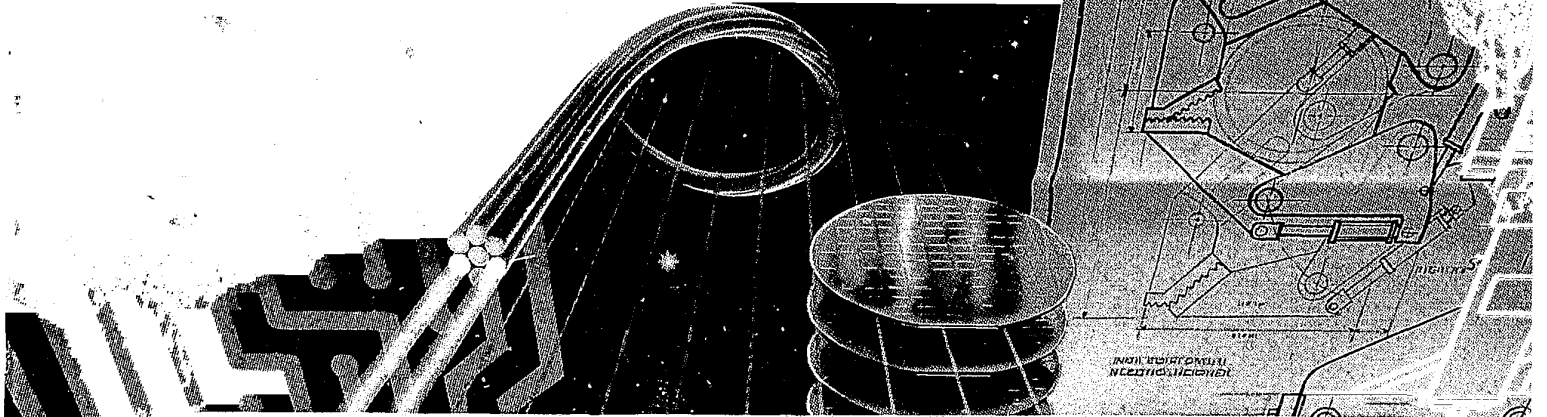


# FBI

# Law Enforcement Bulletin



130680-  
130686

U.S. Department of Justice  
National Institute of Justice

This document has been reproduced exactly as received from the person or organization originating it. Points of view or opinions stated in this document are those of the authors and do not necessarily represent the official position or policies of the National Institute of Justice.

Permission to reproduce this copyrighted material has been granted by  
FBI Law Enforcement Bulletin

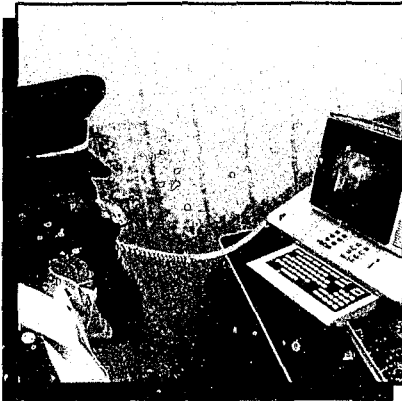
to the National Criminal Justice Reference Service (NCJRS).

Further reproduction outside of the NCJRS system requires permission of the copyright owner.

130680 -  
130686



### Features



Page 8

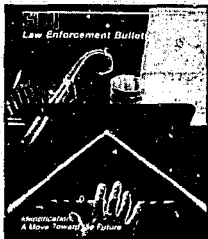


Page 11

- 1 Identification: A Move Toward the Future** 130680  
By Bruce J. Brotman and Rhonda K. Pavel
- 8 Visiophones** 130681  
By Pierre Marie Bourniquel
- 11 The FBI's Forensic DNA Analysis Program** 130682  
By Jay V. Miller
- 21 Medicaid Fraud** 130685  
By Larry L. Bailey
- 26 Judicial Acceptance of DNA Profiling** 130686  
By John T. Sylvester and John H. Stafford

### Departments

- 7 Book Review**
- 18 Point of View** 130684
- 16 Police Practices** 130683
- 24 The Bulletin Reports**



**The Cover:** The "technology explosion" witnessed in recent years will have a dramatic impact on law enforcement in the years to come.

United States Department of Justice  
Federal Bureau of Investigation  
Washington, DC 20535

William S. Sessions, Director

Contributors' opinions and statements should not be considered as an endorsement for any policy, program, or service by the FBI.

