B89 The Important Role of Classical Analytical Techniques in Modern Problem Solving Approaches in Non-Routine Cases

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The goal of this presentation is to stimulate thinking concerning the highly varied nature of physical evidence problems that arise with regularity in criminalistics and to draw attention to the dangers of overreliance on modern technology at the expense of thoughtful scientific approaches to these problems. Modern instruments are merely very useful tools. They do not replace the experienced scientist's brain.

Introduction: Technological developments over the last few decades have made an impressive array of powerful analytical tools available to the modern forensic science laboratory. The development and refinement of chemical instrumentation over the past sixty years has revolutionized analytical chemistry and molecular biology. Physical methods have largely replaced wet chemical ones. The changes are nothing short of astounding. This has not necessarily translated into better criminalistics case solutions across the board. It certainly has improved the ability to provide better answers to relatively straightforward questions, such as "did the bloodstain found in the suspect's car come from the homicide victim" and many similar associative evidence questions? Criminalistics is not limited to these questions. Such simple routine questions are often posed by scientifically naïve investigators or attorneys before the evidence reaches the laboratory. For many cases the laboratory-generated answers to these questions suffice to provide an adequate case solution. In other case situations evidence amenable to such easily developed routine questions may not exist or such questions may not be particularly relevant in the context of the case. One of the most challenging aspects of criminalistics is that the physical evidence problems that are presented by anything but the simplest cases do not define themselves. Modern forensic science laboratories have many sophisticated tools. However, before these powerful tools can be applied to the case solution, the analytical problem must be defined. A scientific assessment of the totality of the potential evidence is required before an approach to the analysis of the physical items in the case can be designed. This is the role of the criminalist.

Routine and Non-Routine Analyses: Narrow predefined questions can be answered readily with the routine application of modern instrumental techniques. For such problems, where throughput is important, they are unsurpassed. What is refered to as the microanalytical or microchemical approach is much more flexible and general. It may involve the use of many techniques including the most appropriate instrumental methods . It is an approach, not a method or technique. The experienced analyst's brain is the most critical part of the process. The quality of the analysis does not depend primarily on instrumental parameters. It depends most critically on the experience and quality of the scientist carrying them out. With this approach the first step is most often simply looking at the sample macroscopically and microscopically. Much is learned in this way. Much is lost otherwise. Consider the information that can never be retrieved where something as simple as merely dissolving a sample in preparation for testing by certain instrumental methods comprises the first step. Such seemingly innocuous "cut and extract" or "dilute and shoot" steps often result in the loss of information including contextual information, the degree of homogeneity or heterogeneity, and something about the number and nature of physical components. For some routine analyses, where a simple question is posed, the loss of information may be of little consequence. In criminalistics applications some of these simple first steps in sample characterization may be critical. Follow-on microchemical steps may provide even richer information.

A key adjective used to modify "analyses" in the above discussion is "routine." Indeed, for routine analyses the ascendancy of instrumental methods has been an unalloyed advance. The useful role of microchemical testing in high-throughput, a routine analysis is very limited. It is with challenging non-routine problems where microchemical methods and crystal tests demonstrate their value. They are indispensable tools in a more general microanalytical approach to sample characterization. Such a general approach is needed in physical evidence investigations. Here every case is different, and a "one-size-fits-all" or "cookie-cutter" approach is inappropriate. These are the kinds of challenges that regularly arise in trace evidence problems in criminalistics and for which the microchemical approach is so ideally suited. Nothing else comes close. The microanalytical approach makes the best use of all available methods, including instrumental ones. It is this approach that defines the problem in detail and informs and guides the selection of the most appropriate tools to be employed in its solution. Crystal tests are a key component of this powerful problem solving approach. Their ready availability is essential for its successful application.

The Microanalytical or Microchemical Approach: There is an unfortunate tendency among members of the public and even among some scientists to associate and perhaps even equate high tech instrumentation with science. This turns reality on its head. A minimally trained technician can often generate valid and useful data for predefined problems using modern instrumentation. This is not the case with crystal tests and microchemical approaches. In-depth knowledge of chemistry and the scientific method is necessary to exploit the microchemical approach. It takes an experienced scientist to define and redefine the problem as the analysis proceeds and to select the best tools. There is no better way to deal with complex trace evidence problems. However, this approach does require experienced scientists. Unfortunately, "penny wise and pound foolish" laboratory administrators might see this as a drawback.

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In Summary, at first glance it might seem that many instrumental methods would offer a speed advantage over microchemical testing. However, this is often only true for routine problems where many samples are being analyzed and the instrument set-up time can be averaged over a large number of samples, so that it is a small fraction of the "per sample" analysis time. For the non-routine or "one-off" problems occurring in criminalistics, microchemical methods often enjoy a substantial speed advantage. Typically, when the need is recognized during the course of a complex analysis, the analyst can complete the test (or succession of tests) without breaking stride by having to leave the microscopy bench. T he risk of sample loss and contamination may be reduced.

References

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2. De Forest, P.R., "Recapturing the Essence of Criminalistics", Founders Lecture, California Association of Criminalists, ***Science and Justice***, Vol. ***39***, July-September, 1999, pp. 196-208.

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