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SMOKING BULLETS

A Technique Useful in Some Bullet Comparisons

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Firearm examiners and criminalists routinely conduct comparisons of the rifling markings on bullets in order to determine whether or not exhibits under study were fired in particular weapons. Frequently, it is also desirable, if not necessary, to photograph identifications which result. This article is presented to describe a very simple technique which has been found to be of assistance in some examinations conducted in the California State Bureau of Criminal Identification and Investigation laboratory. The method involves adding a thin coating of magnesium oxide smoke to bullets under study and is particularly applicable to cases where the bullets are difficult to compare. In many instances examinations are relatively simple to conduct and identifications or eliminations can be rapidly completed. On other occasions, however, the comparisons may be quite complicated and require considerable time on the part of the examiner. Thus, anything which will assist the examiner and increase the speed with which his work can be completed is beneficial.

For many years bullet comparisons have been conducted almost exclusively through use of the comparison microscope, although the comparison camera (1), the striagraph (2) and other special apparatus have occasionally been employed by some workers. Further, it appears that specific techniques employed in examinations made with the comparison microscope have changed little since this instrument was first developed. While variations and improvements in microscopes, lenses, cameras, and light sources have occurred over the years, the techniques employed in their use have seldom been altered to any extent. There even appears to be a reluctance on the part of some examiners to try new methods or adopt procedures commonly accepted and used in other fields of criminalistics. While the technique discussed in this article is only occasionally of use, it has been found extremely helpful in specific instances. It therefore should be considered and tested even though at first it may appear that fine structure on bullets is being eliminated from consideration in making comparisons by means of this technique.

Some causes of difficulties encountered in bullet comparison, particularly in studying jacketed bullets, are the following:

1. Reflections from shiny bullet surfaces examined under oblique illumination;
2. Lack of coarse markings on bullet surfaces;
3. Extremely large numbers of fine striae in particular areas;
4. Partial obliteration of characteristic markings on bullets by fine abrasions on the surface often due to debris in a weapon barrel or material through which the bullet has passed;
5. Differences in color of areas under study on the test and questioned bullet surfaces;
6. Differential corrosion of metal surfaces of bullets;
7. Other very thin surface deposits which are not the same on the two bullets being compared.

Photomicrographs are taken of many bullet comparisons either to show a jury the method employed in making such studies or to illustrate the basis upon which an identification has been made. Although the camera can record on film anything which is visible to the eye, an accurate portrayal of what can be seen and evaluated under a microscope is sometimes difficult to illustrate with photomicrographs. In addition to most of the other difficulties previously listed, this may be due to specular reflection encountered when strong oblique illumination is employed or to lack of depth

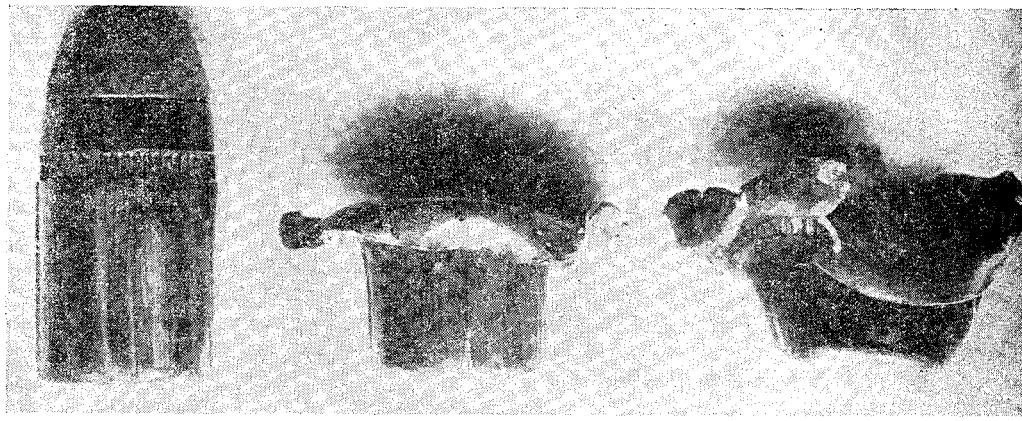

FIGURE 1
Test and damaged .32–20 evidence bullets

of definition of microscope objectives where curved surfaces are under study.

