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THE INTERRELATIONSHIP OF LAW AND SCIENCE

PAUL L. KIRK*

TRADITIONALLY, law and science have had little in common. They developed as a result of different social and intellectual needs; their viewpoints and philosophies have deviated in significant ways and their practices have had little similarity. It is not surprising that common interest and aim have been slow in developing, and that mutual understanding has often been lacking.

However, there has always been a philosophical bond between the two professions of science and the law, rarely recognized, but present nonetheless. To both, logic and fact are of primary concern. The attorney who is unusually effective in the courtroom may still find himself at a loss if the demonstrable facts are not favorable or are missing. The scientist also, who lacks factual backing for his theory is unlikely to generate acceptance. There are differences in the manner of application of logic in the two professions of science and the law, with statistical inference and degree of proof both being treated somewhat differently.¹ In science, we still speak of the atomic theory, and long before the existence of atoms was positively proved, all scientists accepted the theory as fundamentally correct. During this period, the attorney might well have argued that in the absence of absolute proof, the existence of atoms was speculative. Thus, while logic may not have equal connotation in the two professional disciplines, both use it and depend on it. Perhaps the difference in the two attitudes is similar to that between preponderance of evidence, and proof beyond a reasonable doubt.

There was a time when the law was based on concepts and practices that would not be uniformly acceptable today. In these early times, science was essentially nonexistent as a cultural force. The law assumed ethical and moral significance long before science became an important factor in ordinary living. With the later, vigorous scientific and technological progress, the law and science inevitably developed more areas of overlapping concern, in line with the alterations produced by science in every other phase of modern life.

With the automobile came the automobile accident that required legal consideration of liability. With industry came patent litigation, industrial accidents, and other matters of legal interest. With improved transportation, communication and the means for committing crimes, came the more elaborate crime that made necessary its interpretation in terms of basic physical and chemical technology. The merging of science with the law became inevitable and necessary.

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1. For a more definitive discussion of some of the implications of these differences, the reader is referred to McElrath & Bearman, *Scientific Method, Statistical Inference, and the Law*, 1956 Science 589.

With different approaches, philosophies and methods, it is truly remarkable that so much blending of science with the law has already occurred. However, there remains the problem of educating the attorney in the proper role of science in legal practice, and of educating the scientist who becomes an expert witness in his relation to the law. The answers to this problem are not simple, and progress is still slow.

The professional discipline that has most effectively joined science with the law is termed *criminalistics*,² sometimes *forensic science*. Criminalistics has been defined as that profession and scientific discipline directed to the recognition, identification, individualization and interpretation of physical evidence through application of the natural sciences to law and science matters. The important term in this definition is "scientific discipline." It is as much a discipline in its own right as is medicine, which also is not chemistry, not biology, not physics, but a fusion of all three, modified and adapted to a specific purpose, the treatment of disease in human beings. In the same way, criminalistics includes all of these and some other sciences such as botany and mineralogy, and selects from all of them portions that may be utilized in interpreting events of legal significance, whether criminal or civil. Criminalistics is science, and science must be introduced into the courtroom by scientists. It is not a conglomeration of techniques, but a separate philosophy and practice not duplicated by any other science or occupation. Although commonly heard, the word "technician" is not applicable to its practice, because the technician merely follows prescribed routines, and is not expected to understand their underlying fundamentals. He knows how, but not why.

The difficulties encountered by the attorney in dealing with the expert witness stem largely from the above considerations.³ He may not realize that a chemist is not able to solve every chemical problem, and may hire as an expert a person who is highly competent in a limited area of chemistry, and at the same time lacks investigative knowledge or experience. For example, the paint chemist blends and tests paints for their protective or decorative qualities, and may know the ramifications of various admixtures of vehicle and pigment combinations—but, he almost certainly has never identified a paint chip as to its origin, because this is not a normal function of a paint chemist. It is, however, a very important part of the knowledge of the criminalist, even if he has never blended a paint in his life. Thus, it is surprising if the paint chemist is a suitable expert for testimony regarding paint identification.

