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Charles M. Wilson

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THE IDENTIFICATION OF EXTRACTOR MARKS ON FIRED SHELLS*

CHARLES M. WILSON†

In the literature of firearms identification there are many references to the value of extractor marks on fired shells as "class" characteristics, but very little has been published regarding the "individual" characteristics of such marks.¹ As a matter of fact, firearms identification technicians in general have considered extractor marks of no value in identifying a shell as having been fired from a particular firearm; and practically all of the few published references to the "individual" characteristics of extractor marks are rather vague and indefinite.

Apparently the earliest reference pertaining to the identification of fired shells is contained in the 1907 Annual Report of the Chief of Ordnance of the United States Army in which an account is given of shell comparisons and identifications having been made in an actual case.² Unfortunately, however, no details are offered in this report as to the method or technique used in effecting the identification. Moreover, the report does not state whether the identification was made on the basis of breech face markings or of the markings left by firing pin, extractor, ejector, or by the gun chamber itself; it merely refers to "various external surfaces of the

* References to extractor marks on fired shells in this article are confined to firearms equipped with the hook or claw type of extractor as distinguished from the crescent shaped extractors or ejectors. See, as regards distinction between these two classes of extractors, Hatcher, J. S., *Textbook of Firearms Investigation, Identification and Evidence* (1935) 22; 24; 29; 40; 261-263. See also Figures 3 and 4 *infra*.

† Assistant Director, Chicago Police Scientific Crime Detection Laboratory.

¹ See Gunther, C., "Markings on Bullets and Shells from Small Arms," *Mechanical Engineer* 52 (2):113 (1930); Goddard, C., "The Valentine Day Massacre: A Study in Ammunition-Tracing," *Am. J. Police Science* 1(1):60-79 (1930); Kraft, B., "Critical Review of Forensic Ballistics," *Ibid.* 2(1):52-67 (1931), 3(2); 125-143 (1931); Mezger, O., Heess, W., Hasslacher, F., "Determination of the Type of Pistol Employed from an Examination of Fired Bullets and Shells," *Ibid.* 2(6): 473-500 (1931) 3(2):124-146 (1932); Fontaine, R., "Identification of Shells," *J. Criminal L. and Crim.* 23(3):542-545 (1932); Burrard, G., *The Identification of Firearms and Forensic Ballistics* (1934) 57, 112, 123-126; Gunther, C., and J., *The Identification of Firearms* (1935) 58, 81-83; Hatcher, J., *Textbook of Firearms Investigation, Identification, and Evidence* (1935) 22-23, 26-30, 36-37, 40, 261, 263.

² *Brownsville Investigation* (War Dept. Document No. 303), Annual Report, Chief of Ordnances (1907) 6.35-36.

cartridge case, produced by similar complementary markings in the chamber and on the breech mechanism of the rifle." In the event the extractor marks were used as the basis for the identification, this, to the writer's knowledge, would represent the first time in which an identification was effected by this means. However, the indefiniteness of the report will not permit of a conclusion either that extractor marks were or were not used for this purpose.

De Rechter and Mage state that extractor marks, along with ejector marks, are generally "uninteresting and quite weak" and from this statement it is reasonable to infer that these two experts have not encountered much or any success in effecting identifications based upon extractor marks.³

Kraft states that extractor marks "may sometimes be used to identify fired shells," but no information is given as to the technique to be used, nor does Kraft explain or offer illustrations as to the use of extractor marks in effecting shell identifications in any actual case.⁴

Goddard, in an article describing the results of his examination of the evidence in the St. Valentine day massacre, refers to the existence and source of extractor (and ejector) marks and to their value as "individual" characteristics.⁵ Unfortunately, however, the article does not contain an illustration of the similarity of extractor marks, and no information is given as to the technique employed in effecting satisfactory comparisons.

Of the references with which the writer is familiar, the only one containing really specific data upon the subject is the report of a case published by Mezger and Heess.^{6a} These two workers describe and illustrate an identification of a shot gun shell based upon the individual characteristics of the marks left by an extractor, as such marks appeared in oblique illumination.

Gunther,⁶ and Burrard,⁷ make no reference in their books to the use of extractor marks as a source of individual or identifying characteristics. Hatcher states that extractor marks "would hardly prove that the suspected cartridge case came from any one individual gun."⁸

³See Kraft, B., *op. cit. supra* note 1 at p. 60.

⁴*Op. cit. supra* note 1. Södermann considers ejector impressions as being more significant than those made by the extractor. *Ibid.*, p. 132.

⁵*Op. cit. supra* note 1.

^{6a}Mezger, O., and Heess, W., "Die Identifizierung verfeuert Schrotpatronenhulsen," *Archiv für Kriminologie* 93:117 (1933).

⁶*Op. cit. supra* note 1.

