NIST's Role in Forensic Science

past, current, future

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Changes in Needs/Expectations in Forensic Science Sector

- Forensic science in the U.S. is continuing in a period of changing expectations and requirements. There is growing concern about the scientific foundation, measurement rigor, and statistical validity of many forensic analyses that is leading to renewed attention to how scientific data are presented in evidentiary settings as well as to expectations of forensic science laboratories.

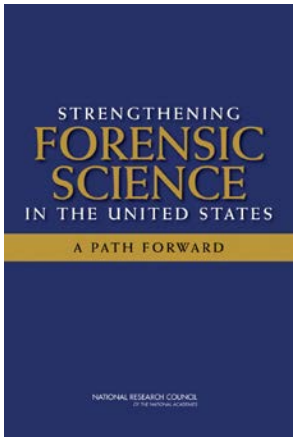
- In 1993, the Supreme Court ruled that **" trial judges must ensure that any and all scientific testimony or evidence admitted is not only relevant but reliable".** The Court emphasized that the admissibility of evidence be based on the experts "principles and methodology" and "not on the conclusions that they generate."

U.S. Supreme Court: DAUBERT v. MERRELL DOW PHARMACEUTICALS, INC., 509 U.S. 579 (1993) 509 U.S. 579; Argued March 30, 1993; Decided June 28, 1993; http://laws.findlaw.com/us/509/579.html

Helping Ensure the "Science" in Forensic Science

A landmark forensics report by U.S. National Research Council of the National Academies was issued in Feb. 2009.

"With the exception of nuclear DNA analysis, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source."



New Role for NIST:

- **National Commission on Forensic Science**
  - Was established via MoU on Feb. 8, 2013 between DOJ and NIST
    - to help improve the reliability of forensic science data/information and to develop policy recommendations for the U.S. Attorney General.
    - to be comprised of forensic science practitioners, academic researchers, prosecutors, defense attorneys, judges, and other relevant stakeholders

- **NIST will:**
  - Co-Chair the Commission
  - Administer Guidance Groups of subject-matter experts for specific forensic science disciplines
  - Validate select existing forensic science methods and guidance
  - Develop and critically evaluate new methods

Forensics at NIST

NIST has a long and rich history of work in support of law enforcement.

Currently providing research and measurement services such as validated test methods, Standard Reference Materials, and Reference Data in areas such as:

- crime scene investigations
- computer forensics
- fire investigations
- drug detection
- drunk driving testing
- biometrics (fingerprints and handwriting analysis)
- firearms/ballistics
- standards for body armor, nonlethal weapons
- explosives detection technologies
- sports integrity/fairness
- genetics and DNA-based identification

that support the Departments of Defense, Justice, and Homeland Security in carrying out their programs.

Forensics at NIST

NIST's involvement in Forensic Science began in 1930's

1934

NBS's William Souder

"one of the nation's best and least known criminologists."

