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GUEST EDITORIAL

The Guest Editorial for this issue of the Journal of Forensic Sciences was prepared by William Y. Doran, acting director of the FBI Laboratory, to commemorate the 50th Anniversary of the establishment of the FBI Laboratory.

——Editor, Journal of Forensic Sciences

The FBI Laboratory: Fifty Years

A microscope, some ultraviolet light equipment, a helixometer, and some surplus bookshelves—these marked the beginnings of the FBI Laboratory 50 years ago. After consultations with selected businessmen, manufacturers, and scientists, some additional basic scientific equipment was acquired and personnel were selected and trained. On 24 Nov. 1932, the FBI Laboratory was officially established. During its first month of service, 20 cases were handled by FBI Laboratory examiners and after a full year, a total of 963 examinations had been performed. In contrast, during fiscal year 1981, 910 810 examinations were performed on 174 124 specimens submitted for analysis. Approximately 33% of those examinations were performed for state and local law enforcement agencies.

The analytical facilities of the FBI Laboratory are located in the J. Edgar Hoover FBI Building in Washington, DC. In June 1981, the Forensic Science Research and Training Center at the FBI Academy in Quantico, VA, was officially dedicated. All of the FBI's forensic science training and research functions are coordinated from that facility. Our primary objective is to maintain a highly professional and competent team of forensic science experts with a broad range of capabilities to service the varied needs of the federal law enforcement community. With respect to state and local jurisdictions, the FBI Laboratory serves to complement the services provided by non-federal crime laboratories.

The Forensic Science Research and Training Center, FBI Academy, Quantico, VA

Growth in the crime laboratory community proliferated in the late 1960s and early 1970s as a result of funding provided by the "Omnibus Crime Control and Safe Streets Act of 1968." The resultant needs of newly developing crime laboratories were expressed by individual state and local crime laboratory directors, beginning in 1973, wherein they requested the FBI to take a more direct and active role in providing leadership in the area of research and training in the forensic sciences. Over the next few years, the needs of this crime laboratory community continued to grow, particularly in the area of specialized scientific courses and research that was unavailable elsewhere. As a result of these expressed needs, in January 1975, the FBI Laboratory began offering specialized scientific courses for state and local crime laboratory personnel at the FBI Academy, Quantico, VA. This was an effort to enhance the capacity of these laboratories in dealing with the ever-growing demands placed upon them. To a large degree the growth in the demand for these courses is attributed to the rapid rise in the rate of violent crime and the increased needs for quality scientific examinations of evidence associated with violent crime. Crime laboratory personnel across the country became increasingly aware that the need for forensic science research and train-

ing was rapidly outpacing the capacity and facilities available to provide these services. As a result, it became the collective dream of the nation's leaders in the forensic science field as expressed through The American Society of Crime Laboratory Directors (ASCLD) that a common laboratory building be erected to be used for forensic science research and training. The leaders of ASCLD recommended that this facility be located at the FBI Academy in Quantico and that the FBI assume a leadership role in its management. These efforts resulted in planned budgeting within the FBI for such a facility, and in January 1980, ground was broken for the construction of the Forensic Science Research and Training Center (FSRTC) at the FBI Academy.

On 16 June 1981, the FSRTC was formally dedicated. It presently houses a permanent instructional staff comprising a Forensic Science Training Unit and a group of scientists comprising the Research Unit. This facility is the only one of its kind in the United States. It is presently used by the FBI to provide expert forensic science instruction to state and local crime laboratory personnel. Research projects are conducted by members of the permanent staff in an effort to upgrade and expand the forensic science capabilities available to the law enforcement profession. Additionally, this facility provides the opportunity and means for bringing in researchers from academia and other areas of specialty to engage in research projects of interest to the forensic science community. The facility, a three-story separate building, encompasses approximately 2600 m^2 (28 000 ft^2) of working space for staff and students, with approximately 840 m^2 (9000 ft^2) of this space dedicated to research efforts.

A large multipurpose classroom is a vital part of this research and training complex. Seating as many as 250 students, this room accommodates special seminars and large groups. The facility also encompasses two smaller classrooms: a small multipurpose room and a microscopy training classroom. These classrooms contain the wide spectrum of scientific and audiovisual equipment necessary to make each student highly functional in forensic science training.

It is anticipated that the forensic science training and research opportunities provided by this facility with its staff of instructors and researchers will have a significant impact on the entire criminal justice system. It provides the necessary balance between the case examination mission of the FBI's operational laboratory and the research and training so vital to upgrading and expanding the forensic science capabilities available to the law enforcement profession. The new facility makes it possible for numerous specialized scientific courses to be taught and enables the training of as many as 60 students at a time. Training offered in this facility that is unavailable elsewhere includes several courses crucial to the investigation of crimes of violence, such as "Basic Serology," "Introduction to Hairs and Fibers," "Laboratory Examinations in Arson Matters," and "Biochemical Methods of Bloodstain Analysis." Other forensic science support courses such as "Collection and Preservation of Physical Evidence" and "Bombing Crime Scene" are offered to local investigators. With the new facility and present course schedule, the potential capacity for training will approach 1600 students per year.