In order to overcome at least some of these problems encountered in particular instances, the technique of coating bullets with a very thin layer of magnesium smoke has been employed in the author's laboratory on a number of occasions. The technique is extremely simple and involves only the burning of a short length of magnesium ribbon (available from most chemical supply companies) held with tweezers under the object to be coated. After the end of the ribbon is ignited, the bullet is held three to four inches above the burning tip and rapidly rotated. The magnesium oxide smoke arising from the burning ribbon deposits fairly uniformly on the bullet surface. Normally, the smoke coating of bullets must be tried several times to obtain equal and thin deposits on two or more exhibits. This is not difficult since the smoke deposits can be readily removed by holding the object under a faucet and, after drying, immediately recoated. Originally, this method of coating objects was developed and employed in tool mark comparison cases where a reasonably heavy smoke deposit was desired in order to completely cover surfaces where the test and questioned tool marks were on different types of materials (3). In later work (4) thinner smoke deposits were applied when the marks under comparison were on metallic surfaces. In the case of bullets, the striations under examination are usually much finer than those to be found in many other tool mark studies. For this reason great care is necessary in order to apply a very thin film of smoke which will not obliterate characteristic markings.

In making examinations of smoked bullets, as in the case of tool marks, the structure observed is much more obvious and easier to compare if strong oblique lighting is used. Microscope illuminators with either ribbon or coil filaments and condensers, but without color or diffusion filters, are best. Fluorescent or diffused tungsten light sources, often employed in bullet comparisons, are less satisfactory.

Bullets being studied under a comparison microscope should first be examined in the normal manner. If it appears difficult to rapidly phase the two bullets, magnesium smoke treatment will often assist by emphasizing course structure and masking much of the very fine detail present. As in the case of tool marks, after a match is obtained the smoke deposit may and normally should be removed, and the same matched areas again studied to make certain that real differences present are not eliminated from consideration. The method has been found most useful in making comparisons of jacketed bullets which frequently have bright surfaces with much fine detail. Only seldom will it be beneficial on lead bullets or those which contain a reasonable number of coarse marks or striations.

In addition to assisting in phasing and later comparing land and groove engravings on bullets, the magnesium smoke treatment is of particular value where photographs are to be taken. The technique will eliminate specular reflection which often makes photography of shiny bullet surfaces difficult. In some cases, where there is much very fine detail present or there are fine surface markings on one of the bullets which were not produced by the gun barrel, a photograph may be quite con-

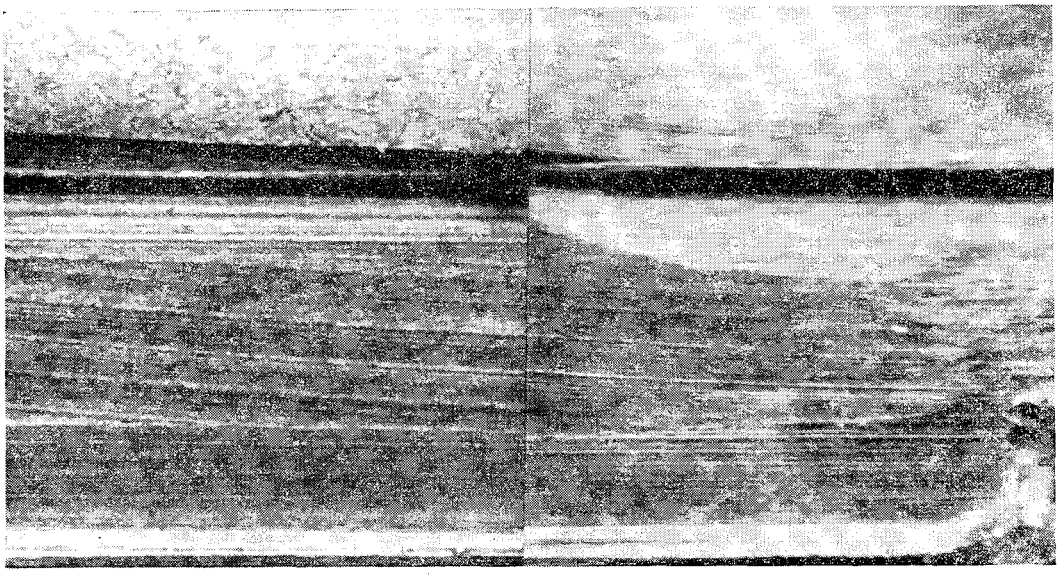

FIGURE 2
Comparison of land engravings on test and one of the questioned bullets shown in figure 1