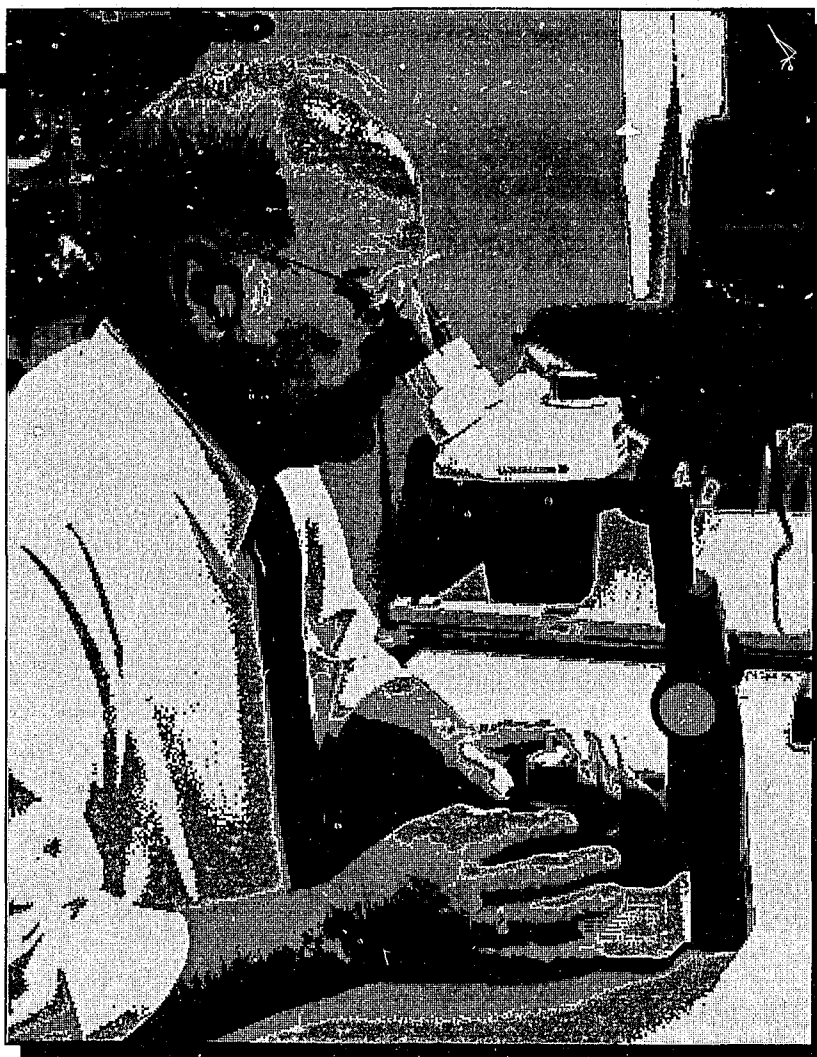
The Attorney General has determined that the publication of this periodical is necessary in the transaction of the public business required by law of the Department of Justice. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget.

**Editor**—Stephen D. Gladis, D.A.Ed.  
**Managing Editor**—Kathryn E. Sulewski  
**Art Director**—John E. Ott  
**Assistant Editors**—Alice S. Cole  
Karen F. McCarron  
**Production Manager**—Andrew DiRosa  
**Staff Assistant**—Carolyn F. Thompson

The *FBI Law Enforcement Bulletin* (ISSN-0014-5688) is published monthly by the Federal Bureau of Investigation, 10th and Pennsylvania Avenue, N.W., Washington, D.C. 20535. Second-Class postage paid at Washington, D.C., and additional mailing offices. Postmaster: Send address changes to *FBI Law Enforcement Bulletin*, Federal Bureau of Investigation, Washington, D.C. 20535

# The FBI's Forensic DNA Analysis Program

By  
JAY V. MILLER



**D**NA testing is one of the most significant breakthroughs in forensic science. Applying DNA technology to the identification of individual biological specimens gives crime laboratories and law enforcement a new tool for resolving violent crimes and sex offenses.

The FBI's DNA program covers four basic areas—DNA casework, technical assistance, the National DNA Index, and DNA research. This article updates the FBI's progress in these areas and highlights the need for uniform testing methods as DNA technology becomes more widespread.

## DNA CASEWORK

The FBI Laboratory, which began conducting forensic casework in 1988, is now the principal provider of forensic DNA testing services in the Nation. The Lab receives DNA cases from law enforcement agencies throughout the country, conducting more forensic DNA examinations than all other public and private forensic laboratories combined.

