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## POLICE SCIENCE

### WHAT PROBLEMS MUST CRIMINALISTICS SOLVE

JAMES W. OSTERBURG

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Criminalistics has been defined as

that profession and scientific discipline directed to the recognition, identification, individualization, and evaluation of physical evidence by application of the natural sciences in law-sciences matters.<sup>1</sup>

Kirk has suggested that criminalistics is

... poorly understood by the great majority of people, including the scientific public. It is generally assessed in terms of high-grade detective work rather than in terms of a serious and very demanding type of applied science.<sup>2</sup>

Elsewhere Kirk states that criminalistics as a science

... is new, even though many of its techniques are not. The fact that few architects of this science have emerged is perhaps due more to a lack of acceptance of criminalistics as a science in its own right than to the lack of persons who could have simplified the principles operating in this synthetic and conglomerate subject.<sup>3</sup>

If criminalistics and forensic science are equated, some of Kirk's views are shared by Walls who in his presidential address to the British Academy of Forensic Sciences said:

Forensic science, which is after all a pretty obscure and esoteric sort of profession, is frankly small beer in the world of science. It is in fact so

<sup>1</sup> California Association of Criminalists. Definition adopted at the 21st semiannual seminar at Ventura, California, May 26, 1963.

<sup>2</sup> KIRK, P. L., *Criminalistics*, 140 *SCIENCE*, 357 (1963). At p. 367.

<sup>3</sup> KIRK, *The Ontogeny of Criminalistics*, 54 *J. CRIM. LAW, CRIMINOL., AND POL. SCI.* 235 (1963). At p. 236.

small that it is only now becoming aware that it has any problems or organization. It is, as you all know, only a couple of generations or less since it started as the hobby, or at least sideline, of a few talented scientists, or doctors with a scientific bent, who liked getting mixed up with the police and enjoyed the kind of problems this association brought them. (I am, of course, talking about science as distinct from medicine.) They could still in those days without being geniuses cope with all the science the job demanded. *Now*, most people realize that that is no longer true. If forensic science is to grow as it should—and what doesn't grow dies—or is even to use all the scientific knowledge which even now it could, just has to be a collaborative affair. No one can now be an expert in all its branches.<sup>4</sup>

Crime laboratories have existed in the United States for a little over a third of a century. The police reluctantly accepted what was offered and did little to maximize the potential contribution. With very few exceptions almost no research has been conducted, per se, in the field. This is attributable, in part, to three factors: lack of funds, lack of research-oriented personnel, and lack of encouragement bordering on active discouragement by police administrators. A major problem facing criminalistics is remedying the lack of resources (men and equipment) and changing the climate to one of support and encouragement of research. Even this, however, will be insufficient unless recognition is given to the fact that criminalistics is an eclectic discipline that is fed not only by science and mathematics, but by philosophy and jurisprudence as well. Indeed, it may be said that while criminalists must be scientists,

<sup>4</sup> WALLS, H. J., *Whither Forensic Science?*, 6 *MED., SCI. AND THE LAW*, 183 (1966).

scientists are not necessarily criminalists. The fundamental difference perhaps is best explained by the interest of the criminalist in both the identification and individualization of physical evidence (and people). Ordinarily, the scientist is concerned only with identification. Thus, a fiber analyst for example, is content with determining that a strand is of synthetic or natural origin and in further classification to the point that it is identified as human hair. The criminalist goes beyond this and is interested in learning, if possible, if it is the hair of a particular individual.

#### ADAPTATION OF SCIENCE AND TECHNOLOGY

The problem of the adaptation of science and technology to the needs of criminalists may be illustrated by continuation of a discussion of the scientific examination of hair. It is a fairly common clue material, and it would be desirable to be able to study it critically to the point of individualization. The probative value is obvious if a criminalist were able to state that the hair found beneath the fingernail of a crime victim came from John Doe and could not have come from any other person.