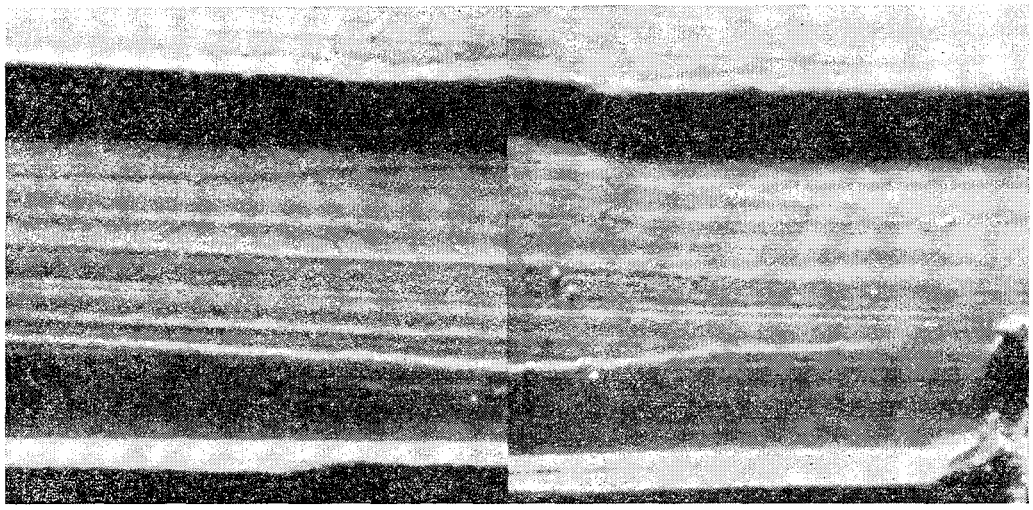

FIGURE 3
Comparison of the same area on the two bullets shown in figure 2 after magnesium smoke treatment

fusing to the expert as well as to attorneys and jurors. In other cases, deposits or corrosion on one of the bullets will result in a photograph which in no way illustrates a comparison as well as the visual examination through the microscope. Many bullets removed from bodies are found to be unevenly stained or have surfaces which are unevenly oxidized. While the detailed structure can often be readily compared microscopically, a photograph will not properly illustrate what can be observed through variation of bullet positions or direction of illumination. In many such cases a light coating of magnesium smoke will drastically improve the photographic results and at the same time decrease the time which must be spent in photography.

Comparison conducted in two homicide cases will serve to illustrate the technique discussed. The first case involved the examination of two distorted

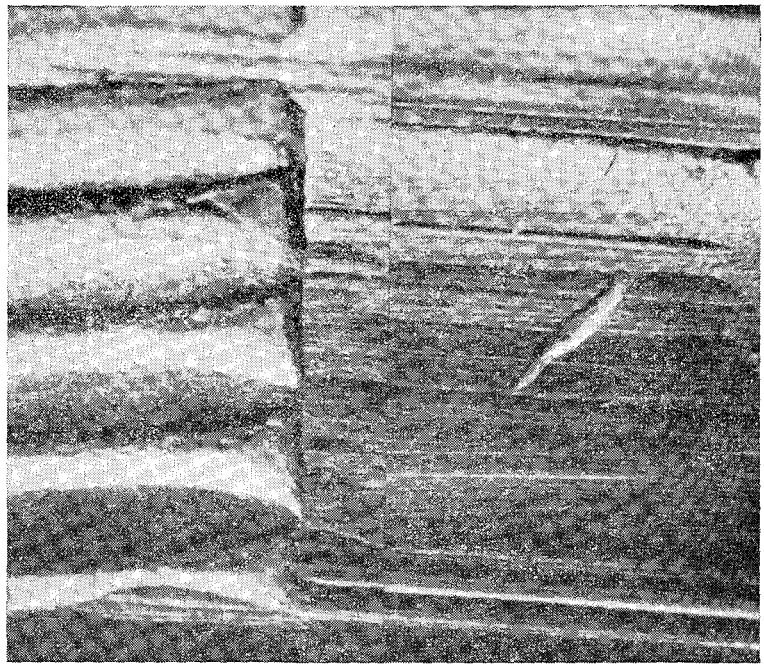

FIGURE 4
A portion of the groove engravings on test and questioned .25 automatic bullets. This illustration does not properly show correspondence which could be observed microscopically.