Above all, the criminalist is a specialist in identification and determination of the source of evidence items. It is not very important what type of evidence

2. Cf. Kirk, *Criminalistics*, 1963 Science 367; Kirk, *The Ontogeny of Criminalistics*, 54 J. Crim. L., C. & P.S. 235 (1963).

3. The utilization of chemists as experts has been discussed more extensively in *Science Aids Law Enforcement*, 32 Chemical & Engineering News 4936 (1954); *Chemists in Court*, 32 Chemical & Engineering News 5046 (1954). See also *Expert Witness*, Industrial & Engineering Chemistry, August, 1954, p. 25A.

is involved because the principles of identification are universally applicable and the approaches to determining the source, or individualization, apply to all types of evidence. It is this distinction, between the identification specialist, and the specialist in industrial, or medical, or commercial aspects of a particular type of evidence, that is least understood by the attorney.

In further analysis of this distinction, it may be useful to compare the identification of handwriting with the identification of a firearm that has fired a particular bullet. Most attorneys would not consider them analogous in any respect and would employ a document examiner and a firearms expert respectively. While this may sometimes be necessary, consider the following facts: The writer leaves marks on paper, which are never precisely duplicated in any two samples, but which always carry certain features determined by his individual writing habits. On the other hand, the firearm leaves marks on a bullet, which are never precisely duplicated on any two successive firings, but which always carry certain features of the individual rifling characteristics of the firearm. The analogy is startling, and in fact, a primary reason that the firearms examiner does not examine handwriting, or vice versa, is that generally he has restricted himself by not learning the fundamentals of identification. He has yielded to the popular idea that the human brain is so limited in its capacities that he is automatically forced into a mold of specialization from which he cannot escape. This view is not without some merit, but the choice of specialization based on the evidence examined, rather than on the approach to examination of evidence, is often tragic in its results.

The true expert witness must know the fundamentals of investigative and identification method. This is proved day after day in the court room, where the person who is highly experienced in some very narrow area related to the type of item that is in evidence, demonstrates that he does not know investigation, and his efforts may be futile when he is opposed by a person who knows far less about the specific type of evidence, but is capable of finding the clue that solves the matter decisively—because he knows basic science and investigative technique. An illustration is in order.

A repairer of electric blankets testified that he had repaired approximately a million electric blankets, and was intimately familiar with every type of electric blanket manufactured. He testified further that the blanket in question simply could not have been the cause of a fire through shortcircuiting, because of the numerous safety features built into the blanket alleged to have initiated the fire. It was further brought out in cross examination that this "expert" did not know the fundamental physical laws of electricity. The opposing expert, who had never before carefully examined an electric blanket, but who knew the principles of electricity and electric circuits was able to demonstrate that the wiring of this particular blanket deviated from that of the other similar blankets so well known to the first expert. Furthermore, the error in attaching the wires allowed the safety features of this blanket to be bypassed, thus making

a shortcircuit possible, even though it could not happen in the other thousands of similar blankets. This is the difference between the investigator who utilizes scientific information to the solution of events, and the highly experienced person in some limited area who has no investigative knowledge or experience. It must not be overlooked that unusual events that lead to court action nearly always involve some deviation from normal—otherwise the unusual event would not have occurred.