When Neutron Activation Analysis became feasible about ten years ago, it was quickly recognized as holding great promise as a means of characterizing human hair. It was not long before claims were made that this new analytical tool would solve or was about to solve this classical problem of criminalistics.<sup>5</sup> Now, after a longer period of time and the expenditure of several hundred thousands of dollars, the problem is still unsolved. As a matter of fact, there is some evidence to indicate that there is a natural variation in the trace element content of human hair which is dependent upon the area of the body from which the specimen was obtained. In addition, a similar variation has been noted along the length of a single hair indicating growth-time difference. Thus, obtaining a suitable comparison sample is a major difficulty. The initial remarks concerning the obvious value of NAA in solving the question of individualization of hair are now more cautious, for research has illuminated many unrecognized problems. Although money was not unlimited, sufficient funds have been universally expended so that it is now possible to obtain some appreciation of the costs involved in exploiting one method's capabilities (NAA) for the examination of a single

clue material. It is reasonable to extrapolate the cost (approximately one million dollars) to determine the value of NAA in solving the question of the individualization of human hair.

Other research problems are worthy of mention. Blood is a common clue substance which cannot be individualized at present, although some fundamental progress is currently being made through academic research relative to elucidation of the nature of the chemistry of agglutination. Those responsible for this work are hardly aware of its potential for criminalistics. Ultimately, the insight provided, if employed further for the needs of criminalistics, might add another step toward the individualization of blood.

The time elapsed between the examination of a firearm and its last firing is another problem of considerable interest to the criminalist and the detective. No accurate estimate of this time is possible at present.

The innovative use of some well-established analytical tools, for example, coupling pyrolysis, gas chromatography, and mass spectrography for the examination of clue materials, is another possible application of instrumentation to criminalistics. There are undoubtedly many other techniques that scientists could suggest as being of potential value in law enforcement work.

Let us consider gas chromatography in slightly greater detail. Most chemists are barely familiar with presently available instrumentation for the examination of a suspected drunk driver's breath. When asked how the problem should be attacked, the chemist invariably suggests that gas chromatography is the most suitable technique. However, there are considerations that are not obvious; therefore, they are generally overlooked by a chemist unfamiliar with the operational requirements of law enforcement. For example, it is important to recognize that a breath instrument often must be operated by police officers (and then only a few times a year by an individual officer) and must therefore be simple to operate, require little standardization and be quite stable; that it must not be so expensive as to eliminate the possibility of purchase by police departments; and, that it must be competitive in price with existing breath-testing devices. When these desiderata are applied, no instrument manufacturer has been able to market a suitable gas chromatograph despite the fact that an attempt was made and a prototype instrument was shown at several annual meetings of the American Academy of Forensic Sciences in

<sup>5</sup> PERKONS, A. K., and JERVIS, R. E., Application of Radio-Activation Analysis in Forensic Investigations, 7 J. FORENSIC SCIENCES, 449 (1962). At p. 463.

the early nineteen sixties. This is a typical illustration of the obvious solution that fails to fructify in the light of the realities of law enforcement.

One final anecdote is in order. In recent years sound spectrography for the analysis of an individual's speech pattern has been suggested as applicable to criminal investigation. Yet, the pioneer developer of the "Voice Spectrograph" stated at the June, 1966 National Symposium on Science and Criminal Justice that he had become disenchanted with attempts to apply voice print identification techniques to the problems of law enforcement. Unpleasant developments such as time lost in court appearances, trial delay tactics, and personal attacks upon him caused his disillusionment. It is fair to state that most scientists who have never been exposed to trial work would probably react in similar fashion to the atmosphere generated in most county courtrooms. The importance of keeping the research aspect of criminalistics separate from the case work aspect should now be apparent.

This description of several attempts to adopt science and technology to the needs of law enforcement has been recounted to indicate the problems involved and to provide the basis for the suggestion of a possible solution. It should be quite clear that interest, good intentions, and the spare time of a "few talented scientists" are no longer sufficient. Today we must be concerned less with *ad hoc* solutions and more with an all-inclusive, *systematic* study of the problems. Before attempting to deal with recommendations concerning the institutionalization of this objective, it is desirable first to examine some important related topics to provide perspective.