Washington Post 1954

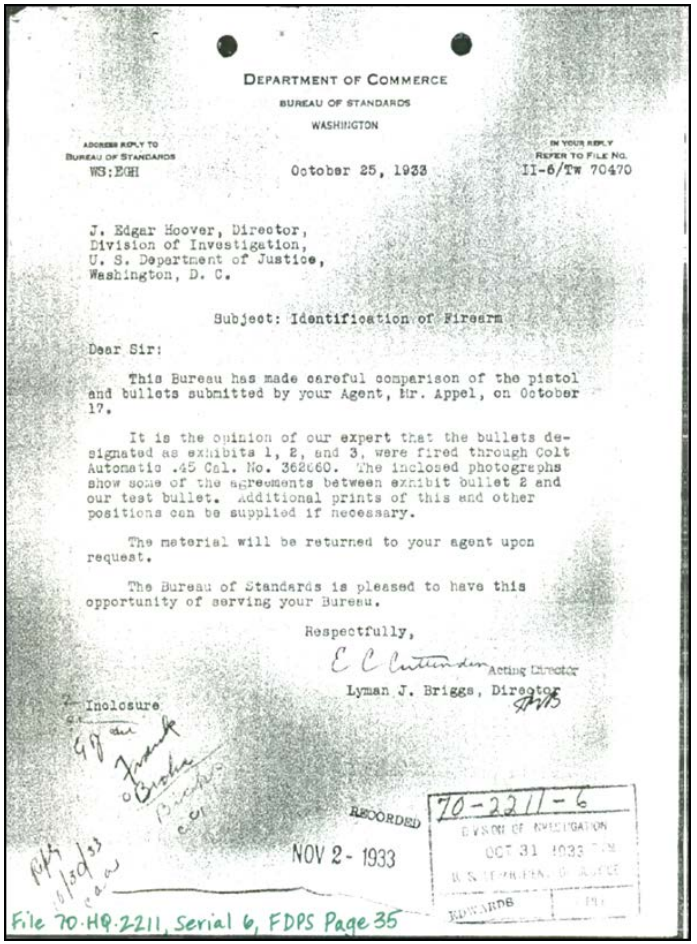
History of Forensics at NIST

The nation's first crime lab:

From 1932, National Bureau of Standards expertise in firearms and document identification helped solve hundreds of crimes.

Souder helped the Division of Investigation (now the FBI) establish its crime lab in 1932.

In 1935, Souder's testimony on handwriting samples was key to convicting Richard Hauptmann in the kidnapping and murder of Charles Lindbergh's son.



DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

ADDRESS REPLY TO BUREAU OF STANDARDS
WS:EGH

October 25, 1933

IN YOUR REPLY REFER TO FILE NO.
II-6/Tw 70470

J. Edgar Hoover, Director,
Division of Investigation,
U. S. Department of Justice,
Washington, D. C.

Subject: Identification of Firearm

Dear Sir:

This Bureau has made careful comparison of the pistol and bullets submitted by your Agent, Mr. Appel, on October 17.

It is the opinion of our expert that the bullets designated as exhibits 1, 2, and 3, were fired through Colt Automatic .45 Cal. No. 362660. The inclosed photographs show some of the agreements between exhibit bullet 2 and our test bullet. Additional prints of this and other positions can be supplied if necessary.

The material will be returned to your agent upon request.

The Bureau of Standards is pleased to have this opportunity of serving your Bureau.

Respectfully,

E C Crittenden Acting Director
Lyman J. Briggs, Director

Inclosure

RECORDED
NOV 2 - 1933

70-2211-6
DIVISION OF INVESTIGATION
OCT 31 1933
U.S. DEPARTMENT OF JUSTICE

File 70-HQ-2211, Serial 6, FDPS Page 35

In 1933 Letter from NBS Director Lyman J. Briggs to DoJ Division of Investigation, NBS Director J. Edgar Hoover Reports on ballistics analysis, confirms that evidential bullets match a specific Colt .45 revolver.

History of Forensics at NIST

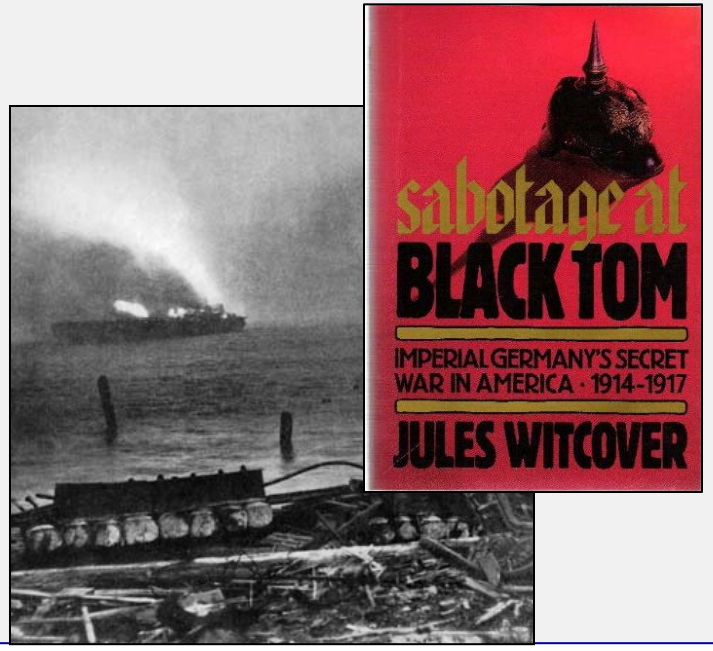
Early 1930s:

Souder was participating in 50 to 75 federal investigations/year involving:

- extortion
- kidnapping
- theft of money orders
- raised checks
- forgeries
- stolen securities
- threatening letters

As one example:

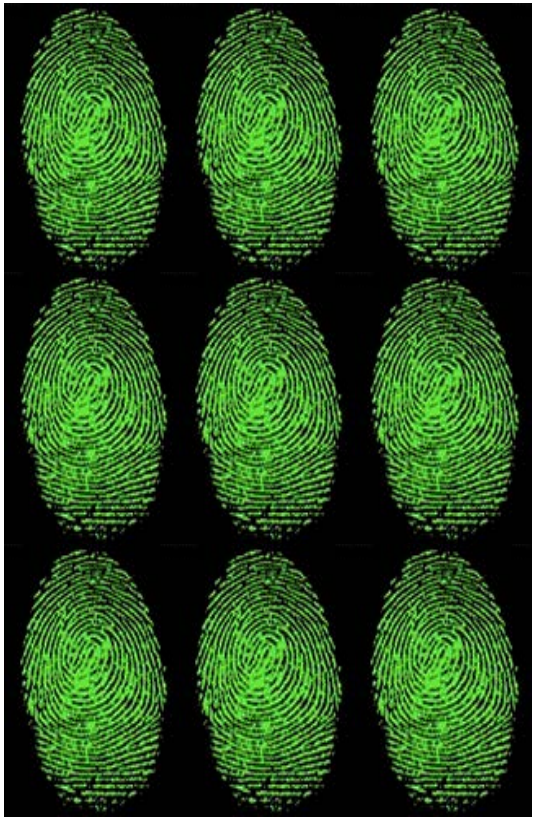
- German agents caused an American munitions shipment bound for Europe to explode in New York harbor in July 1916.
- In the early 1930s, Souder analyzed a handwritten letter from one of the agents, a critical piece of evidence in the case that eventually forced Germany to pay the United States for damages.



History of Forensics at NIST

Late 1960s:

The FBI turned to NBS for scientific and technical support for its first computerized scanning equipment to read and record fingerprint characteristics.



History of Forensics at NIST

1971: The National Bureau of Standards established a Law Enforcement Standards Laboratory to provide coordinated efforts to support and advance standards and technology used by law enforcement officers and agencies.

This evolved into the current NIST Office of Law Enforcement Standards (OLES) whose mission is

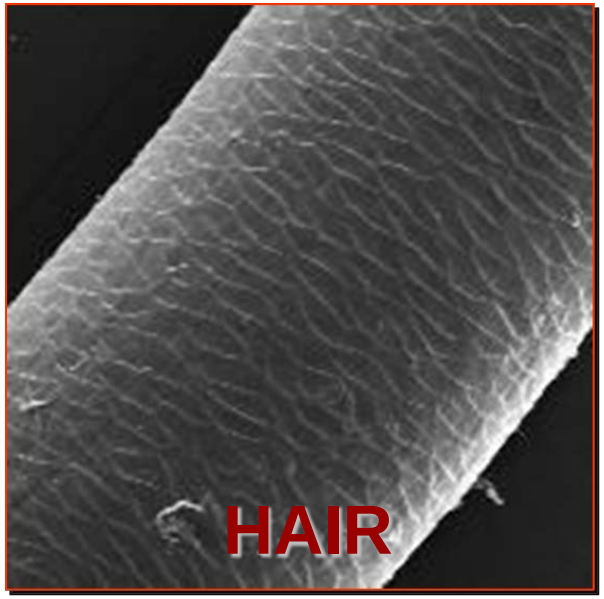
"to help criminal justice, public safety, emergency responder, and homeland security agencies make informed procurement, deployment, training and operating decisions by developing performance standards, measurement tools, operating procedures and equipment guidelines".