The demand for forensic DNA typing continues to grow as the technique gains judicial acceptance. Since 1988, DNA examiners from the FBI Laboratory have testified in over 120 trials and admissibility

hearings throughout the United States.<sup>1</sup> Of the approximately 2,000 DNA cases submitted annually to the FBI Laboratory's DNA Unit, about two-thirds are for rape investigations and the remaining one-third involve murder or other violent crimes. Most cases submitted to the Laboratory for DNA typing (or profiling) cannot be conclusively resolved using traditional forensic tests for blood or semen. However, the results of DNA typing can be used to associate biological evidence found at crime scenes with specific individuals, or to exclude suspects.

About 75 percent of the DNA cases examined by the FBI Labora-

tory yield sufficient interpretable information to determine conclusively whether the evidence can be associated with the subject in question or whether the subject can be excluded from consideration. Significantly, about one-third of the examinations performed by the FBI's DNA Unit have excluded the suspect identified by the submitting law enforcement

agency as the source of the biological evidence collected from the crime scene.

### **TRAINING, STANDARDS, AND TECHNICAL ASSISTANCE**

The FBI Laboratory conducts DNA training and research at the Forensic Science Research and Training Center (FSRTC) located at the FBI Academy in Quantico, Virginia. The FSRTC is the focus of the FBI's efforts to provide a full range of technical assistance to State and local crime labs working to implement DNA testing.

The FSRTC provides classroom and laboratory training in DNA analysis methods, works to develop national standards and guidelines for DNA testing, conducts technical seminars, and sponsors the Visiting Scientist Program. The FBI Laboratory has been working aggressively to educate State and local crime lab personnel on DNA analysis techniques and to promote a standardized approach for DNA testing.

#### **Training**

Since 1989, the FSRTC has conducted 10, 4-week DNA courses to train over 270 forensic scientists from State and local laboratories. In addition, the FSRTC has trained 29 forensic technicians from 12 foreign countries.

Following each DNA course, a few graduates remain for an additional 3 months as "visiting scientists" at the FSRTC. Visiting scientists work with the FBI's researchers to refine existing DNA analysis methods and to assist in the research and validation of new techniques. A

total of 29 forensic scientists from 26 law enforcement agencies have participated in this program.

In addition, a 1-week course on how to present expert testimony in court for DNA cases is currently being developed for State and local DNA examiners. And, the FSRTC frequently hosts conferences on technical and legal issues concerning DNA.

#### **Standards**

As a Federal agency, the FBI is in a unique position to provide leadership in developing national standards for forensic DNA testing. Still, the cooperation and assistance of law enforcement officials at State and local levels is necessary to create a national system.

Toward that end, the FBI Laboratory sponsors the Technical Working Group on DNA Analysis Methods (TWGDAM), which provides a forum for crime laboratories to discuss and exchange technical information on DNA testing. The TWGDAM committee was established as a cooperative effort to formulate standards and guidelines for forensic DNA laboratories.

TWGDAM is comprised of scientists from industry, forensic laboratories, and the academic community, who meet several times each year. In its effort to build consensus and to define guidelines for DNA laboratories, quality assurance guidelines for forensic DNA testing and guidelines for DNA proficiency testing were subsequently published by TWGDAM. Adherence to these guidelines is often considered by courts to be a major factor in determining the admissibility of DNA

“  
**DNA profiling may  
be the most  
significant  
breakthrough in  
forensic science  
since the  
development of  
fingerprinting.**  
”



*Mr. Miller is program manager for the National DNA Index at FBI Headquarters, Washington, DC.*

test results as forensic evidence. And, in April 1991, TWGDAM revised and expanded these guidelines, in anticipation of the next generation of DNA technology.

Currently, 13 State and local crime labs are performing forensic DNA analysis according to FBI protocol. Most of these laboratories are members of the TWGDAM committee. An additional 8 to 10 laboratories will begin performing DNA casework based on the FBI protocol by the end of 1991.

### Technical Assistance

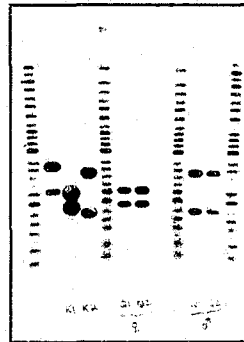
A survey conducted by the FBI Laboratory in 1990 measured the plans and attitudes of State and local crime laboratory directors regarding DNA testing. The survey found overwhelming support for the FBI's efforts in conducting research on DNA analysis methods, training State and local DNA examiners, and maintaining centralized files for a national DNA data base. In addition, the survey revealed support for the FBI Laboratory's efforts to develop and provide DNA-related software and automation tools to help State and local crime laboratories establish their own DNA testing capabilities.