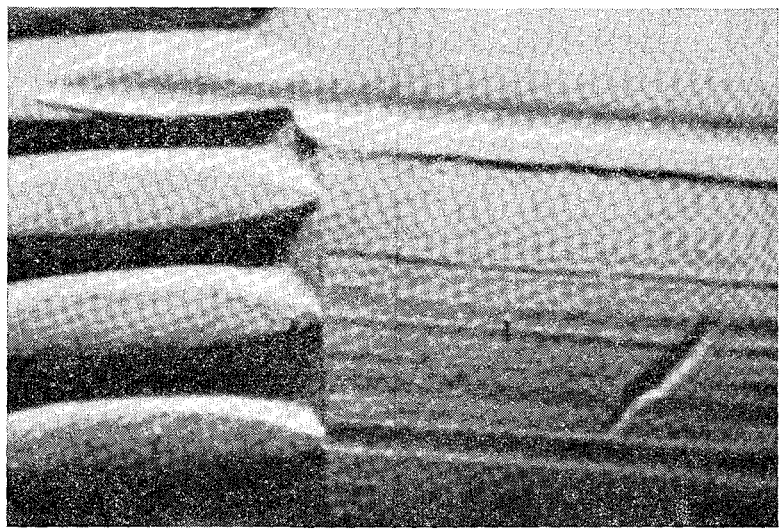

FIGURE 5
The same areas on the two bullets shown in figure 4 after magnesium smoke treatment. Similarity of course structure is much more apparent.

.32–20 bullets removed from the body of a victim. Good test bullets were readily obtained by test firing the Colt revolver of the suspect. Figure 1 illustrates one test and the two questioned bullets. Many areas on the bullets removed from the victim were undamaged and contained considerable fine stru ture. Due to the wealth of fine markings present in the land engravings and general similarity of some of these even in different bullet grooves, considerable time was required both to phase the

bullets and to align discernible striations for photography. One such comparison of land engravings is illustrated in Figure 2. After magnesium smoke treatment, the phasing of the bullets and alignment of more coarse markings required only a minute or two. Figure 3 illustrates the comparison of the same area on the bullets shown in Figure 2, but after smoke treatment. While some fine structure has been masked, the prominent markings are far more apparent and easier to observe. In addition, their alignment and lighting was much easier to accomplish, photographic exposure time greatly decreased and specular reflection eliminated.

The other illustrative case involved .25-caliber bullets fired in a Rigarmi semi-automatic pistol. Due to the condition of the pistol barrel, both land and groove engravings varied considerably on different test and questioned bullets. In addition, the markings present were not at all consistent throughout their length. Naturally, the fine structure varied far more than did the deep gouges and coarse marks, which interfered with comparison of the latter. While good correspondence was found in some areas and a study of all areas on the questioned and several test bullets resulted in an identification, the preparation of good photographic exhibits was impossible. Figure 4 shows a photograph of groove engravings which certainly would not illustrate an identification to either a specialist or a lay person. In this case the questioned bullet remained in the victim's body for some time before removal which also resulted in some areas being much darker than others due to surface corrosion. After magnesium smoke treatment, the correspondence is obvious, as shown in Figure 5. Although Figures 4 and 5 illustrate the same areas on the bullets, there is a slight difference in their position under the microscope objectives. In each of these two cases the normal photographs were taken under diffused tungsten light from above and at an angle to the bullets. The comparisons of the bullets after smoke treatment were conducted with non-diffused light from microscope illuminators striking the bullets at a slightly greater than grazing incidence angle.

The comparison of markings, particularly on jacketed bullets, is sometimes difficult and time consuming. The preparation of illustrative photomicrographs and court exhibits is also complex in some instances. A method for applying a fine coating of magnesium smoke which has proven to be beneficial in some cases is reported. This technique assists in rapidly phasing bullets, conducting preliminary comparisons, and preparing suitable photomicrographs for illustrative purposes.

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