The research program associated with this facility has these objectives:

- To develop new and reliable scientific methods that can be applied in forensic science.
- To study technical problems confronting forensic scientists and develop methods to overcome these problems.
- To evaluate current technology and ascertain its application to forensic science.

The results of research projects are made available to the crime laboratory community through publication in scientific journals and through presentations at scientific seminars and meetings. Research projects presently underway are "Detection of ABO Blood Group Substances in Hair," "Sex Determination of Forcibly Removed Hairs," and "Analysis of Explosives and Explosive Residue by Ion Chromatography." A research project to be initiated

in the near future is the "Individualization of Human Bloodstains Through Identification of Histocompatibility (HLA) Antigens."

New or improved techniques recently made available through research and development efforts are "New Techniques for Tagging Petroleum Products," "The Ficin Capillary Tube Method for the Lewis Typing of Red Blood Cells," and "A Method for Determining the Sex of an Individual from a Dried Bloodstain Using Radioimmunoassay of Steroids."

Today, the case-working functions of the FBI Laboratory are conducted within three major sections: Document, Scientific Analysis, and Special Projects.

The Document Section

Analyses performed in the Document Section include the comparison of handwriting, hand printing, mechanical printing, paper, inks, indented writing, charred paper, and shoe print and tire tread impressions as well as examinations involving gambling matters, polygraph techniques, decipherment of secret codes, and language translations. The Section maintains various reference files and standards files in order to facilitate its work. Such files include the National Fraudulent Check File, the Anonymous Letter File, the Bank Robbery Note File, and the National Stolen Art File. During 1981, more than 1129 bank robbery notes were searched in the computerized reference file resulting in 144 associations with other handwritten notes. In one instance a bank robbery note in a Detroit, MI holdup was associated with several notes used in Portland, OR, which resulted in the solution of 17 bank robberies committed along the West Coast.

Because of the growing number of stolen art works, the Document Section has developed a computerized central repository of information and photographs of stolen art objects. The file, which contains more than 4000 descriptive items of art objects reported stolen, is being used to assist FBI Field Offices in reporting and locating stolen art. With the completion of additional research, it is planned that this service will be extended to all levels of law enforcement.

In order to develop additional forensic science techniques in the field of document examination, research projects using computers are being conducted in such areas as image enhancement and the rapid retrieval of information contained in the Bank Robbery Note File and the National Stolen Art File. Current research is being conducted with the Electrostatic Detection Apparatus (ESDA) for locating indented writing on documents. This device has been successful in developing messages on pages several layers beneath the original writings. Much work has also been done in the area of a computerized method for classification of photocopiers. The Office Copier Standards File is based upon a system created by the Xerox Corporation and modified by the United States Secret Service Laboratory.

Over the next several years, a number of projects have been planned to include applied technology to the solution of document problems and will address fingerprint and line crossings, X-ray and thermal imaging, typewriter research, and digital imaging and analysis of texts.

The Scientific Analysis Section

The Scientific Analysis Section is subdivided into units whose functions correspond approximately to the various disciplines included under criminalistics. These are Chemistry/Toxicology, Firearms/Toolmarks, Serology, Explosives, Instrumental Analysis, Elemental Analysis, Mineralogy/Metallurgy, and Microscopic Analysis.

The Laboratory has made applications of high technology to the analysis of physical evidence a priority. In 1965 neutron activation analysis was put on line as a quantitative method for the analysis of many kinds of materials for their inorganic chemical composition.

In the early 1970s the first atomic absorption unit was added to our capability. This was followed in 1974 by the scanning electron microscope with an X-ray analyzer so that today the Laboratory has a unit dedicated to performing qualitative and quantitative inorganic chemical analyses using neutron activation, atomic absorption, X-ray-induced fluorescence, and scanning electron microscopy with electron-induced fluorescence.

Among the kinds of materials examined by these techniques for their inorganic constituents are metals, gunshot primer residue materials, ores, biological materials such as hairs, paints, and plastics. The results obtained by the applications of these methods of analysis frequently add information to that gathered by other examinations in the Laboratory and permit a more precise characterization of the examined materials.

In the past ten years there have been significant developments in new types of instrumentation and analysis methods. The Laboratory acquired or brought on-line such diverse equipment as fourier-transform infrared spectrophotometers (FT-IR), liquid chromatographs, and ion chromatographs.

This instrumentation resulted in new analytical techniques in the areas of paints, polymers, cosmetics, and explosives.

In the analysis of paints and polymers, for instance, the FT-IR and its enhanced sensitivity coupled with diamond or sapphire cell sample preparation techniques allowed significant qualitative data to be gleaned from specimens hitherto thought to be too minute for analysis.

In the area of explosives analysis there has been a transition from thin-layer chromatography (TLC) to liquid chromatography (LC) for a more rapid and sensitive separation and screening technique wherein detection limits have been lowered to approximately 1 ng for TNT, cyclotrimethylenetrinitramine (RDX), pentaerythritol tetranitrate (PETN), and others. Other LC methods have been developed to analyze undetonated explosives such as smokeless powder to determine manufacturer and product.

