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## THE EVALUATION OF PHYSICAL EVIDENCE IN CRIMINALISTICS: SUBJECTIVE OR OBJECTIVE PROCESS?

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Criminalistics is the science of individualization (1). Two principles, *identification* and *identity*, are intimately involved in the process of individualization. Identification is the procedure of placing an entity in a predefined, restricted class; establishing an identity or individualization is an extension of this process and refers to the evaluation of the combination of conditions that uniquely characterize an entity.

Among those interested in the development of Criminalistics as a discipline in its own right, the above definition is held to be quite important. For those who view Criminalistics as a forensic science the definition offered by the California Association of Criminalists may be more satisfactory.

Criminalistics is that profession and scientific discipline directed to the recognition, identification, individualization, and evaluation of physical evidence by the application of the natural sciences in law-science matters.(2)

### CLASS AND INDIVIDUAL CHARACTERISTICS

The criminalist studies physical evidence, e.g., latent fingerprints, fired bullets, questioned documents, and so on, to determine *class* and *individual* characteristics in order to establish an identity between the crime scene evidence and the comparison-test standard. Class characteristics provide the basis for identification; individual characteristics provide the basis for establishing an identity. Table I is an attempt to illustrate the nature of these characteristics for those who are not too familiar with criminalistics.

Individual characteristics are attributable to several sources:

- a. natural phenomena—as in the details present in the skin ridges of a finger, the topographical irregularities in crepe-rubber sole patterns, or the reamer marks in a gun barrel.
- b. minor damage through abuse—as in

attempting to use a tool that is inadequate for the job. For example, employing a ball-peen hammer where a sledgehammer would have been necessary to accomplish the task.

- c. more serious damage through misuse—as in using an instrument carelessly or for a job for which it was never intended. For example, repeated striking of a typewriter key on another to the point of battering its typeface, or employing an ax to cut through the metal skin of a safe.

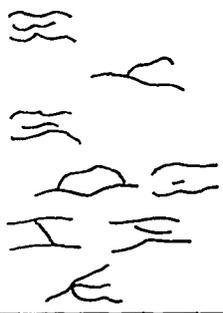
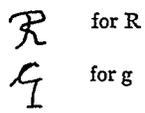
- d. uneven or accidental wear—as an automobile tire on an improperly aligned wheel or the worn areas and bruises on the sole and heel of a shoe.

The recognition of and distinction between class and individual characteristics is not always obvious or simple and sometimes is quite subtle. For example, is the damaged serif on the typeface the result of normal wear through ordinary typewriter usage or has its damage been caused by misuse as indicated above in (c). If normal wear is the reason, the damage to the typeface may be sufficiently commonplace to represent a class characteristic; if unusual wear is the reason, the damage is atypical and represents an individual characteristic. A clear-cut decision may not always be possible, for as with all science there is a gray area that poses difficulty in evaluating the "characteristic continuum." Specialized education and experience are the foundations upon which the solution of questions of this kind is based. The largely subjective basis of the evaluation of the class and individual characteristics is suggested in the preceding sentence.

### INTERPRETATION OF COMPARISON DETAILS

When class characteristics are similar in both objects and individual characteristics have been noted in both, three conclusions are possible

TABLE I  
CLASS AND INDIVIDUAL CHARACTERISTICS IN VARIOUS TYPE OF EVIDENCE

Type of Evidence	Characteristics		
	Class	Individual	
	Example	Example	Visual Appearance
Colorless liquid	an alcohol	ethyl alcohol	—
White powder	an alkaloid	Heroin*	—
Suspected dried seminal stain	stiffness fluorescent in ultra-violet light positive acid phosphatase test	an intact spermatozoon	see any book on Legal Medicine
Fingerprints	arches  loops  whorls	ridge ending,  bifurcation,  short ridge,  enclosure, dot,  bridge, spur,  trifurcation	
Bullets	caliber no. of lands and grooves direction of twist of rifling	scratch marks or striations in the lands and grooves	See Fig. VII-4 on p 151 in Reference no. 3.
Handwriting	hand printing cursive writing	any deviation from the model letters of the system used to teach handwriting, i.e., peculiarities of letter formation	 for R for g
Shoe impressions	heel sole mfr's name or design	gouges, cuts and other marks acquired accidentally through wear	See Fig. 34 on P 87 in Reference no. 4.
Tool impressions	hammer, screwdriver, jimmy	nicks, dents, broken edges, and other damage from misuse or abuse	See Fig. III-4 on p 48 and Fig. III-15 on p 62 in Reference no. 3.