The criteria by which the expert may be selected are simple, and often not appreciated. First, if scientific principles are involved, the witness must be a scientist. Technicians, and second rate dabblers in science do not suffice. Second, and possibly more important, the witness must know investigative procedure and philosophy. It is in this matter that many competent scientists fail to meet the requirements. Perhaps investigation is an art. If so, the witness must be the artist, for science alone cannot always be adapted to the special requirements of the matter at issue. Third, the witness must have a working knowledge of legal procedure if he is to be effective. It is in this requirement also that many scientists fail, for they do not realize the special requirements of legal, as opposed to scientific, proof. Furthermore, they are always likely to complicate or confuse the legal issues by their lack of understanding of legal process and the manner in which the lawyer approaches his problems. Fourth, the witness must be capable of reducing his testimony to the level of understandability by a lay jury who will decide the issue.⁴ Clear exposition in lay terms may be effective; complicated technical discussion that is not understood, however correct, will fall on deaf ears. The requirements for the effective expert witness are indeed formidable, but they can be met and are met by the properly trained criminalist. It is equally formidable for the doctor to confront the victim of a very bad accident, with broken bones, internal injuries and in shock, but proper training and intellectual discipline on the part of the surgeon allows him to deal objectively with the complex matter, taking first things first, and skillfully attending to each thing in its proper order. This approach also characterizes the skilled expert in the court room, a person who knows the correct approach, the order of presentation, the ability to sift the decisive from the irrelevant detail, and to present it clearly and unequivocally to the jury. Such a witness is reliable, objective, and understands his business. The development of these skills is the function of criminalistic training.

UTILIZING THE EXPERT

The skill of attorneys in making maximum use of the experts they hire is extremely variable. If the attorney has some technical or scientific background, he generally asks the right questions and understands the answers. Lacking such a background, he may fall into a variety of errors. Some of these may be illustrated by the following general suggestions:

4. Cf. Souder, *Effective Testimony for Scientific Witnesses*, 1954 Science 819.

1. The expert (excluding medical and psychiatric witnesses)⁵ must be given an adequate knowledge of background of the matter at issue, but he is not concerned with the type of background that is strictly related to individuals, either principal or witnesses. His concern is with the physical facts and items of evidence. The background he requires must be of the type that gives a basis for evaluating the physical facts, and for reconstructing the crime or event. Eye-witness accounts are generally worthless for these purposes, and may tend to prejudice the expert. Sometimes there are facts that can be established by eye witnesses that aid in interpretation. All other such accounts should be excluded. On the other hand, environmental factors can be critical. For example, there may be paint chips on the evidence, and they may have vital significance. However, they may have been present for reasons that are completely unrelated to the matter at issue. This type of information is critical.

2. The laboratory expert will require standards for comparison. If these are less than adequate, failures or errors may result. The need is well known in the matter of document examination, but even here, the standards that are furnished are very often insufficient to allow a firm expert opinion. The worst feature of this deficiency is that the expert may not know that the standards are inadequate, and if he believes them to be, serious errors may result.

The requirement for adequate standards is just as applicable to other forms of evidence as to documents. Paint chips of unknown origin can only be compared with paint chips of known origin. Evidence glass fragments require that known glass be made available for comparison. Whatever the type of evidence, similar items of known origin must be obtained before any meaningful comparison can be made. In the effort to obtain such standards, the expert may often advise the attorney or his investigator to good advantage.

3. The expert should be approached in a totally objective manner. He is not an advocate, and should not be influenced toward any opinion that does not grow out of his own objective investigation. An expert on the witness stand quickly loses the trust of the court if he appears in any way to be advocating a cause, rather than merely to be establishing facts on which the court can reach its own conclusions. Emotional or biased involvement on the part of the expert with either side of a case inevitably lowers his value.

4. The consultative service of an expert should be freely sought and used in a broader manner than is customary. In some instances the expert's advice may even extend into the strictly legal aspects of the case for the reason that he may have been involved in many more matters of the type in question than has the attorney, and, if experienced, may know the legal approaches very well. This advice may very reasonably and profitably be extended to the matter of questioning in court. Many times, an attorney is so concerned with a particular

5. Special aspects of some of these problems may be explored in Louisell, *The Psychologist in Today's Legal World*, 39 Minn. L. Rev. 235 (1955); Diamond, *The Fallacy of the Impartial Expert*, Archives of Crim. Psychodynamics, Spring, 1959, p. 221.

angle of a case, that he tries to push the expert into an unproductive area, while overlooking other more useful approaches. In addition, the expert will have his own preferred manner of testifying. To disrupt his approach can have the effect of rendering his testimony ineffectual. At times, an attorney may not even know how to qualify a technical expert properly. It is not improper to ask the expert for his preferred method, and even to take from him a list of questions to ask, both for qualification and for direct examination. The opposing attorney, naturally, may be expected to utilize his expert for the purpose of providing useful lines of cross examination.