#### IDIOSYNCRASIES OF CRIME LABORATORY WORK

The question of an adequate, representative sample is well-recognized in science, and a standardized procedure for securing it is generally available for established analytical methods. On the other hand, criminals who leave physical evidence at a crime scene do so unwittingly and certainly do not concern themselves with the adequacy and representativeness of the sample. Nevertheless, this is the specimen that is available for examination, and, obviously, some limitations are placed on the laboratory. Yet, when the sample is not typical but rather is peculiar in some fashion, the possibility of its individualization is enhanced considerably. The determination of similar "peculiarities" or "individual characteristics" in the

evidence specimen and in a comparison specimen obtained from a suspect is a major task of criminalistics. Thus, trace constituents instead of major components in a specimen, are the focus of interest to the criminalist. In most scientific endeavors the opposite is more likely to be true. Kirk has expressed this important general difference as follows:

Criminalistics is concerned with the unlikely and the unusual. Other sciences are concerned primarily with the likely and the usual.<sup>6</sup>

*Other Anomalies.* The crime laboratory is unusual in that it is dependent upon nonscientists to recognize, collect, and preserve evidence specimens. In addition to the requisites of science, there are also imposed the requirements of procedural law pertaining to criminal cases. Unless the police officer complies with the demands of both disciplines, the evidence becomes unemployable. Thus, any blunder has as its consequence complete negation of the efforts of the crime laboratory regardless of how well it is equipped and how informed its staff may be. Thus, education and training of high order are necessary for police officers concerning the recognition and handling of physical evidence.

*Follow-up Delay.* There are many aspects of crime laboratory evidence examinations that require a prompt analysis and report if the investigator is to capitalize on the clues offered by physical evidence. Consequently, delay occasioned by the remoteness of laboratory services interferes with the "follow-up" aspects of the investigation. Since there are many places in the country where such delay is possible because of inadequate or nonexistent crime laboratory services, the administration of justice suffers in those areas. Furthermore, the mere establishment of a state or regional laboratory will not in itself necessarily rectify the shortcoming unless considerable attention is also directed to the education of investigators concerning what the laboratory can do for them and what they must know and do if the laboratory is to be able to serve them.

#### THE EFFICACY OF BEHAVIORAL SCIENCE

While it may seem far afield from the problems of criminalistics to be discussing the behavioral sciences, their potential has hardly been tapped by law enforcement. This situation is likely to continue

<sup>6</sup> KIRK, 140 SCIENCE, 368 (1963). 368.

unless the method chosen to institutionalize criminalistics research also includes provisions for complementary research by behavioral scientists.

The most commonly held conception of the contribution of science to the administration of justice ignores the behavioral sciences, paying heed only to the physical, biological, and medical sciences as a means of improving criminal investigation. A broader view, however, requires that the knowledge of the behavioral sciences be incorporated with the natural sciences in developing a general investigative theory. Most police administrators, illustrative of the lack of formal educational requirements for the position, generally fail to recognize the latent worth of the behavioral sciences; consequently, little use is made of this resource in police work today. An appropriate means of suggesting the value of these sciences is to indicate how they shed light on the utilization of the findings of the crime laboratory. Horowitz,<sup>7</sup> a psychologist, has shown that one of the conditions necessary to secure a confession is knowledge or belief by the suspect that evidence is available against him. Thus, "positive laboratory results," using the term loosely, are quite useful in satisfying this condition and may be of considerable assistance in the interrogation of a suspect.

Another example of the value of behavioral science research is found in movement-pattern studies of teenagers and young adults in urban communities. Some geographers have recently undertaken research of this character. Since these youthful groups are responsible for much of the reported crime, such information has obvious tactical value for the patrol and investigative functions of police work.

Kirk has suggested that there is an important interrelationship between criminalistics and behavioral science:

Signs abound that the ultimate role of criminalistics will be far broader and more significant than merely the study and interpretation of evidence. To illustrate, there is now strong evidence that certain mental diseases, notably schizophrenia, are associated with abnormal blood components.<sup>8</sup> It also is recognized that alcoholics and drug addicts have metabolic abnormalities. Conditions such as these are certainly related to criminality,

and it may well be that detectable physiological or other abnormalities may also be characteristic of certain forms of criminality.<sup>9</sup>

In the face of several Supreme Court decisions, knowledgeable use of science—physical and behavioral—is necessary if the restraints now placed upon previously acceptable investigative behavior are to be successfully surmounted.