The chemist's interest usually stops at this point; the criminalist, however, is concerned with detecting the possible source. For example, heroin from Mexico is made by acetylation of opium directly and contains meconic acid, monoacetylmorphine, and so on. Heroin from Asia (Mafia-European) is made from morphine and the acetylation is generally complete. In addition, the interest of the criminalist sometimes centers on the diluent used to cut the alkaloid.

depending upon the number, relative position, and degree of "unusualness" of the individual characteristics:

a. The evidence details arise from the same source, that is, they have a common origin. There are many, but not unusual, individual characteristics present in both. If one or more unusual characteristics are present, (as, in fingerprints, a trifurcation, or a spur, or both) fewer of the more common characteristics (as a ridge ending), are required. The relative position of each comparable characteristic must be the same in each object.

b. The evidence details observed in both objects could have a common origin. (There are several individual characteristics, none of which is particularly unusual, present in both objects.)

c. No explanation such as a common source or origin is possible for the evidence under study. (There are no, or at best only a few, individual characteristics present in both.)

d. When no similar individual characteristics are found in either object a conclusion that the two objects came from different sources is reasonable.

The evaluation of the details permitting conclusions (a) or (b) is still a subjective rather than an objective matter in many areas of criminalistics.

#### STATEMENTS IN THE LITERATURE

The literature of criminalistics is replete with statements that illustrate the essentially nonobjective character of the interpretation and evaluation of evidence. Examples involving a variety of types of physical evidence are given below to support this thesis.

##### *Fingerprints*

*The points necessary for establishing identity.* There are contradictory opinions on the number of identical points required to establish positive identification. The New Scotland Yard Authorities, London, recommend that at least sixteen identical points should be established in order to prove the similarity. Some American authors recommend that at least twelve identical points should be established, besides the core and the delta, for a positive identification. The Federal Bureau of Investigation, United States Department of Justice, is of the view that if there are twelve points of similarities in the two impressions, the identification is absolute and

such impressions will not have any dissimilar ridge formation. Some of the experts of our [Indian] Finger Print Bureau are satisfied with six identical points.(5)

##### *Toolmarks*

... some individuality will appear, but the number, peculiarity, or clarity of these features may be so slight as not to permit a definite statement to be made. Here we have a "borderline" case in which the specimens show evidence of identity short of positive proof. Instances of this occur in the examination of all sorts of evidence, and in the field of tool marks and firearms identification are the most frequent cause of a difference of opinion among examiners. Such differences arise primarily through differences in interpretation of the characteristics seen, assignment of greater or less significance to the features observed, variations in methods of analysis utilized, inequalities in experience of the examiners, and other factors. Unlike the field of fingerprint comparison, there is no set number of characteristics required for a positive identification of a tool mark. The characteristics of the latter are the result of too many possible causes, and take on too great a number of forms, to be classified so simply. It thus becomes incumbent upon each examiner to familiarize himself with a great variety of "tools," marks, impressions, and their characteristics. He must be able to distinguish those features which are accidental or otherwise peculiar to the specimen as an individual, and those which are characteristic of the class as a whole. Having acquired such information through study and experience, he must then adopt those methods of analysis which will best reveal the identification peculiarities both to his own satisfaction and to that of others.

Because of the difficulty of assigning any sort of numerical "identity value" to specific features found in impression marks, the conclusion reached in such comparisons is of a somewhat different order (of opinion) than the identification of a fingerprint, though it be just as positive, and even granting that numerical assignments to the latter are somewhat arbitrary.(6)

##### *Firearms*

Biasotti, one of the few persons who have made a statistical study of individual characteristics of fired bullets, has commented:

From the number of texts devoted exclusively to the subject of firearms and tool mark identification, it might appear that this specialized area of physical comparison is a highly developed science with well-defined criteria for evidence evaluation. On the contrary, a review of the literature reveals a very superficial treatment of this basic problem of evaluating results and establishing identity. Practically the entire body of literature in this field has been devoted to topics ancillary to the main objective of establishing identity.(7)

Later in the article he remarks that:

If we accept the present apparent state of development as adequate and believe that no objective statistical data for establishing identity can be developed, then the subject of firearms and tool mark identification will remain essentially an art limited by the intuitive ability of individual practitioners.(8)

The following statement appears in one of the better known texts on firearms identification. It is eloquent in its unwitting revelation of firearms identification experts' self-image; it is significant for its unintended explanation of the state of the art and the reasons for it.

