NIST Technical Colloquium on **Quantifying the Weight of Forensic Evidence**
May 5, 2016
Gaithersburg, MD

Image from Professor Colin Aitken

http://www.ed.ac.uk/polopoly_fs/1.165056!/fileManager/statistical-crime-fighters-2.jpg

Perspectives and Challenges from NIST Involvement in Forensic Science

John M. Butler, Ph.D.

NIST Fellow & Special Assistant to the Director
for Forensic Science

Topics to Cover

- NIST involvement in forensic science
- Early forensic history of NBS/NIST
- Challenges faced & some urban legends
- DNA challenges
- Thoughts on potential improvements
- Lessons from history

Standard NIST Disclaimer

Points of view are mine and do not necessarily represent the official position or policies of the US Department of Justice or the National Institute of Standards and Technology.

Certain commercial equipment, instruments and materials are identified in order to specify experimental procedures as completely as possible. In no case does such identification imply a recommendation or endorsement by the National Institute of Standards and Technology nor does it imply that any of the materials, instruments or equipment identified are necessarily the best available for the purpose.

Acknowledgments and Disclaimers

My Background → influences my perspective

- I developed an early interest in forensic science and research before the CSI TV shows!
  - Largely from enjoyment of puzzle solving (e.g., Rubik's cube) and reading Sherlock Holmes; took four years of biology in high school
- Did my PhD research (UVA analytical chemistry degree) at the FBI Laboratory's Forensic Science Research Unit (1993-1995)
  - Pioneered modern forensic DNA testing with short tandem repeat (STR) markers and capillary electrophoresis (CE)
- Came to NIST as an NRC postdoc in 1995, left to work in a Silicon Valley biotech startup in 1997, and returned to NIST in 1999 to lead the forensic DNA team (now the Applied Genetics Group)
  - Developed the STRBase website and have written five textbooks on forensic DNA typing and >150 articles (primarily on methodology issues); **interpretation of evidence has became a recent passion (2010 to present) largely from what I learned in writing my last two books**
- In April 2013, I left the NIST lab and moved to the Special Program Office to help with the overall NIST efforts in forensic science
  - **My interests now range well beyond just DNA…**

NIST Involvement in Forensic Science

Why?

Why is NIST involved in forensic science?

- **Our assistance and <u>technical expertise was requested</u> by DOJ and others**
  - Establishment of FBI Laboratory (early 1930s)
  - Automated fingerprint detection (1960s to present)
  - Law Enforcement Standards Laboratory (established in 1971)
  - **"Starch Wars" (1977 to 1978)**
  - Input on TWGDAM/SWGDAM (1988 to present)
  - DNA reference materials (early 1990s to present)
  - **FBI's DNA Advisory Board (1995 to 2000)**
  - Digital forensics (late 1990s to present)
  - National Institute of Justice (NIJ) funding (1970s to present)
  - White House Subcommittee on Forensic Science (2009-2012)
  - MOU leading to NCFS and OSAC (2013-present)

The "Starch Wars" Led to NBS/NIST Involvement in Forensic DNA Efforts

Forensic Science Review
(Jan 2006) 18(1): 59-72

The "Starch Wars" and the Early History of DNA Profiling

J. D. Aronson
Department of History
Carnegie Mellon University
Pittsburgh, Pennsylvania
United States of America

- **Dennis Reeder (NBS protein gel scientist) asked to investigate**
  - 10 years later asked by FBI to be part of TWGDAM (then 17 years later part of DNA Advisory Board)
  - DNA reference material work started
- Dennis meets John M. Butler at a TWGDAM meeting at the FBI Academy and hires JMB (twice)

Abstract

Just as the movie Star Wars had a prequel, so did the "DNA Wars"-the series of legal, scientific, and personal battles th[...] [...]he n[...] p[...] e[...] adequately appreciated in the recent history of forensic science. After reviewing the early history of blood typing, I will describe **the development of the Multi-System approach to blood protein analysis that took place in California from 1977 to 1978**. I will then elucidate the history of the Starch Wars, and demonstrate the ways that they shaped subsequent disputes over DNA evidence, especially in California. I will show that: (a) **many of the forensic scientists, law enforcement officials, and lawyers who became prominent players in the DNA Wars were deeply involved in the court cases involving protein electrophoresis**; and (b) many of the issues that became controversial in the disputes over DNA evidence first emerged in the Starch Wars. In the conclusion, I will suggest various ways to improve the quality of forensic science based on my analysis of the Starch Wars.