History of Forensics at NIST

Continuing in the 1980's:

- NBS publishes the *Fire Investigation Handbook* as "a reference tool designed to be used by the beginning or the experienced fire investigator.

- The National Bureau of Standards participates on the International Committee on Forensic Hair Comparisons to advance forensic hair comparison as a science.



Forensic Standard Reference Materials

- Arson
  - SRM 2285 - calibration of chromatographic instrumentation used for the classification of an ignitable liquid residue
- Alcohol in Blood
  - SRM 1828b – Ethanol in Water
- Bullet/Firearms
  - SRM 2460 – Standard Bullet
  - SRM 2461 – Standard Cartridge Case
- Drugs of Abuse:
  - SRM 1507b – THC in Urine
  - SRM 1508a - Cocaine Metabolite in Urine
  - SRM 1959 – Drugs of Abuse in Serum
  - SRM 2379, 2380 – Drugs of Abuse in Human Hair
  - SRM 2381 – Morphine and Codeine in Urine

- DNA:
  - SRM 2391c – PCR-based DNA Profiling Standard
  - SRM 2392-1 – Mitochondrial DNA Sequencing
  - SRM 2395 – Human Y-Chromosome DNA Profiling Standard
- Explosive Simulants
  - SRM 2905, 2906, 2907 – Explosives
  - RM 8107 – Additives in smokeless powder
- Microscopy Standards for Trace Evidence
  - SRM 1961, 1963a, 1965 – Particle Size Standards
- Laboratory Instrument Calibration:
  - SRM 1543 – Gas Chromatography/Mass Spec Performance Standard
  - SRM 935a – Ultraviolet absorbance Standard
  - SRM 1921b – IR Transmission Wavelength

NIST Forensics-related Databases

- Biotechnology
  - Special DB 130 Short Tandem Repeat **DNA** Internet Database
- Chemistry
  - SRD 1a NIST/EPA/NIH **Mass Spectral Library: with Search Software** NIST '11
  - SRD 115 **Hydrocarbon Spectral Database**
- Fire Investigation
  - **Fire Modeling** Programs
  - NIST FASTData **Fire Test Database**
- Computer
  - Special DB 28 NIST **National Software Reference Library**
  - **Computer Forensics Tool Testing** (CFTT) Project Web Site
- Biometrics
  - Special DB 4 - 8-Bit Gray Scale Images of **Fingerprint** Image Groups
  - Special DB 9, 14 - Mated **Fingerprint** Card Pairs
  - Special DB 10 - Supplemental **Fingerprint** Card Data
  - Special DB 27 - **Fingerprint** Minutiae from Latent Matching Tenprint Images
  - **Facial Recognition** Technology Database (FERET)
  - Special DB 29, 30 - Images from Paired **Fingerprint Cards**
  - Special DB 18 NIST **Mugshot** Identification Database