In general, ambition and hard work are far more important than academic training. Experience and gun knowledge are certainly valuable but are not absolutely essential. Most Firearms Identification Experts were gun cranks before their appointment. Natural intelligence and cleverness are, however, imperative. Common sense will do more in the long run than a Doctor of Philosophy Degree. A certain knowledge of microscopy is essential but can be picked up as one goes along.(9)

#### *Questioned Documents*

Writing identification involves the discovery and study of all identifying characteristics; the differentiation between those which are typical and those which are abnormal or represent the unusual; . . .(10)

As a measure of judgment is called for, it follows that the comparison of handwriting must be, in part, a subjective process . . .(11)

A handwriting, an automobile, or a person are identified according to the same principles. Correct identification results from a combination of common qualities and individual qualities in sufficient number. Even without the serial and engine number, a general description and a few

individual dents and scratches, the history of which is known to the owner, are sufficient absolutely to identify an automobile from all other machines ever made. "The man who owns one" that has been thus dented and scratched under his own observation, if not a result of his own carelessness, will not be deceived. He would, however, be laughed out of court, or out of the garage, if he attempted to prove ownership by the method sometimes employed in court to prove the genuineness of a disputed writing by pointing out what can be found in thousands of machines.

The "dents" and "scratches" in a handwriting are its individual characteristics. One without knowledge and without experience does not know what they are nor how to look for them. This book is intended to assist in this undertaking of finding and weighing handwriting characteristics, but this ability cannot all be acquired from any book. One of the first qualifications necessary is called "common sense" which, however, is not a common quality.(12)

#### THE RECOGNITION OF UNUSUAL CHARACTERISTICS

The literature cited earlier refers either directly or by implication to the relative importance of individual characteristics in the comparison process. Although no set number of individual characteristics exists for establishing an identity, there is general agreement that an "unusual" characteristic has greater significance than those which are more common and that fewer of the former are required. In a borderline case judgment of identity or nonidentity may rest upon the presence of at least one unusual characteristic when the total number is small. Judgment of unusualness is based on the experience and training of the expert as is judgment of identity. Clearly then, the question of unusualness is of critical significance in the process of individualization.

*The Operating Characteristics of Experts.* In fingerprints individual characteristics are well-defined, easily recognized, and few in number. Accordingly, this field offers the greatest opportunity to study whether experts are in agreement as to what are unusual characteristics. A study of this matter was made (13). Wide differences rather than a consensus were found among the eighty-two experts who participated. "If, in the simplest problem of identity, the problem is more complex than many seem to realize, how much more occult

is the evaluation of (characterizing) details in other areas of criminalistics?" (14). This is a haunting and disquieting question that demands satisfaction.

#### EVIDENCE EVALUATION BASED ON FREQUENCY DISTRIBUTION

The transformation of evidence evaluation from a subjective to an objective process will become possible when certain conditions have been met:

1. Criminalistics must be recognized "not as a conglomeration of techniques but (as) a separate philosophy and practice not duplicated by any other science or occupation" (15). It must be given the resources necessary for its nurture and growth; fundamental and applied research are vital to its development.

2. Standardized methods of analysis will have to be developed for the examination of common clue materials. Large numbers of specimens obtained from a variety of sources will have to be analyzed. The frequency distribution of class and individual characteristics may then be established. Similar studies must be made continually to detect changes as they occur in trace contaminants and other individual characteristics. "After the data have been gathered and analyzed, the next requirement for objective evaluations of evidence is an understanding of the proper relationship of the data to the problem of identification and individualization. This is an area that has been grossly neglected, and often distorted, in the past few decades" (16).

*The Role of Statistics.* Many disciplines require the development of statistical techniques to handle the problems peculiar to them. Criminalistics has this need also; population sampling, experimental design, and dependence of variables are subjects to be treated by statisticians to meet the requisites of the criminalist. Yet, as Kirk and Kingston have pointed out, "... statisticians are not criminalists and do not understand the specific character of the requirements of this field, while criminalists equally do not understand statistics, and do not know how to use it constructively" (17). In another paper these same authors significantly comment that "The use of statistical evaluations of physical evidence cannot be rushed. It will take time to determine appropriate areas of applicability, to decide upon the proper methods of analysis, to gather the necessary data, and to establish a confidence in the results both among the criminalists and in the courts" (18). Thus, the need

for a cooperative research effort is clearly indicated. Any institute resulting from recommendations by the President Johnson's Commission on Law Enforcement which ignores the importance of an interdisciplinary effort is doomed to failure at worse or, at best, mere mediocrity.

When a mathematics of criminalistics is developed, the role of probability in evidence evaluation will be better understood and perhaps it may be possible to "contend that 'beyond a mathematical doubt' transcends 'beyond a reasonable doubt' in the courtroom" (19).

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