Mark Stolorow, who came to NIST in 2008 from industry and now leads the NIST OSAC Affairs Office, was one of the developers of the Multi-System almost 40 years ago and involved in those early court battles…

DNA Identification Act (1994)

Public Law 103-322

42 § 14131. Quality assurance and proficiency testing standards

(a)   Publication of quality assurance and proficiency testing standards

(1) (A) Not later than 180 days after September 13, 1994, the Director of the Federal Bureau of Investigation shall appoint an advisory board on DNA quality assurance methods from among nominations proposed by the head of the National Academy of Sciences and professional societies of crime laboratory officials.

(B) The advisory board shall include as members scientists from State, local, and private forensic laboratories, molecular geneticists and population geneticists not affiliated with a forensic laboratory, and **a representative from the National Institute of Standards and Technology.**
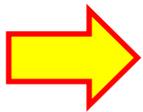
(C) **The advisory board shall develop, and if appropriate, periodically revise, recommended standards for quality assurance**, including standards for testing the proficiency of forensic laboratories, and forensic analysts, in conducting analyses of DNA.

DNA Advisory Board (DAB)

DNA Advisory Board (DAB) Members

- **Joshua Lederberg** (Rockefeller University) – chair 1995-1998
- **Arthur Eisenberg** (University of North Texas Health Science Center) – chair 1998-2000
- **John Hicks** (Alabama Department of Forensic Sciences)
- **Shirley Abrahamson** (Wisconsin State Supreme Court)
- **Ranajit Chakraborty** (University of Texas Health Science Center)
- **Bruce Budowle** (FBI Laboratory)
- **Larry Presley** (FBI Laboratory)
- **Jack Ballantyne** (Suffolk County Crime Lab)
- **Jay Miller** (FBI Laboratory)

- **Dennis Reeder** (National Institute of Standards and Technology)
- **Margaret Kuo** (Orange County Sheriff's Office)
- **Bernard Devlin** (Carnegie Mellon University)
- **Marcia Eisenberg** (Laboratory Corporation of America)
- **Paul Ferrara** (Virginia Division of Forensic Science)
- **Terry Laber** (Minnesota State DNA Lab)
- Dwight Adams, Randall Murch, Barry Brown (FBI Laboratory)
- David Coffman (Florida Department of Law Enforcement)
- Fred Bieber (Harvard Medical School)
- Mary Gibbons (Oakland Police Department)
- Eric Juengst (Case Western Reserve University)
- Susan Narveson (Phoenix Police Department)
- Mohammad Tahir (Indianapolis-Marion County Crime Lab)
- Dawn Herkenham (FBI Laboratory)

Existed from 1995-2000

This group gave birth to the FBI Quality Assurance Standards (QAS) that are now maintained by SWGDAM (Scientific Working Group on DNA Analysis Methods)

Panel 1

Co-lead with DOJ

National Commission on Forensic Science

NIST Point-of-Contact (POC): **John Butler**

A federal advisory committee for the U.S. Department of Justice

http://www.justice.gov/ncfs

Panel 2

Organization of Scientific Area Committees

POC: **Mark Stolorow & John Paul Jones**

NIST-administered effort dedicated to identifying and developing technically sound, consensus-based documentary standards and guidelines

http://www.nist.gov/forensics/osac/

Panel 3

NIST Forensic Science Research Program

NIST Forensic Science Center of Excellence (announced May 2015)

POC: **Sue Ballou**

SIX FOCUS AREAS

1. *Ballistics and Associated Tool Marks*
2. *Digital and Identification Forensics*
3. *Forensic Genetics*
4. *Toxins*
5. *Trace*
6. *Statistics*

http://www.nist.gov/forensics

Other Recent Meetings NIST and Partners Have Convened on Forensic Science Topics

1. Forensic firearms analysis (July 2012)
2. DNA mixture interpretation training (Apr 2013)
3. Emerging synthetic drugs (May 2013)
4. Forensic handwriting (June 2013)
5. *DNA Technical Leader Summit (Nov 2013)*
6. Cloud computing forensics (Mar 2014)
7. DNA probabilistic genotyping – Part 1 (May 2014)
8. Mobile forensics (June 2014)
9. DNA validation concepts & resources (Aug 2014)
10. DNA probabilistic genotyping – Part 2 (Sept 2014)
11. Research biometric datasets (Jan 2015)
12. Forensic optical topography (Mar 2015)
13. **Quantifying weight of evidence (May 2016)**

- **OSAC Public Meetings** (Feb 2015 and Feb 2016)