⁷*Op. cit. supra* note 1.

⁸*Op. cit. supra* note 1 at p. 27.

In view of the prevailing attitude with regard to the value of extractor marks as "individual" characteristics, the writer submits herewith an illustrated report of a recent case of his in which he was successful in effecting an identification based upon a comparison of extractor marks. In presenting this report the writer makes no claim to any "discovery" nor does he pretend to be the first to be successful to the extent described herein. However, the successful application of a rather novel technique in the examination of the evidence involved in this case seems to warrant its being called to the attention of other workers in the field.

At the scene of a shotgun murder which occurred in a small town in Illinois, five fired shells were recovered, and they, together with the suspected shotgun,⁹ were submitted to the writer for examination. The shells contained no breech block markings, apparently because the cartridges had been loaded with progressive burning powder and the primer cups had been set too deep beneath the plane of the head of the shell to produce a sufficient "setback" (with this type of propellant) to take on the breech block impressions. Microscopic examinations of the firing pin cavities in the fired shells, and of the firing pin in the suspected shotgun itself, revealed that there were no individual characteristics present, the firing pin having an unusually smooth hemispherical surface. The only markings of any possible significance, from the standpoint of identification, were those left by the extractor hook, and even they appeared too obscure to be of any practical value when viewed microscopically in the oblique type of illumination commonly employed in examining the surface of fired shells or fired bullets. (See Figure 1.)

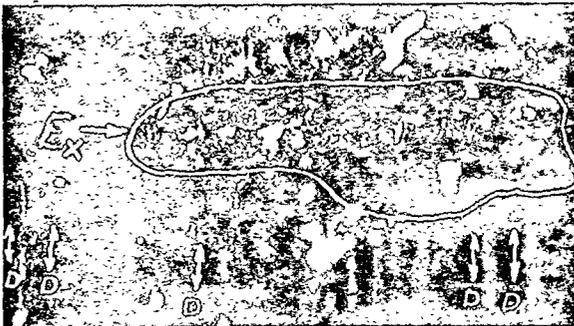


FIGURE 1
Photograph of Extractor Mark, Using Conventional Oblique Type of Illumination

Area *Ex* encloses extractor mark on shell. *D* refers to die marks in brass head of shell, which marks have no relation to the particular firearm in which the shells are fired. (Bausch & Lomb 16 mm. Short Mount Metallurgical Type Achromatic objective used in microscope.)

⁹ A Remington, model 11, 20 gauge auto-loading shotgun.

Because of the apparent inadequacy of ordinary oblique illumination, the writer resorted to the use of the Leitz Ultropak illuminator, a microscope accessory making it possible to obtain "dark field" illumination of opaque objects.¹⁰ With this type of illumination the uppermost tips of the ridges of the extractor marks appeared self luminous and at magnifications of approximately 100X the extractor marks appeared to possess some highly individual characteristics. Employing this technique, comparison microscope examinations of fatal and test shells revealed a minimum number of sixty-two points of similarity, and considerably more if the depressions or valleys on either side of the ridges were also considered. (See Figure 2.)

Upon the basis of the similarity of the extractor marks in fatal and test shells, as disclosed in Figure 2, the writer testified at the murder trial of the owner of the suspected shotgun that in his opinion the evidence gun had fired the fatal shells. After the admission of this testimony the defendant changed his plea from not guilty to guilty, made a complete confession, and admitted that his gun had fired the fatal shells.

It is not surprising that greater use has not been made of the extractor marks on shells fired in repeating, auto-loading, and full-automatic types of firearms when we consider the fact that the Ultropak illuminator was not produced and announced until 1932. Now, however, the availability of this valuable piece of equipment should render extractor marks of far greater significance than in the past. Moreover, this illuminator can be used to good advantage in the examination and photomicrography of ejector marks, firing pin imprints, and of other types of objects necessitating higher magnifications than those ordinarily required.¹¹

In an attempt to determine the immediate cause or source of the striations constituting the extractor marks, as shown in Figure 2, a microscopic examination was made of the extractor hook, and this revealed a serrated edge such as that shown in (b) of Figure 4-B, C. The appearance of the depressions of the irregular terminus of the tip was characteristic of a fracture of hardened steel. The hardened high-carbon steel from which extractor hooks are made

¹⁰ See Heine, H., "Der Ultropak," *Zeitschrift fuer wissenschaftliche Mikroskopie Technik* 48 (4) (1932). (Reprinted by Leitz, 1932.) See also bibliography in Leitz catalogue No. 18, pp. 4-6.

¹¹ As regards the use of this illuminator in the identification of die marks on wire, see Wilson, C., "The Comparison and Identification of Wire in a Coal Mine Bombing Case," *J. Criminal L. and Crim.* 28(6):873-904 (1938).