The FBI Laboratory works closely with the law enforcement community to advise on policy issues affecting forensic DNA testing. The National Association of Attorneys General, the National District Attorneys Association, and the American Society of Crime Laboratory Directors (ASCLD) have issued resolutions supporting the concept and the need for national DNA testing standards. In addition,

ASCLD's Laboratory Accreditation Board adopted a resolution calling for the establishment of a Proficiency Testing Program for accredited laboratories.

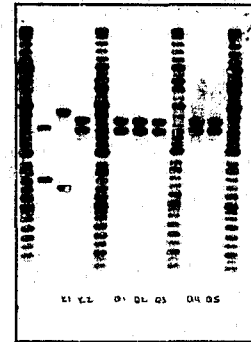
The FBI also advises State legislatures considering legislation

regarding DNA testing programs, admissibility of DNA evidence, and the establishment of State DNA data bases. And, the Laboratory frequently provides speakers to address conferences and seminars on forensic DNA testing.



### DNA Profiles

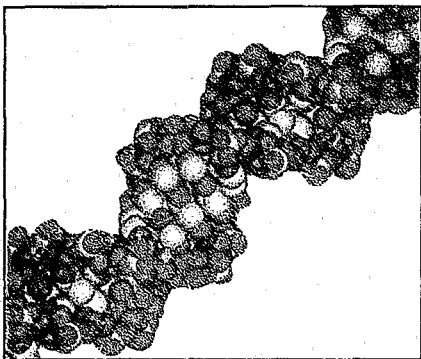
This picture is from a rape case. The forensic evidence is from vaginal swabs taken from the victim at the hospital where she was treated. Investigators wanted to know if the DNA from the sperm cells on the swabs matched the suspect's DNA. Known blood samples were then taken from the victim (K1) and suspect (K2). The lanes marked Q1 and Q2 (female) show the DNA banding pattern from the female portion of the vaginal swabbing. They match the victim's bands in K1. The lanes marked Q1 and Q2 (male) contain the male sample from the same swabs; they match the suspect's bands in K2, thus linking the suspect to the victim.



This picture shows the banding pattern for a DNA probing of evidence recovered in a murder investigation. Blood stains were found on the suspect's clothing, and investigators wanted to determine whether it came from the victim or the suspect. Blood samples were collected from both the victim and suspect for comparison to the blood found on the suspect's clothing. The lane marked K1 shows the suspect's bands from his known sample. The K2 lane shows the victim's bands from his known sample. These bands were then compared to the questioned samples (Q1-Q5) taken from the suspect's clothing. The pattern in K2 matches the patterns in the lanes Q1-Q5, thereby associating the suspect with the victim and the crime scene.

## NATIONAL DNA INDEX

The FBI is establishing a National DNA Index to enable crime laboratories to exchange DNA profiles for unknown subjects and convicted sex offenders. The index will assist agencies in developing investigative leads, since subjects can be searched against the file of convicted offenders. The index will also serve as a clearinghouse for DNA pro-



### What is DNA Analysis?

Genetic patterns found in blood or semen can be as distinctive as fingerprints. Traditional serology tests on body fluids often do not discriminate enough to either exclude or include a suspect from a crime. DNA analysis provides much more conclusive results.

The unique genetic patterns found in each person's DNA make it possible to associate a suspect with a crime, or to exclude a suspect, with a very high degree of accuracy. Except in the case of identical twins, every person's DNA, and resulting DNA pattern, is different.

files, directing the querying crime laboratory to the source laboratory when there is a "hit" in the index.

The FBI is developing computer software to automate the functions of forensic DNA laboratories and to link State and local laboratories to the national system.<sup>2</sup> The software will be provided free to crime laboratories participating in the National DNA Index.

The system is being designed to ensure privacy and security. Rather than store criminal history information, the index will store only DNA profiles. When a match is made, the two crime laboratories involved (the one conducting the query and the one that originally submitted the matching profile) can then exchange detailed technical information to verify the match and to coordinate information flow between the respective investigating agencies. However, in order to guarantee an effective system and to ensure that results are comparable, all crime laboratories must use substantially the same methods for DNA testing.

The FBI is working with 10 pilot DNA laboratories (in the 7 cooperating States) to gauge the feasibility and operational requirements of the National DNA Index system. Testing the basic means for exchanging DNA profiles among laboratories will soon be complete, and a full test of the National DNA Index in the pilot laboratories should occur in 1992.

The FBI will safeguard DNA profiles stored in the national system in three major ways.

1) The system will be designed and tested to protect against unauthorized access.