#### THE ROAD TO PROGRESS

*Criminalistics as a Discipline.* Recognition of criminalistics as a discipline in its own right is important if any tangible future progress is to be made. This is not sufficient however; long term, impressive financial support is also necessary. If through the wise expenditure of such funds, the proper intellectual environment is provided, it should be possible to assemble the critical mass of intellect necessary to develop the field. The progress and efforts thus far of those who have been working in the field have been well-described by Kirk:

With all of the progress that has been made in this field, and on a wide front, careful examination shows that for the most part, progress has been technical rather than fundamental, practical rather than theoretical, transient rather than permanent. Many persons can identify the particular weapon that fired a bullet, but few if any can state a single fundamental principle of identification of firearms. Document examiners constantly identify handwriting, but a class of beginners studying under these same persons, would find it difficult indeed to distinguish the basic principles used. In short, there exists in the field of criminalistics a serious deficiency in basic theory and principles, as contrasted with the large assortment of effective technical procedures.<sup>10</sup>

There is little reason to believe that any greater progress can be expected unless the "small beer" status mentioned by Walls is lost and a drastic increase in resources is made available to develop the discipline. This writer has heard several persons approvingly comment on man's ability to photograph the back of the moon while his inability to solve crime through the use of science became the subject of captious comments. Before

<sup>7</sup> HOROWITZ, M., *Psychology of Confession*, 47 J. CRIM. LAW, CRIMINOL., AND POL. SCI., 197 (1956).

<sup>8</sup> FESSEL, W. J., and GRUNBAUM, 54 AM. INTERNAT. MED., 1136 (1961).

<sup>9</sup> KIRK, *SCIENCE*, At p. 370.

<sup>10</sup> KIRK, 54 J. CRIM. LAW, CRIMINOL., AND POL. SCI., 235 (1963).

belittling criminalistic success, it would be well to contrast the several billions of dollars spent for space research with the piddling funds (certainly considerably less than a million dollars) that have been spent on *all* published research in criminalistics in America.

*Major Principles.* A discipline exists when a body of facts have been discovered and some fundamental principles have been elucidated to give coherence to the area of study. In criminalistics two of the major principles involved are *identification* and *identity*. Kirk explains these terms as follows:

*Identity* is defined by all philosophical authorities as uniqueness. A thing can be identical only with itself, never with any other object, since all objects in the universe are unique. If this were not true, there could be no identification in the sense used by the criminalist. Bowing to general scientific usage, we must however, accept the term *identification* in a broader context, referring only to placing the object in a restricted class. This is necessary because every science has its own small realm of identification, which may refer to species (botany and zoology), compound (chemistry), and mineral (geology and mineralogy). In this sense, the criminalist would identify the object as a paint chip, but not relate it to the painted surface from which the chip was derived. He would even identify the marking as a fingerprint, but without relation to the hand that placed it, and another object as a bullet, without reference to the firearm that fired it. For the criminalist to use the word "identification" in its accepted context is to admit that there is no reason for his special existence. If the best that could be done by the document expert were to testify that the sample is handwriting, he would never reach the witness stand. Yet this is precisely what would be meant in the other sciences, and this is *all* that would be specified by the term. It is clear that the time has arrived to be more specific and precise.

The criminalist does not attempt identification except as a prelude to his real function—that of individualizing. The real aim of all forensic science is to establish individuality, or to approach it as closely as the present state of the science allows. *Criminalistics is the science of individualization*. It is concerned only incidentally with identification in its ordinary sense.