Current NIST Research Activities in Support of Forensic Science

Forensic DNA

Funds	Project	Proj.Period
NIST/FBI	DNA extraction efficiency evaluation from various swabs	Continuing
NIST/FBI	U.S. population data with Insertion/Deletion (InDel) markers	Continuing
NIST/FBI	Evaluation of Abbott's Plex-ID system for mtDNA base composition	Continuing
NIST/FBI	Evaluation of rapid DNA testing instruments	Continuing
NIJ/OLES	DNA stability on treated and untreated paper with room temperature storage	Continuing
NIJ/OLES	DNA extraction method improvement (collaboration with David Ross at NIST)	Continuing
NIJ/OLES	Quantitative PCR and digital PCR method evaluation for DNA quantitation	Continuing
NIJ/OLES	Concordance studies on commercial STR kits (with Promega, Life Technologies, & Qiagen)	Continuing
NIJ/OLES	Characterizing new autosomal and Y-chromosome STR loci	Continuing
NIJ/OLES	U.S. population data on 23 Y-STR loci (PowerPlex Y23)	Continuing
NIJ/OLES	U.S. population data on rapidly mutating (RM) Y-STR loci (part of international collaboration)	Continuing
NIJ/OLES	U.S. population data on 29 autosomal STR loci (all commercial STR kit loci)	Continuing
NIJ/OLES	STR allele sequencing for variant characterization	Continuing
NIJ/OLES	Evaluation of probabilistic genotyping TrueAllele software for DNA mixture interpretation	Continuing
NIJ/OLES	Validation studies on ABI 3500 Genetic Analyzer	Continuing
NIJ/OLES	Data analysis for FBI-coordinated Consortium Validation Project with new STR kits	Continuing

Current NIST Research Activities in Support of Forensic Science (cont'd)

Forensic Biometrics

NIST	Face Recognition Research and Testing	Continuing
NIST	Speaker Recognition and Voice Biometrics	Continuing
NIST	ANSI/NIST-ITL Standard for the Interchange of Biometric Data	Continuing
NIST	Conformance Testing for Biometric Data Interchange Formats	Continuing

Microbial Forensics/Detection

DHS, OoS	Metrics for Microbial Material Characterization to Support Biological Agent Detection and Test and Evaluation	8/2012-9/2013

Toxicology

NIST	Urine, Blood and Breath Chemical Analysis Measurements & Standards Research(ethanol, drugs, etc.)	Continuing

Controlled Substances

NIST	Controlled Substance Measurement & Standards Research	Continuing

Nuclear Forensics

DHS/DNDO/NTNFC	Radiological Reference Material Development Support	04/2012-03/2013
DHS/DNDO/NTNFC	Expertise Development Post-Doctoral Fellowship	04/2012-03/2013
DHS/DNDO/NTNFC	Radiological Reference Material Development Support	04/2013-03/2014
DHS/DNDO/NTNFC	Isotopic and Assay Characterization of Ba-134 IDMS Tracer	04/2013-03/2014
FBI	National Technical Nuclear Forensics Standard Reference Materials	09/2011-08/2013
NIST Forensics Challenge	Nuclear Forensic Reference Materials (RM) for Attribution of Urban Nuclear Terrorism	04/2012-10/2012

Current NIST Research Activities in Support of Forensic Science (cont'd)

Forensic Biometrics		
NIST	Face Recognition Research and Testing	Continuing
Crime Scene		
NIST	Sensor Research; trace gas, scent, smell, canine, etc.	Continuing
NIST	Sampling for Trace Biological and Other Particulate	Continuing
Digital Evidence		
NIST/OLES/OAs	Computer Forensics Tool Testing (CFTT)	Continuing
NIST/OLES/OAs	National Software Reference Library (NSRL)	Continuing
NIST/OLES/OAs	Computer Forensics Reference Data Set (CFReDS)	Continuing
Digital Forensics		
NIST	Cloud Forensics	Continuing
NIST	Rapid DNA Analysis Research and Development	Continuing
NIST	Microbial DNA Analysis Research and Development	Continuing
Engineering Forensics		
NIST	Materials fatigue and failure analysis	Continuing
Environmental Forensics		
NIST	Measurement & Standards Research for contaminants in the environment	Continuing
Explosives		
NIST	Explosive Measurements & Standards Research	Continuing

Current NIST Research Activities in Support of Forensic Science (cont'd)