Another new instrument, the ion chromatograph, and its associated methodology have allowed solution of persistent problems involving the identification of undetonated dynamite, water gels, and slurry explosives. Currently programs are underway that entail the analysis of commercial explosives for the purposes of identifying manufacturer and products in situations where unknown explosives are recovered in undetonated devices and compared with suspect sources of explosives that have been developed.

The ion chromatograph has been incorporated into analytical techniques centered on classical X-ray diffraction used in post-blast residue analysis. The IC permits definitive qualitative and quantitation characterization of ions present in bombing debris. This in conjunction with simultaneous X-ray diffraction analysis hastens identification of unknown compounds with more positive association with potential sources.

Future emphasis will be directed toward explosive vapor detection of both undetonated explosives and by-products from explosion sites. The development in 1980 of a Computerized Bomb File has proven a considerable asset in the handling of bombing cases and thereby permits rapid searching of bomb components, constructions, techniques, targets, and affiliations for the objective of relating cases to a common group or individual.

Improvements in firearms identification since 1972 have been realized by the development of The General Rifling Characteristics (GRC) file of The Criminalistics Laboratory Information System (CLIS). CLIS was brought on-line through The National Crime Information Center in 1978 and has been used by state and local crime laboratories throughout the United States. The Laboratory expects to continue to improve the techniques used in gunshot residue detection, to expand the data base of the CLIS GRC file, and to develop new techniques for gunshot residue detection for future applications.

In addition to the application of standard microscopic and optical methods for comparisons of textile fibers, microspectrophotometric techniques are employed that provide visible absorption data for dyed fibers.

Techniques of enzyme and protein electrophoresis have proliferated in the last ten years.

The forensic serologist could characterize a bloodstain in the ABO and Rh systems in 1972; since then, techniques have been developed to provide grouping results in twelve additional systems.

Advances in the field of seminal stain analysis have provided more reliable procedures as well as new techniques, some of which the FBI is evaluating at this time. New techniques in current use have greatly increased our ability to characterize seminal material.

Determination of a bloodstain's sexual origin represents a major tool to the forensic serologist and is just beginning to come into use. The FBI Laboratory is now in the process of implementing the procedure on-line, based on measurement of hormone levels in the blood, on selected case work.

The Special Projects Section

The need for graphic assistance to the Bureau's mission was recognized near the beginning of World War II. Initially and for many years thereafter, technicians assigned to prepare illustrative charts in support of field investigations and administrative activities performed this function with conventional tools and drafting instruments of the period; however, in recent years technology has revolutionized the state of the art. Forensic illustration has been no exception and today the computer takes its place in this area of the FBI Laboratory along with a host of other innovative techniques that enhance the product.

Photoelectric typography controlled by computer is on board and capable of producing high-speed composition of charts and forms in less than one tenth the time required prior to its introduction. This capability permits the rapid preparation of visual aids to supplement the witness's verbal testimony in court.

Computer graphics and image processing have important ramifications for the FBI Laboratory. With the speed and accuracy of the computer combined with the imagination and talents of visual information specialists, there is virtually unlimited potential for development of investigative aids in the area of automated facial composites and mug file search and retrieval. The Special Projects Section (SPS) is currently exploring the nature and cost effectiveness of available technology for these purposes.

Use of advanced photogrammetry techniques permits the SPS to determine very accurate measurements of all objects in a photograph. These techniques also allow us to determine heights based upon shadows and to confirm the exact time of day a picture was taken. It has been instrumental in the reconstruction of crime scenes from photographs or video tapes and the location of suspects in crowd photographs.

The Next Fifty Years

With the advances in forensic sciences in the FBI Laboratory and throughout the nation's crime laboratory community within the narrow frame of the last 10 years, it is most difficult to predict our position 50 years from now. With the opening of the FSRTC, there is considerable optimism that the facility will provide the needed focal point within the profession on which to consolidate the efforts of many toward a common goal. In addition to the need to continuously redefine the state of the art, there is a need to expand the applications of current technology for the specialized needs of the criminalist as well as perform validation studies for current methods and develop interpretative data. There are plans for visiting scientist programs and student intern programs as economical, yet effective, means to provide opportunities for individual enrichment and professional development while the researcher is engaged in scientific projects determined to be timely and significant within the forensic science community. In furtherance of this, a seminar held in March of 1982 at the FBI Academy was attended by representative leaders from academia and the crime

laboratory community. The seminar was extremely successful in establishing a working dialogue and in identifying common needs and concerns as well as the hopes and expectations for the FSRTC.

At the Ninth Annual Symposium on Crime Laboratory Development held in September 1981, an International Conference on Criminalistics was convened. It was enthusiastically accepted by those in attendance that there should be an international collaborative effort in forensic science research to avoid duplication of efforts, to develop computer data-based information systems for criminalistics research, and to identify and mutually support the training needs of our scientific experts.

The FBI Laboratory and, indeed, the entire forensic science community have come a long way over the past 50 years. There has been a growing realization within the courts and among the citizenry that scientific crime detection is an essential tool in effective law enforcement performance. There have been improved communications between forensic science professionals throughout this nation and the world. There is cause for optimism that the coming years will be even richer than those past.

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