pin hole as well as other breech face openings can frequently be seen impressed on the cartridge case by this pressure.

Individual characteristics or markings can be divided into 2 basic types.

The first are *impression type markings*, also called stampings. These are formed, as their name implies, by the



forcible application of a hard surface against a soft, leaving an impression of the harder. This may result in an obvious dent on the softer surface, or in many instances only very subtle markings. Impression type markings result from the steel firing pin striking the primer in center-fire cartridges or case rim in rimfire cartridges. Also the internal pressure of firing forces the soft brass head of the cartridge case against the steel breech or bolt face, transferring to the brass some of the milling, turning, and filing marks left when the gun was made. Impression type markings actually produce a combination of both individual and class characteristics.

### Striations

The second type of individual markings are the *striations*. These can also be described as abrasions or simply scratches. They are produced by a harder surface scraping, dragging, sliding or slipping across a softer, leaving a series of abrasions, scratches and scrapes, or striae, from minute microscopic irregularities of the harder surface. As the cartridge is chambered, striations result from the lips of the magazine as the cartridge slides against them, and again on the edge of the chamber as the cartridge slides into place. The extractor also produces striations as it slips over the cartridge rim. The ejector may produce a combination of impression and striation markings as the cartridge case is ejected from the gun.

Examination and comparison of all these individual markings and class characteristics are the basis for identification of a cartridge case as having been fired from a certain gun. An evidence cartridge case is closely examined for the individual markings under a microscope. The same is done with cartridge cases that have been test fired in the suspected gun. The actual comparison procedures are similar to those utilized in bullet identification.

The standard method is to use a comparison microscope, essentially 2 microscopes joined together with a single eyepiece. This permits simultaneous observation of half the view of each microscope, side by side in the eyepiece. A line in the center of the field of view separates the views of the 2 microscopes. If 2 cartridge cases can be brought into position under the respective objectives, so that their individual markings appear to flow from one to the other at the dividing line, an identification is made.

An identification may sometimes be

accomplished with photomicrographs of the heads of the test and evidence cartridge cases. The photographs are cut and superimposed to demonstrate the flow of the individual markings from one cartridge case to the other.

There are many problems and pitfalls for the firearms examiner in the area of cartridge identification. Considerable experience and skill are needed to understand and overcome such problems. For example, the tool markings on the breech or bolt face are not always impressed into the cartridge case clearly enough for use. In center-fire cartridges, the breech face markings are most readily apparent on the primer including the area surrounding the firing pin impression. This is due to the primer being of much softer metal than the cartridge head and, therefore, more impressionable.

It is extremely important in test firing (both center-fire and rimfire) always to use the same brand and type of ammunition as the evidence cartridge. Brass hardness varies among brands of cartridge cases, which therefore differ in their ability to receive usable individual markings. Different types of loadings may also produce different pressure levels and again affect case markings. The smoother the finish on the bolt and breech face, the less apparent the breech face markings on the fired cases. With a given quality of finish, the markings are most apparent in high-velocity rifle cartridges since their breech pressures are the highest.

Manufacturers' headstamps on both center-fire and rimfire cartridges tend to interfere with production and observation of breech face markings.

### COMPUTER "MONSTER"

IN an article suggesting that gun registration could create a computer "monster," *Datamation* magazine quotes H. Richard Cossaboon, president of Management Concepts, as saying that national compulsory firearms registration "would be second only to the Social Security and income tax systems in overall size and complexity." The management information consultant, of Bala-Cynwyd, Pa., added that a gun registration system would require "one of the most gigantic computer operations ever undertaken." Cossaboon believes firearms registration "would require the solving of at least 5 completely unique systems problems: data collection, data conversion, data storage and retrieval, data dissemination and data communications as well as providing a real challenge in overall data systems management." ■

Many times the markings left on cartridge cases from their manufacturing processes resemble the individual characteristics left on them by the gun in firing; these can confuse the uninitiated. Accidental abrasions can result from the cartridge being roughly handled, dropped, or carried about, and such markings can be confused with the markings left by the gun. Cartridges may have been worked through a gun action in loading and unloading before they were eventually fired in the gun. The result is more than the normal number of extractor, ejector, and magazine markings on the cartridge case. This can be confusing where an attempt is made to identify the make and model of a gun by examination of the class characteristics.

### Reloaded cases

In center-fire cartridges, there is always the possibility that the cartridge case has been reloaded once or several times before the last firing. It may have been fired in different makes and models of gun of the same caliber. Each then will have left its own set of class characteristics and some individual characteristics on the cartridge case. Here, close attention to the primer markings (both firing pin and breech face) will be most helpful, as a primer is replaced with each loading.

One must always be mindful of the possibility that intentional alterations have been made in the suspected gun to prevent identification. These could be in the form of changes to the breech or bolt face surfaces, as well as replacing the original firing pin with a different one.

### Other stumbling blocks

One cannot always conclude that finding an automatic pistol cartridge case means it was fired in a self-loading pistol. As one example, special half-moon retaining clips to hold three .45 automatic pistol cartridges were made during World War I to facilitate firing the .45 automatic pistol cartridge in the Smith & Wesson and Colt cal. .45 M1917 revolvers. A cheap single-shot pistol firing the same cartridge was specially made for use by underground forces during World War II. It is also possible topeen the rim edges of certain semi-automatic pistol cartridges so they can be fired in revolvers.

Yet, keeping in mind that there usually are exceptions to all rules, cartridge case identification has earned legal and scientific stature at a growing rate. ■