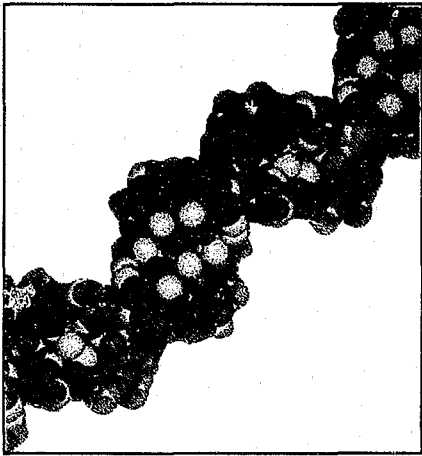
Only crime laboratories that are part of duly constituted law enforcement agencies will have authorized access to the national system.

2) Personal identifying information stored in the national data base will be minimized, thus affording greater protection against unauthorized access that could yield the DNA profile for a particular individual. Only the numerical form of the DNA profile will be stored in the national index.

3) The FBI Laboratory is working with the National Crime Information Center (NCIC) to incorporate proven security concepts and procedures from the NCIC system into the design and implementation of National DNA Index.

### DNA RESEARCH

The FSRTC continually works to develop new forensic DNA technology. The Laboratory recently began research to develop the next generation of forensic DNA analysis methods. This new generation will be based on the polymerase chain reaction (PCR), a technique that multiplies the quantity of DNA material obtained from crime scenes to a level sufficient for forensic analysis. DNA tests based on PCR will allow analysis of much smaller specimens than is currently possible and will also provide crime laboratories with a more rapid way of identifying biological evidence from violent crimes.



## How DNA is Tested

First, the DNA is extracted from the blood or semen sample taken from the forensic specimen. Only a small amount of material containing DNA is needed to perform the test. Other types of body tissue, such as skin, bone, muscle, and hair roots, also contain DNA, but blood and semen are the richest sources.

Then, enzymes, which are a type of protein, are used to cut the DNA into fragments. These fragments are separated, according to size, by a process called electrophoresis. The DNA fragments are placed in one end of a slab of gelatin, which is then charged with

electricity. The DNA fragments migrate through the gel, with the shorter fragments moving faster than the longer fragments. When the electricity is removed, the fragments are left sorted by length in the gelatin. DNA from the victim, suspect, and crime scene evidence are run through the gel in parallel lanes.

The DNA fragments are then transferred from the gel to a nylon membrane to fix their positions permanently. The membrane is "bathed" in a series of probes to locate DNA fragments containing known complementary sequences within the DNA molecule. Each probe contains a radioactive tag and matches a target area of the DNA molecule.

The target areas of the DNA molecule used by the FBI do not contain any genetic information of known purpose. The FBI Laboratory selected target areas that do not relate to any known inherited trait or characteristic, such as eye or hair color, or tendency for any known health condition. These target areas were selected because they vary widely within the human population and are ideally suited for identifying or associating biological samples.

To make the target DNA fragments visible, the membrane is placed against X-ray film and radiation from each probe registers the location of the fragment on the film. Because low-level radiation is used, this step takes approximately 1 week for each probe. Two bands are usually highlighted by each probe—corresponding to one band from each parent.

Typically, a membrane is probed four times to confirm the association or exclusion between the evidence and the suspect's sample.

After the X-ray film is developed, the patterns of bands are compared and analyzed using computer software. If the patterns are the same, it is very likely that some of the cells containing DNA in the evidence sample came from the individual in question. Though a visual match can be seen, a computer is used to calculate the lengths of the DNA fragments, and the estimated fragment lengths are stored in a local data base. Only the numerical values of the fragments are stored in the DNA data base, not the image of the X-ray film or any other genetic information that may be contained in the DNA sample.

## CONCLUSION

DNA profiling may be the most significant breakthrough in forensic science since the development of fingerprinting. The FBI is working closely with State and local crime laboratories to enhance DNA profiling techniques and to establish a National DNA Index. To ensure an

effective and secure system, the FBI Laboratory is fostering a uniform approach to DNA testing and profiling. This will eventually allow crime laboratories to exchange DNA profiles for known sex offenders and other violent criminals, providing a valuable new weapon for both investigators and prosecutors. **LEB**

### Footnotes

<sup>1</sup> As with all types of forensic examinations provided by the FBI Laboratory, DNA analysis is free to any duly constituted law enforcement agency. In addition, the requesting agencies do not incur any travel expenses for DNA examiners who must testify in court.

<sup>2</sup> Arizona, California, Colorado, Florida, Illinois, Iowa, Michigan, Minnesota, Nevada, South Dakota, Virginia, and Washington have passed laws requiring the establishment of DNA data bases for convicted sex offenders or violent criminals.