- Forensics@NIST 2010 (NIJ program managers only)
- Forensics@NIST 2012
- Forensics@NIST 2014
- **Forensics@NIST 2016 (Nov 8-9, 2016)**

Webcasting and video archives exist for most of these meetings

http://www.nist.gov/forensics/conferences_and_events.cfm

Early History of NBS/NIST Involvement in Forensic Science

Wilmer Souder's work

Dr. Wilmer Souder and the National Bureau of Standards Identification Laboratory (1935)
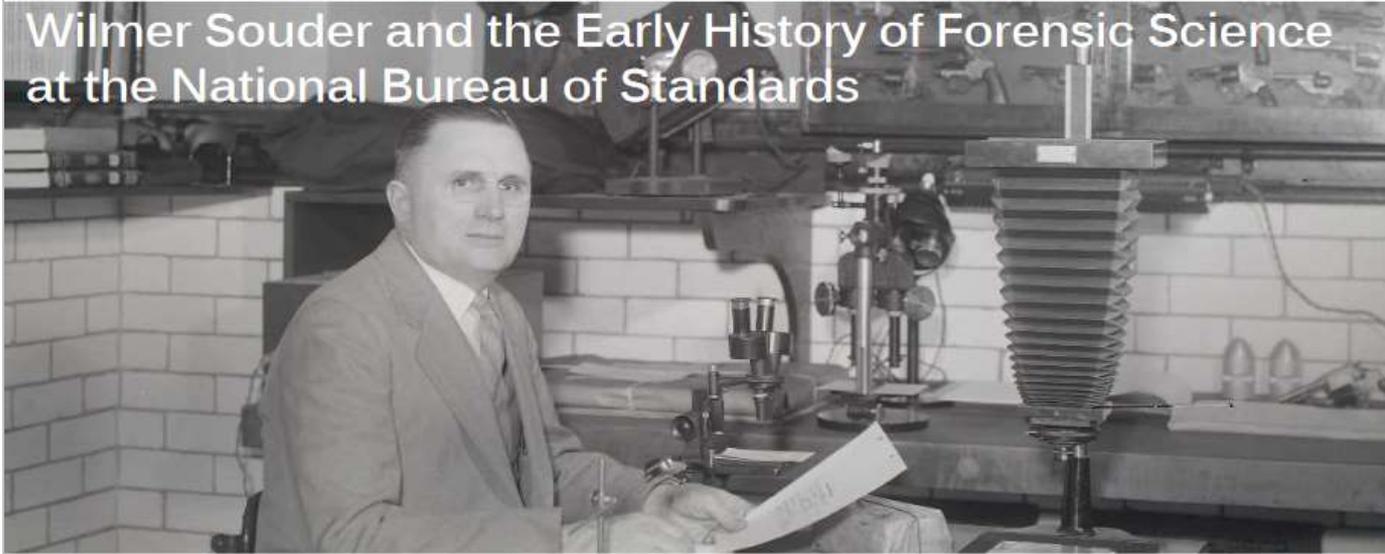

Photo taken April 11, 1935
(rediscovered August 5, 2015 within
National Archives NBS collections)

AAFS 2016 Presentation

The Best Forensic Scientist You've Never Heard Of

Wilmer Souder and the Early History of Forensic Science at the National Bureau of Standards

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

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Kristen M. Frederick-Frost, PhD

Robert M. Thompson, BS

John M. Butler, PhD

FORENSIC SCIENCES

LW1: **Last Word Society**
American Academy of Forensic Sciences
Las Vegas, NV (February 25, 2016)

June 10, 2016
a NIST colloquium presentation will be given on Souder and a NIST museum exhibit opened by his granddaughter

Slides available on the NIST STRBase website:
http://www.cstl.nist.gov/strbase/pub_pres/Souder-AAFS2016-LWS-FINAL.pdf
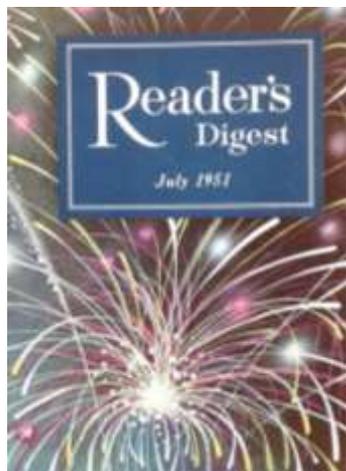
Reader's Digest July 1951 article

When no one else can solve a mystery, Government heads put in a call for Dr. Souder