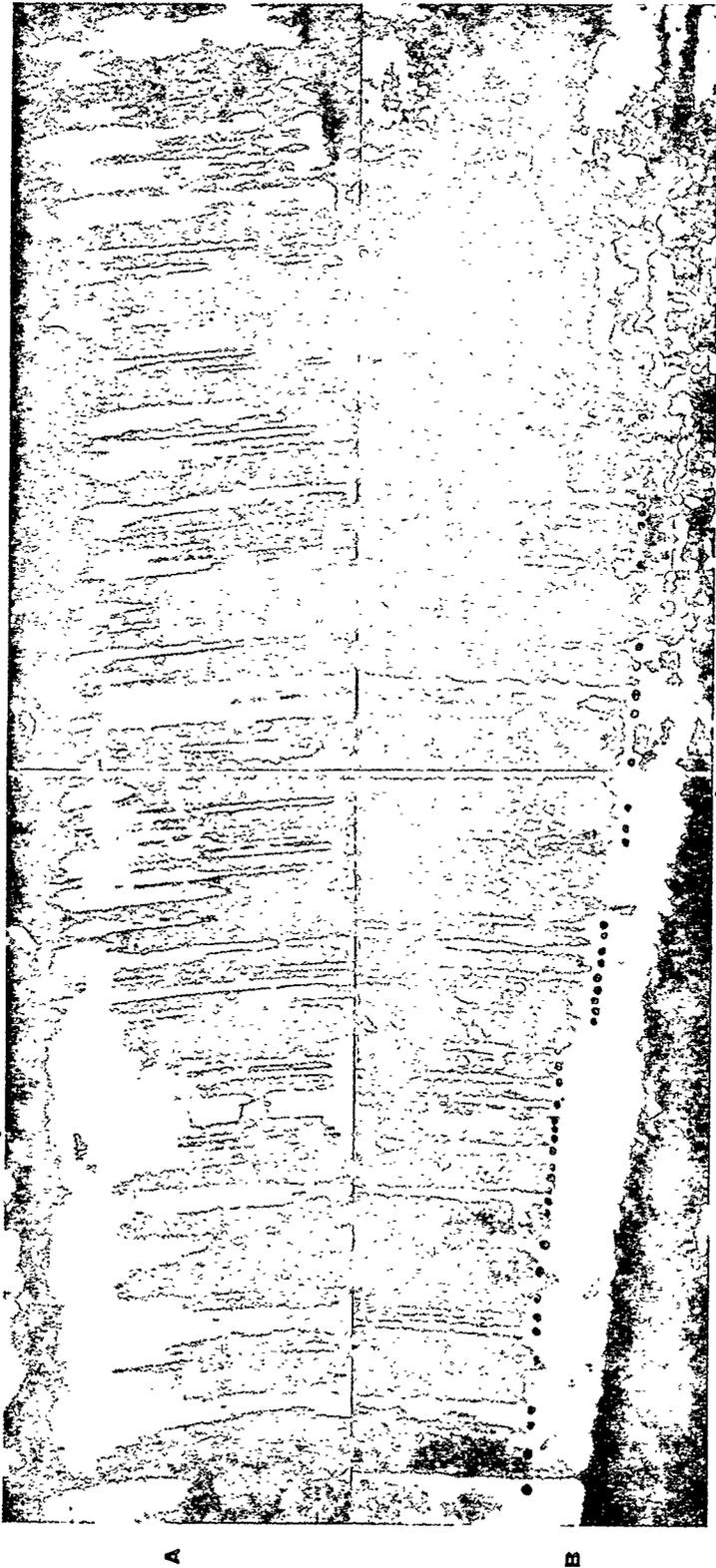


FIGURE 2

Composite Matched Photomicrographs of Extractor Marks on Fatal and Test Shells
(A) Test shell; (B) Fatal shell. Leitz Ultropak Illuminators Used. Original negative approximately 100X. The above illustration, approximately 300X, made from projection enlargement. The dots in (B) indicate 62 ridge tips which have complementary ridges in test shell.