This unfortunate failure of nomenclature undoubtedly derives from the development of methods for identifying an individual by his fingerprints or otherwise, which gave rise to the "identification bureaus" in most police departments. What was actually done was not the identification of the fingerprint, but rather the individualization of a person as the one who left the fingerprint. Thus, the entire subject of criminalistics started with a nomenclature that was inconsistent with science at large, and the terminology has never been brought into line by making the critical distinction of the field as a separate science of individuality.<sup>11</sup>

*Nature and Importance of Associative Evidence.* The criminalist is interested in individuality because it provides the basis for the development of *associative evidence*. This is a nonlegal term used to indicate that a one-to-one correspondence has been established between some crime scene evidence and the criminal. The best known example is that of a latent fingerprint developed at the crime scene which is identified with a recognized fingerprint already classified in some file or which was obtained from a suspect expressly for the purpose of comparison with the latent print. Much of the work of the laboratory consists of the examination of impression evidence, i.e., the comparison of a fatal bullet with one fired from a suspect's gun, a heel imprint with the heel of a shoe in the possession of a suspect, a tire impression with that taken from the tire of a seized automobile, an altered automobile engine serial number to a set of dies located in a disreputable garage, and so on. It is important to note that the examination and evaluation of impression evidence is not the usual activity of scientists in general; yet, this facet is a vital aspect of the criminalist's work.

An overlap in the work of the scientist and the criminalist occurs when "wet chemistry" or modern instrumental methods of analysis are employed to examine and compare crime scene evidence with similar evidence found in the possession of a criminal (for example, a paint chip found at the scene of a hit-and-run homicide and a suspect's automobile). However, the usual interest of the analytical chemist is in the major constituents while the criminalist is interested in the adventitious trace elements that may help to individualize paint. Whether the two points are in

<sup>11</sup> *Ibid.*, p. 236.

sufficient agreement in the qualitative and quantitative components (major and minor) so as to constitute an identity is, at present, a subjective judgment or opinion of the analyst. Such opinions are based on experience, education, and training of the criminalist or "expert." It is self-evident that an important task ahead in criminalistics is the transposition of the interpretative aspect of the work from a subjective to an objective basis.

*Standardization of Procedures:*

The Association of Official Agricultural Chemists, The American Society for Testing Materials, and many other organizations or industrial groups have established official methods of analysis for various substances which they are required to analyze or inspect. As a result of the work of these groups authoritative, competent, and unbiased methods of wide applicability have been developed. Courts, in proceedings where different methods of analysis have been employed and where it becomes necessary to make a choice, usually will recognize the official methods advocated by scientific societies.

The advantages of having standardized procedures and official methods of analysis for examination of evidence in criminal investigations would be similar. Unlike ordinary analytical laboratories, however, the police laboratory has little control over the evidence sample submitted for analysis. For this reason, then, it is not possible to specify exactly how the analysis is to be performed in *all* cases. In these situations the practice now followed of having the analyst choose or develop his own method would continue. He, of course, should be able to explain why he thought it wise, or found it necessary, to depart from the standardized procedure (if such exists).<sup>12</sup>

Nondestructive methods of testing should obviously be enlisted before any procedure that consumes the sample is employed. Accordingly, the whole issue of how instrumental analysis is best applied to examine evidence samples for individuality is raised. This is a major research project that must be undertaken if criminalistics is to shift from a subjective to an objective basis for establishing an identity. A few of the more common types of clue materials—paint, glass, safe insula-

tion, and dirt—might be employed initially to determine which instruments provide the necessary discriminatory information to permit an objective statement regarding the identity of two specimens. In turn, this suggests the need for the collection of statistical data that describes the usual and unusual variations which occur in natural and manufactured materials.

*Tagging Clue Materials.* Instead of relying upon trace elements or other accidentally acquired characteristics, it would be more sophisticated to "tag" the most common clue materials in advance for the purposes of identification and identity. Thus, gun powder or primer material could have some of the rare earths added in small quantities to permit a definitive answer by neutron activation analysis to a frequently asked question: "Can you examine a person's hands and tell whether or not he shot a gun?" Paint, glass, and safe insulation are frequently occurring clue materials in which the problem of identity arises.

