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SPECIAL TECHNIQUES USEFUL IN TOOL MARK COMPARISONS

Roger S. Greene and David Q. Burd

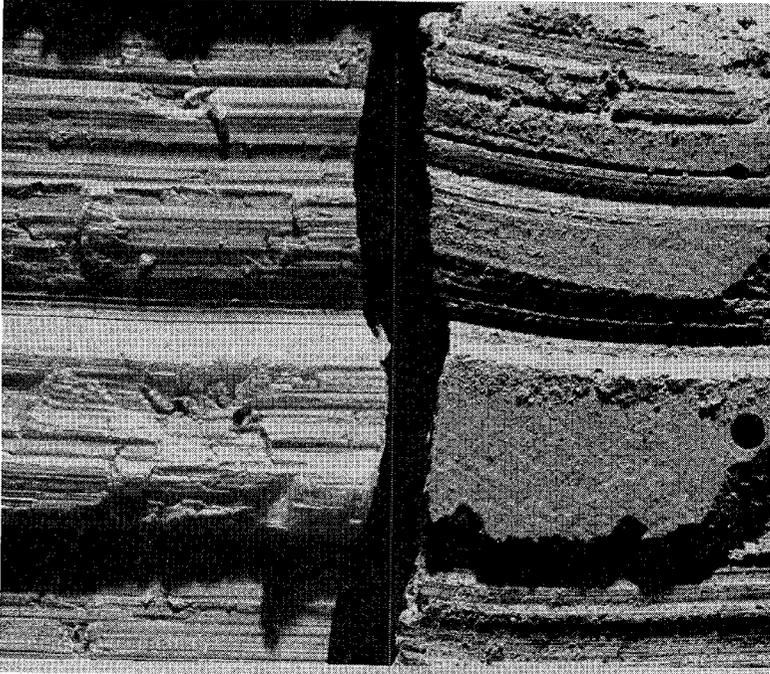
The authors are well known to our readers for their excellent papers dealing with various methods of scientific investigation of evidence. Both have been members of the staff of the Laboratory of the California State Division of Criminal Identification and Investigation for a number of years. Roger S. Greene was appointed as a Criminologist at this Laboratory in 1931, following his graduation from the University of California, and has served continuously except for three years military service during World War II. David Q. Burd joined the laboratory in 1942 shortly after receiving a B.S. degree in Technical Criminology from the University of California.—EDITOR.

The basic methods for the comparison of tool marks in criminal cases have been discussed in several publications.^{1, 2, 3, 4} However, little mention has been made of specialized techniques used to reveal or reproduce marks should difficulties be encountered in direct examination. One recent exception to this was an article on the use of "Faxfilm" by Cowles and Dodge.⁵ The present article is presented to describe two special techniques useful in particular types of examinations. One is a method for magnesium smoke treatment of tool marks, and the other is a plastic casting method useful in the preparation of some types of tool marks for comparison. These special techniques have proven valuable in certain otherwise difficult examinations.

MAGNESIUM SMOKE TREATMENT OF TOOL MARKS

Marks produced on safe insulation by prying tools are occasionally found in safe burglary cases. These marks often are the only evidence by which it can be proven that a particular tool found in the possession of a suspect was used to damage or open a safe. This is particularly true when clear tool marks are not found on the safe metal or where paint or fire clay cannot be found on the suspected tools.

The soft or friable nature of most types of safe insulation render it difficult to make suitable test marks for comparison purposes. The use of lead or similar test materials is most unsatisfactory in such cases, since the appearance of the test surface is distinctly different from that of the questioned mark. Due to the relatively great forces required, it is also hard to make suitable test marks on lead or on samples of safe insulation, when the marking surface on the tool is large. When tests are made on a ductile surface, such as soft metal, they will also differ from marks made by the same tool on a friable substance. Furthermore, it is very troublesome to compare test and questioned marks on surfaces which differ in appearance. Therefore, the most satisfactory test material is



Comparison of tool mark on a piece of safe insulation (right) and a test mark made on paraffin with a wrecking bar (left). Test mark coated with magnesium smoke as described.

one which is similar in appearance to the questioned mark and one on which it is possible to produce test marks easily.

Tests are usually possible using paraffin wax, since it will register fine detail, and tool marks are comparatively easy to record on it. Test marks made on paraffin accurately represent the marking action of the tool surface or edge. However, the translucent appearance of paraffin, particularly under magnification, makes direct comparison of the test and evidence mark somewhat unsatisfactory. It has been found that a very thin coating of magnesium smoke, applied to the surface of the paraffin after the test has been made, serves to furnish an opaque surface that is free from disturbing reflections. The test mark still retains as much detail as can be recorded on relatively coarse material such as insulation.

Magnesium smoke can be applied readily to the test mark by burning a few inches of magnesium ribbon under it. The test material is kept in motion a few inches above the flame of the burning magnesium. Some practice is necessary to secure an even coating of the proper thickness and to avoid melting the surface of the paraffin.