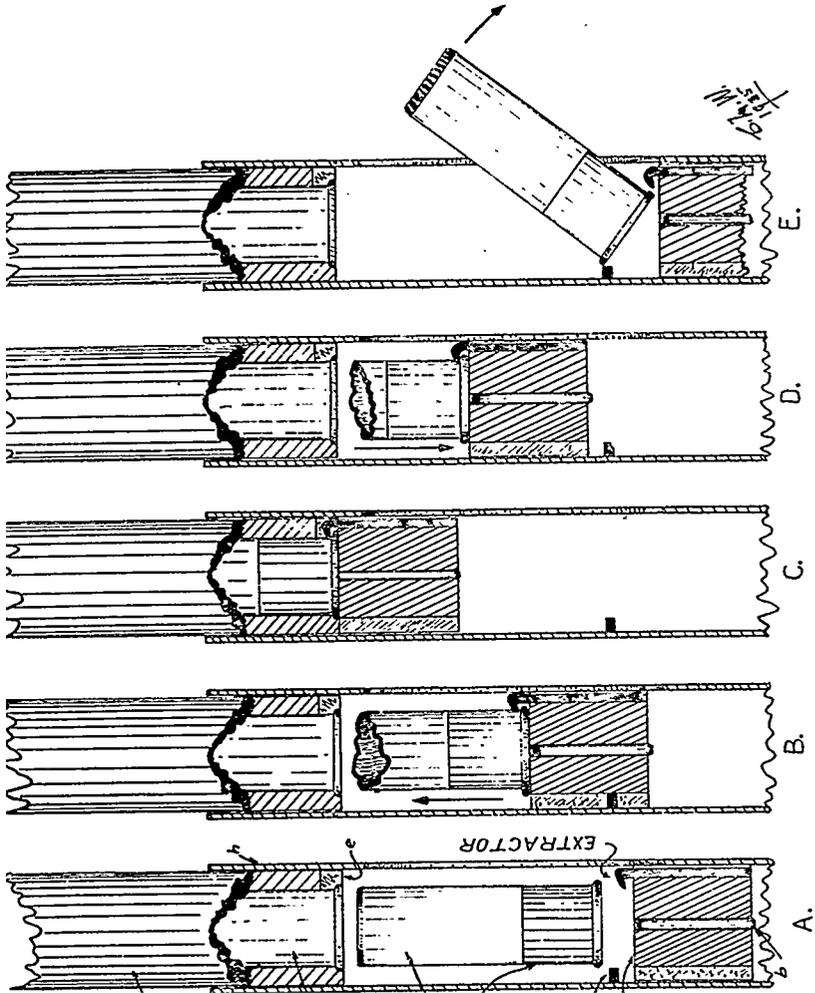


FIGURE 3
 Cycle of Operation of Auto-loading Shotgun
 (Remington, Model 11)

- (A) Loaded shell is fed up from magazine by carrier; (B) Breech mechanism carrying extractor hook pushes shell forward into chamber; (C) Breech closed and locked (firing position); (D) Extractor hook engaged with shell head, and breech traveling to rear; (E) Left side of shell head strikes ejector, casting shell to right and out port inside of receiver.

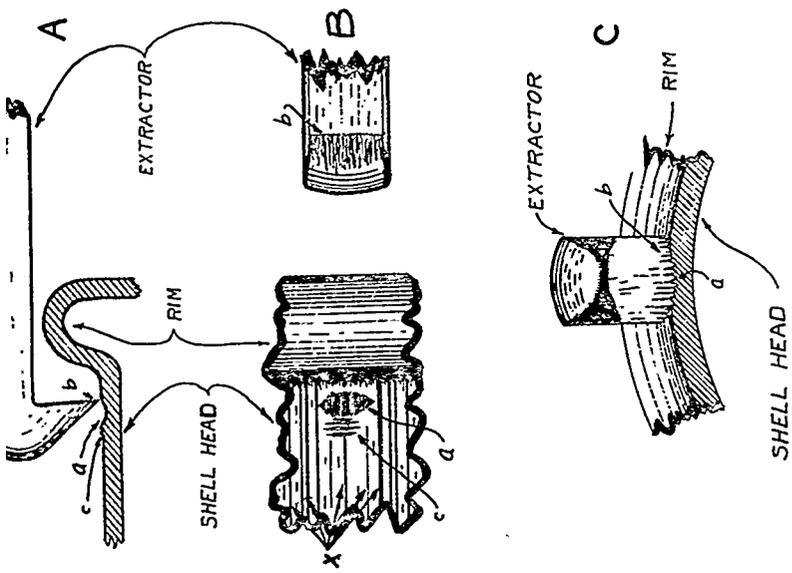


FIGURE 4
 Action of Extractor Hook

- (A) Extractor hook (b) engaged with brass head of shell head sectioned longitudinally.
- (a) Principal extractor cavity or mark.
- (c) "Chatter" marks produced by extractor hook tip.
- (B) Sharp tip of extractor hook (b) fractured and worn along tip including individual characteristics.
- (a) and (c) same as above.
- (x) Die marks in brass head of shell, referred to as d in Figure 1.

is quite brittle and it is reasonable to assume that this serrated tip results from severe strains to which the extractor hook is subjected in the cycle of operation of the firearm. (See Figure 3.) If this assumption is correct, it is to be expected that progressive changes will occur in the extractor hook and therefore in complementary marks left on the brass heads of shells fired in a particular firearm.¹²

¹² Of course, some individual characteristics on the surface result from the machining, grinding, or finishing operation at the time of manufacture.