5. Guidance by the expert of preliminary or field investigation is often of the greatest value. It is a fact that most field investigators, especially in civil matters, are more conscious of people and their statements, than of the physical evidence and physical facts surrounding the event. Thus, it is common for the early part of an investigation to be concerned only with locating witnesses, taking statements and similar activities, while the physical evidence becomes lost, damaged or dissipated. Even when the physical evidence is appreciated and an effort is made to recover it, the methods used are not always satisfactory, and the evidence may be damaged, lost, or contaminated. In dealing with this need, the early use of the expert can be of the greatest assistance. Automobile accident investigation provides a simple illustration. Car owners are always anxious to have their automobiles repaired at the earliest possible time after the accident so that they may have uninterrupted transportation. Every such vehicle that is repaired before being thoroughly examined is essentially lost as evidence. Skid marks and other road markings are often highly critical to reconstructing an accident, but they are subject to erasure by traffic, and by road repair crews. Thus they should be examined at the earliest moment by the expert. Similar considerations hold for fire investigation. After a building that is partially destroyed has been cleared of the fire debris and residues, and perhaps partially or totally dismantled, it is no longer of much value to the investigator. The expert should see it very early, and usually one or more times during the clean-up process, during which low and deep burns may be uncovered.

One of the most futile ways to use the expert is to come to him a year or more after an accident, fire, or other event, with a few witness statements, perhaps a photograph or two, possibly some automobile repair bills, or similar inadequate information, and expect him to perform the miracle of reconstructing and interpreting the entire matter. Although this should never happen, unfortunately it is not uncommon.

6. Advisory participation of the expert in the courtroom is sometimes very useful, and occasionally necessary. It may well be that the attorney will lack the necessary background to understand completely all of the technical ramifications in a complex litigation. Having the necessary information at the proper time is so important that the expert may, to great advantage, be

made constantly available to the attorney, in or out of the courtroom. Errors or weakness of an opposing expert's testimony are more likely to be noted by the technically trained person than by the attorney, and the weight to be assigned to such matters may also be better evaluated. Such service is expensive, and may be effectively duplicated at times by making transcripts available to the expert at the end of the day. However it is accomplished, there are many instances in which such interim advice is priceless.

CIVIL V. CRIMINAL LITIGATION

Technical investigation and expert testimony has come to be associated more with criminal than with civil cases, excepting only those that arise directly out of a technical background, such as patent litigation. This emphasis on the criminal investigation stems directly from the maintenance of crime laboratories by numerous public agencies. It is unfortunate that technical investigation should be mentally associated only with crime in this way, because both the methods and the value of such an approach to the civil case are essentially identical. The laboratory method, added to the investigative skill that is essential for good criminal investigation is equally valuable for civil investigation. The same type of person can do both if he can do either. There are few laboratories available for high grade civil investigation as compared with those whose business it is to investigate crimes. With the development of understanding by lawyers and scientists alike of the potentialities and the needs, this situation may be expected to correct itself in time. Even now, some crime laboratories allow their personnel to engage in limited civil work, and there is a slow but significant expansion of private consulting laboratories into specialization in technical investigation for legal purposes.

It may be considered that the elucidation of demonstrable physical facts is advantageous to all parties concerned in court actions. Inevitably such facts will favor one side or the other, but until the facts are available, administration of justice can be seriously hampered, or totally impaired. Even the attorney whose hopes are not confirmed by establishment of the facts is in better position to reach a favorable settlement or cut his losses if he knows early that the facts are unfavorable. If his opposition develops these facts properly, the results are likely to be far more serious for the unprepared attorney. Considerations such as these have led some forward looking attorneys to utilize expert services even when they have reason to believe that they face an unfavorable factual situation.