The accompanying illustration shows a court exhibit prepared through

use of this technique. On the right is a small piece of insulation from a safe on which the outer metal of the door was peeled away from the insulation by the use of a wrecking bar. This material contains a clear mark made by the tool used. On the left side of the photograph is a test mark made with a wrecking bar recovered in the car of two suspects. Use of the magnesium smoke technique for the preparation of the test mark makes the similarity in the markings readily apparent. Some obvious differences are present in the two marks being compared, but this is to be expected since the tool involved was used to complete the opening of the safe after the evidence mark was made. It also was probably used in the commission of other crimes after this burglary, and prior to its recovery several weeks later in another city. The use of any tool will gradually alter the areas which contact hard or rough surfaces. The defendants in this case were both convicted, primarily on this evidence.

Magnesium smoke can be applied to questioned marks as well as to test marks to render the surface structure more distinct. This technique is useful whenever the substance marked is of variable color or texture, is transparent or translucent, or where there are troublesome reflections from its surface. In a murder case in which the victim was struck on the head with a hand axe, tool marks were found on the skull bone of the deceased. The detail in these marks was difficult to observe, particularly when magnified, because of the structure of the bone. A section of the skull bone bearing the marks was coated with magnesium smoke, as was the test mark made on paraffin with the suspected hand axe. This made possible a microscopic comparison of the marks which resulted in an identification of the lethal weapon.

PLASTIC CASTING OF DIE IMPRESSIONS

It is evident to all familiar with tool mark comparison work that number dies have characteristics which can serve to identify the die impression and the die that produced it. These dies are tools and are subject to variations during manufacture, wear, or alteration while being used or abused. The theoretical basis for this has been outlined in the literature cited. The comparison of die impressions, however, is frequently quite difficult, and the preparation of suitable exhibits to demonstrate their similarity is sometimes impossible unless special techniques are employed.

In examining the detail in die impressions it is often found that the best markings are on the sloping sides of the depressed letters or numbers. Marks in these areas are very difficult to examine. This is particu-

larly true if a stamped metal article has been finished, as in the case on a blued firearm. Further difficulty, due to differences in the reflecting power of the surfaces, may be encountered when a test impression on lead, solder, or gun steel is new and bright. To overcome these differences the most obvious method is to employ some method of casting. Naturally, it is essential to use a method which will faithfully reproduce all details and which can be readily inspected under the microscope. The same casting procedure must be suitable for use on the test as well as the questioned impressions, so that both will be reproduced in the same material.

A technique was employed on a recent case submitted to the authors which proved satisfactory and probably is applicable to the comparison of other types of impressions on metal surfaces. The case involved an attempt to defraud an insurer by submission of a "padded" claim of loss resulting from a burglary. Among the items reported as stolen was a revolver which subsequently was sold by the insured. When sold, this gun had a serial number differing from that of any of the allegedly stolen weapons. Hidden numbers on this revolver corresponded with those of one of the guns for which a claim was paid by the insurance company. Examination of the butt of the revolver proved that the original number had been removed, another number substituted, and the gun re-blued. This new number consisted of six digits made with four different number dies. Several sets of dies were found in the possession of the suspects. One of these sets was proven to have been used to place the new numbers on the revolver. This evidence materially aided in the conviction of the defendants at their trial.

The dies used to place the new number on the revolver corresponded exactly in size and over-all appearance with respective digits in the number. Various defects present on the dies were also present in the new gun numbers. In order to make the preliminary comparisons, test impressions made with the dies on sheet lead were compared with the numbers on the revolver by use of a stereoscopic microscope.

In order to best demonstrate that these particular dies were used, it was necessary to take photographs of the minute imperfections in the numbers on the gun and in the test impressions. To do this, casts were made of the questioned and test numbers, using a transparent, colorless thermoplastic. Various types of plastics would probably serve, but in this instance 1/16 inch thick sheets of "Vinylite" cut to an appropriate size proved suitable. The test and questioned impressions were carefully cleaned of all foreign matter and then coated with a commercially available plastic cement secured from a hobby shop. This cement consisted

essentially of a very active solvent containing a small amount of dissolved plastic. This caused the "Vinylite" to soften and flow under slight pressure and completely fill the impressions. When the plastic was placed on top of the impressions previously coated with cement, care was taken that no air bubbles were trapped in the impressions. Moderate pressure was applied using a clamp, and the cement allowed to harden. It was found that the hardening of the cement could be speeded by the use of moderate heat. After cooling, the clamp was removed and the plastic readily separated from the metal.

Photomicrographs were taken of the two casts under considerable magnification. These clearly showed the defects present in test and questioned numbers. Because of the fineness of detail in the photographs, they were not considered suitable for half-tone reproduction in this Journal. Enlargements (approximately 30X) for use in court clearly showed nine defects or imperfections present in the four dies used to stamp the new serial number on the revolver. These same defects were present on the test impressions made with the dies recovered from the suspects. Other identifying characteristics were also visible on the casts when suitably illuminated and examined.

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