Impression Evidence

NIJ/OLES	NIST National Ballistics Imaging Comparison Proj (using SRM 2460/2461)	2008-2013
NIJ/OLES	Toolmark Indentification Proficiency Test Using Electroform Replicas	2008-2013
NIJ/OLES	The National Ballistics Imaging Comparison (NBIC) Project Utilizing SRM 2460/2461	2010-2015
NIJ/OLES	Technological Refreshment and Production of NIST SRM 2460 Standard Bullets	2010-2015
NIJ/OLES	Toolmark Identification Interlaboratory Study: Electroform Replicas	2010-2015
NIJ/OLES/PSU	Working Group on Presenting Forensic Science Evidence Using Quantitative and Qualitative Terms (QQWG)	November 2012 – April 2014
NIJ/OLES Cognitive Consultants Intl	Web-based Testing and Measurement of Cognitive Suitability for Conducting Latent Print Examination	6/2011- 5/2015
OLES/Cadre Research Labs	Three-dimensional Topography System for Firearm Identification using GelSight	9/2012 -8/2013

Trace Evidence

NIST	Particle Population Chemical Composition and Morphology Analysis	Continuing
NIST	Improved Methods for Soil/Mineral, Man-Made Materials, Fiber, Particle, Dust and other Analysis	Continuing
NIST	Gunshot residue analysis research	Continuing
NIST	Nuclear and radioisotope detection and analysis	Continuing

Current NIST Research Activities in Support of Forensic Science (cont'd)

General Forensics

NIST	Developing Hyperspectral Imaging Methods with visible, x-ray, EELS, Raman, IR, Mass Spec., etc.	Continuing
NIST	Microscopy and Microanalytical Spectroscopy and Imaging	Continuing
NIST	Spectroscopy: Mass, X-ray, IR, UV-Vis, Raman, Electron Energy Loss	Continuing
NIST	Databases: Including Mass Spec; IR; Auger; XPS; Physical and Chemical Properties; Phase Diagram; Diffraction	Continuing
NIST	Crystallographic, Morphologic, Molecular, Elemental, and Isotopic Composition Methods	Continuing
NIST	Measurement & Standards Research for chemical, biological, radiological, nuclear, explosive weapons	Continuing
NIST	Reference Materials for Forensic Analysis	Continuing
NIJ/OLES/ Clemson Univ	Managing Shiftwork and Fatigue in Law Enforcement and Forensic Laboratories	9/2011 - 12/1/2012

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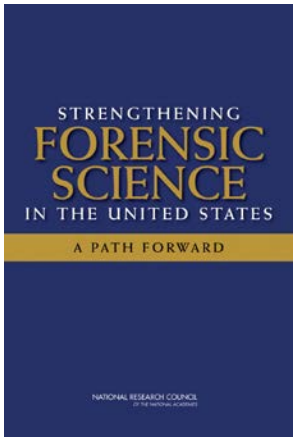

NIST and the Netherlands Forensic Institute (NFI) sign an MOU on Nov. 29, 2012

They agreed to collaborate through activities focused on the following areas:

- Research and development
- Development of forensic standards
- Education and training
- Forensic governance (measures to ensure the ethical, transparent and accountable practice of forensic science)

Tjark Tjin-A-Tsoi, NFI CEO, and Willie E. May, NIST ADLP, sign an agreement at the NIST Forensics@NIST 2012 symposium on Nov. 29, 2012 for the two organizations to collaborate for the advancement of forensic science.

Two presentations and tours of selected labs will provide further details as to NIST's current and anticipated role in Forensic Science

- **Memorandum of Understanding on Forensic Science between NIST and the Department of Justice**
  Mark Stolorow, Director, Law Enforcement Standards Office (OLES)

- **Forensic Science and the NIST Laboratory Programs**
  Richard Cavanagh, Director, Office of Special Programs

- **Forensic Science Lab Tours**
  Led by: Mark Stolorow, Director, OLES
  - **Fire Dynamics**: *Dan Madrzykowski, EL*
  - **The NIST Trace Contraband Detection Program**: *Greg Gillen, MML*
  - **Physical Standards and Scientific Methods for Ballistics Identification**: *Richard Silver, PML*