THE FUTURE OF THE LAW-SCIENCE INTERRELATIONSHIP

It is evident that science can contribute greatly to the solution of legal problems in many directions, and that here lies a fertile field for closer cooperation and coordination. Physical evidence has always been the most reliable of all forms of evidence, but its full utilization has not been regularly achieved.

In this direction progress is inevitable, and should be more rapid than has been true in the past. However, to stop here would be a grave error, for the current rate of scientific accomplishment is so great that it must progressively touch many more areas of interest to the law. To predict future developments may be premature, even foolhardy, but as has always been true in science, the wildest predictions have tended to underestimate the eventual facts.

The outstanding unknown in the entire field of the law is why people commit crime, and what factors predispose to such commission. Theories abound to explain the phenomenon, and often the theories conflict because there is no adequate body of fact to back any of them. The assumption has long been that facts of the type necessary were limited to the social and behavioral sciences, and that only from these areas would solutions emerge. This idea is certainly subject to challenge, because natural science must eventually contribute much of the foundation on which behavioral science must rest.

We say that man is a product of his heredity and his environment. But heredity depends on the genes which are the subject of an advanced, progressive, natural science, genetics; and in the term, environment, we must include internal as well as external environment. The composition of the blood that nourishes the nerve cells is certainly of as great importance to behavior as poverty or mother love. Criminality may at times involve some degree of mental aberration or malfunction, in which proper assessment of values is not possible, and antisocial acts result. The mind resides in the nervous system, and mental reactions are conditioned by emotions that result from various interactions between the glands of internal secretion and the sympathetic nervous system. Thus, any disease or malfunction of the mind can be considered to mirror some dysfunction of these systems, just as a metabolic malfunction may result from some impairment of the liver, or a dystrophy from impairment of the muscle. The plain fact is that the mind is part of the body, and any malfunction of either will affect the other. Thus, biochemistry, physiology, and genetics have a far better chance of clarifying the predisposing causes and mechanisms of mental aberrations, than do any of the unaided social sciences.⁶

That the above statements are not mere speculation is indicated strongly by the fact that some forms of one of the more common mental disorders, schizophrenia, is already believed to be a metabolic disease, since its presence can be detected by abnormal proteins of the blood, along with other biochem-

6. The facts of biochemical individuality and its implications in the behavioral sciences has been most thoroughly elucidated by Roger J. Williams, who states, "biochemistry merits inclusion as one of the most important of the so-called 'behavioral sciences.' Because biochemical individuality points the way toward individuality in the broadest sense of the word, it has profound implications not only in medicine, psychiatry, and psychology but also in human relations, education, politics and even philosophy." *Cf.* *Encyclopedia of Biological Sciences* (1961); *Etiological Research in the Light of the Facts of Individuality*, 18 *Texas Reports on Biology and Medicine* 168 (1960); *Berkeley Conference on Personality Development in Childhood, The Biological Approach to the Study of Personality* (1960).

ical deviations from normal. The fact that similar physiological disturbances have not been found to be associated with other mental diseases is at least partially because insufficient search has been made by other than the superficial methods of psychiatry and behavioral psychology.

The significance to the law of this aspect of the application of science is not great at this time, because these areas are still somewhat nebulous and poorly defined. That this situation will persist is unbelievable. Science will inevitably locate mechanisms, causes and effects of mental aberrations as surely as it already has for many of the common diseases. When this occurs, the entire legal concept of such matters as responsibility, insanity, and corrections will require revision in the light of the new knowledge. This liaison between science and the law will be far more significant, deeper and stronger than the present interrelation based only on the assistance that science can provide in matters concerning physical evidence. It is important that both scientists and lawyers continue their efforts to understand each other and the fields they represent, because more and more scientists will inevitably find themselves in the courtroom, and the law will be thereby enriched.