Industry is not likely to enter into any agreement to "tag" a product if the expense is significant. Furthermore, an official request and a definitive answer to the needs of criminalistics would also be expected. Accordingly, there has been little cooperation extended by industry to achieve this end. A research institute working closely with operating crime laboratories, and with funds to underwrite the costs of tagging a product, is one possible means by which this valuable aid to law enforcement might be achieved.

*Survey of the Literature.* Undoubtedly, there is much to be gained by a survey of the literature for developments in science that seem applicable to the needs of criminalistics. This writer<sup>13</sup> and Walls<sup>14</sup> have both called attention to the potential value of such an effort. Indeed, the advantage of knowledge "spin-off" from the space-science effort was quickly recognized by the government, universities, and industry. For example, The Aerospace Research Applications Center was established at Indiana University with the aim of disseminating the results of governmental research and development programs to civilian-oriented industry. This endeavor could serve as a model for the survey of science for the needs of criminalistics.

It is appropriate at this point to mention that criminalists have not been laggards in recognizing the potential value of new scientific instruments.

<sup>12</sup> O'HARA, C. E., AND OSTERBURG, J. W., AN INTRODUCTION TO CRIMINALISTICS, New York: Macmillan, 1949. At p. 689.

<sup>13</sup> *Ibid.*, p. 693.

<sup>14</sup> WALLS, *op. cit.*, p. 185.

For instance, a paper<sup>15</sup> on the electron microprobe x-ray analyzer was presented to the Academy of Forensic Sciences at a time when there were only a few in operation in industrial research laboratories in this country and only 150 in operation throughout the world. At least one crime laboratory (the Illinois State Bureau of Criminal Identification and Investigation) has acquired a microprobe and is now exploring, within budgetary allowances, its use in the examination of physical evidence. If we accept the present negligent attitude of society toward criminalistics research, this is indeed a commendable effort. The question that must be asked, however, is: "How best can new developments in science be studied and, if found useful, be made part of the routine of crime laboratory operations?"

#### THE INSTITUTIONALIZATION OF RESEARCH

This is not the occasion to describe how the many research suggestions offered above are to be implemented; however, it is in order to discuss a few important considerations relative to the institutionalization of criminalistics research.

A research institute is necessary. It should not engage in case work, yet should not be so removed from the needs of the operating crime laboratories that there is danger of its becoming an ivory tower. A relatively small permanent staff augmented by scientists drawn from industry and the universities, as well as by criminalists on leave from their departments, (comparable to an academic sabbatical leave) might be the means of retaining the best of both the practical and academic worlds. Of major importance to the success of any such institute in securing capable scientists is the question of establishing a climate which is attractive to them. While seemingly ineffable to administrators, scientists quickly sense whether an

institution has the proper attitude for the conditions under which their work thrives. If this singular quality is not readily apparent, the denigrating aspect of the police relationship will probably be a major deterrent in acquiring a scientific staff. To some extent the environment of a university campus—graduate students, library resources, and cultural opportunities—would be likely to overcome a natural reticence of scientists to cut themselves off from their colleagues and discipline in order to develop a new discipline—criminalistics.

It must be emphatically stated that such a research institute must not be allowed to become a monolith. Research in criminalistics should be conducted in universities and generous funds must be made available for this purpose. Universities have served society well as the fountainhead of knowledge and are familiar with the problems of developing a new discipline.

*Expansion of Laboratory Services.* There are many areas of the country where laboratory services are nonexistent. Some measures must be taken to overcome this deficiency. In addition, as police officers rely more on scientific aids in the investigative process, existing laboratories will require larger staffs. The entire question of education of criminalists needs careful consideration. The number of universities concerned with criminalistics as a discipline will have to be increased in order to provide the staff necessary to permit the greater utilization of science in the future.

#### RECAPITULATION

This paper has been written in tutorial fashion to inform interested readers about the needs of criminalistics. A primary purpose was to disrobe the scientist of his misconceptions of how science is employed in the quest of justice. Criminalistics was described as a discipline in its own right and several suggestions were made to indicate the means of growth.

<sup>15</sup> WHITNEY, W. P., AND MACDONELL, H. L., Forensic Applications of the Electron Microprobe, 9 J. FORENSIC SCIENCES, 511 (1964).