Washington's Detective X

Condensed from *This Week Magazine*
Emile C. Schurmacher

Rediscovery of Wilmer Souder's Notebooks

Transferred to NIST Archives in 2003
by Alcohol, Tobacco, Firearms, and Explosives Laboratory

Detailed analysis started in May 2015

Content of Souder Notebook Entries

- Date for Evidence Submission
- NBS Test Number
- Submitting Agency
- Submitting Agent
- Summary of Findings
- Disposition of evidence (chain-of-custody)
- Case court outcome if known
- Newspaper Clippings from cases

NBS: National Bureau of Standards (name changed to NIST in 1988)

Number of Cases Worked by Wilmer Souder
## based on entries in his notebooks

Lindberg baby kidnapping ransom note evaluations (May 9, 1932 & Jan 16, 1935)

838 cases over 25 years

Mary Baker ballistics case (May 20, 1930 & Oct 31, 1930)

During World War 2, Souder was Security Officer for the National Bureau of Standards. From 1946-1950, he was NBS Metrology Division Chief with heavy administrative responsibilities. **He retired in early 1954 at age 70.**
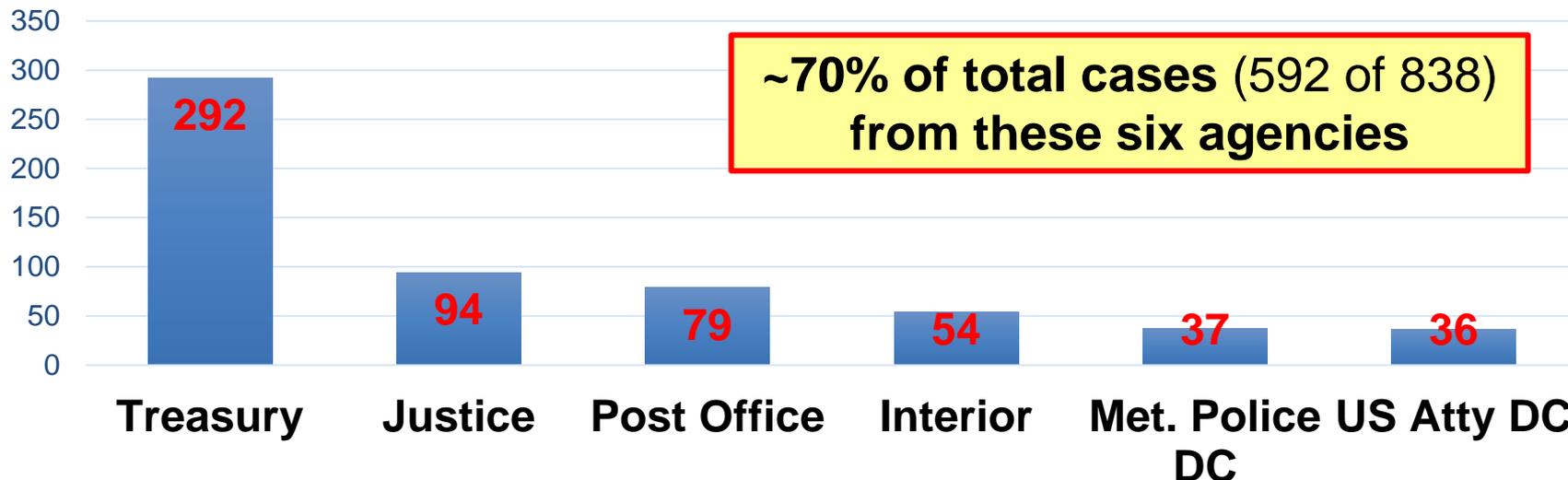
Talk at NCWM (June 5, 1929)
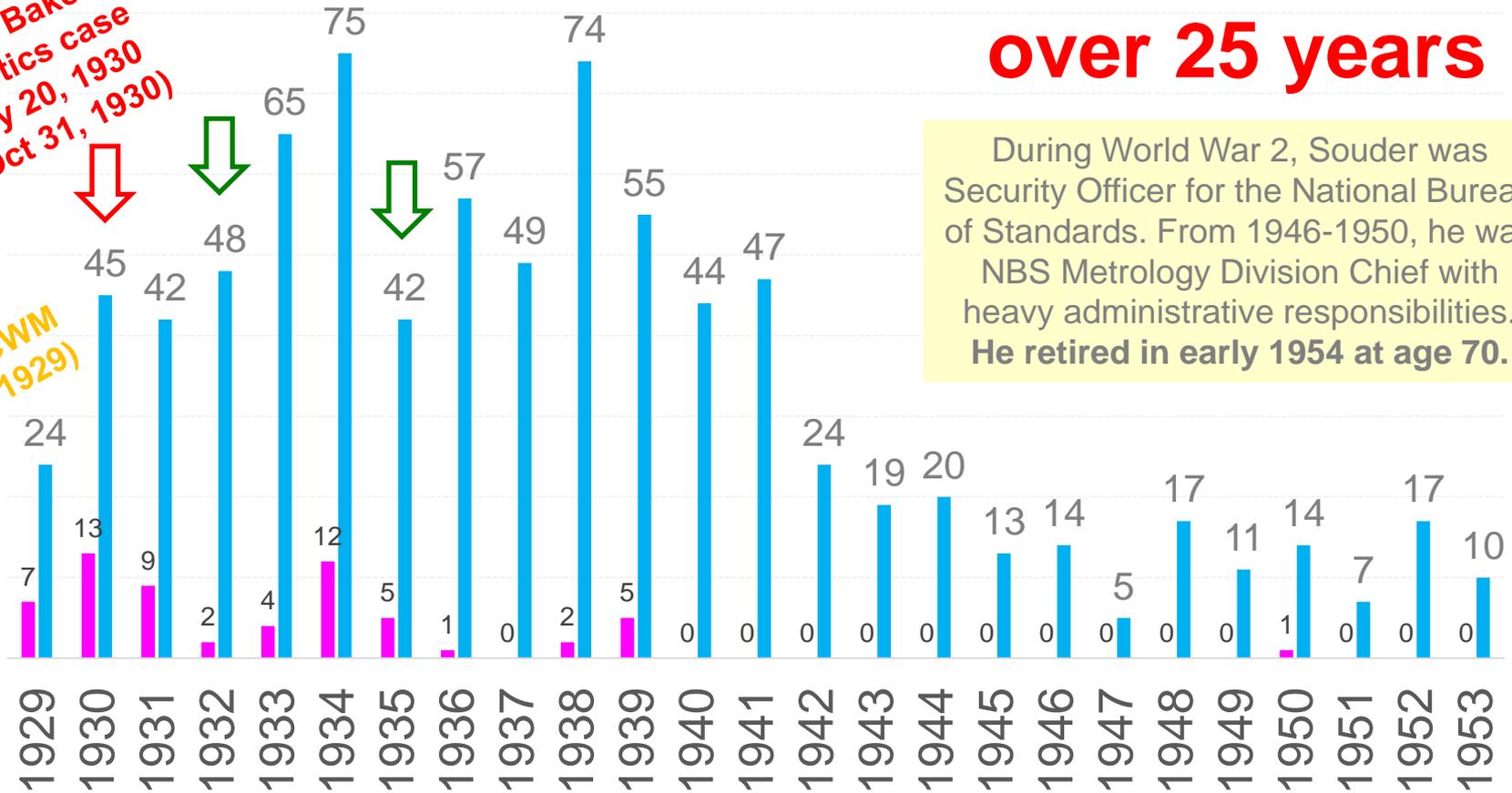
FBI Laboratory begins operation (Nov 24, 1932)

■ # ballistics ■ Total Cases

Submitting Agencies
(Handwriting, Typewriting, and Ballistics Casework)

Total Number of Cases Submitted (1929-1953)

~70% of total cases (592 of 838) **from these six agencies**

Agency	Cases
Treasury	292
Justice	94
Post Office	79
Interior	54
Met. Police DC	37
US Atty DC	36

Remaining 30% of cases were from >75 additional agencies including:

Census Bureau
Civil Service
Department of Agriculture
Department of Commerce
House of Representatives
Library of Congress
Senate Judiciary Committee
State Department

DC Health Department
DC Office of Weights & Measures
DC Supreme Court
National Labor Relations Board
New York Police Department
Office of Civil Defense
Patent Office
Security & Exchange Commission

Bureau of Prisons
Federal Housing Admin.
Federal Trade Commission
General Accounting Office
Government Printing Office
Military Intelligence Division
US Secret Service
War Department

Early NBS/NIST – FBI Connection

Studied chemistry at the University of Chicago and graduated in 1917

Charles' older brother
William D. Appel
(NBS: 1922-1959)

Wilmer Souder, on leave from NBS, received a PhD in physics at the University of Chicago and graduated in 1916 but stayed to teach courses in physics and chemistry until 1917
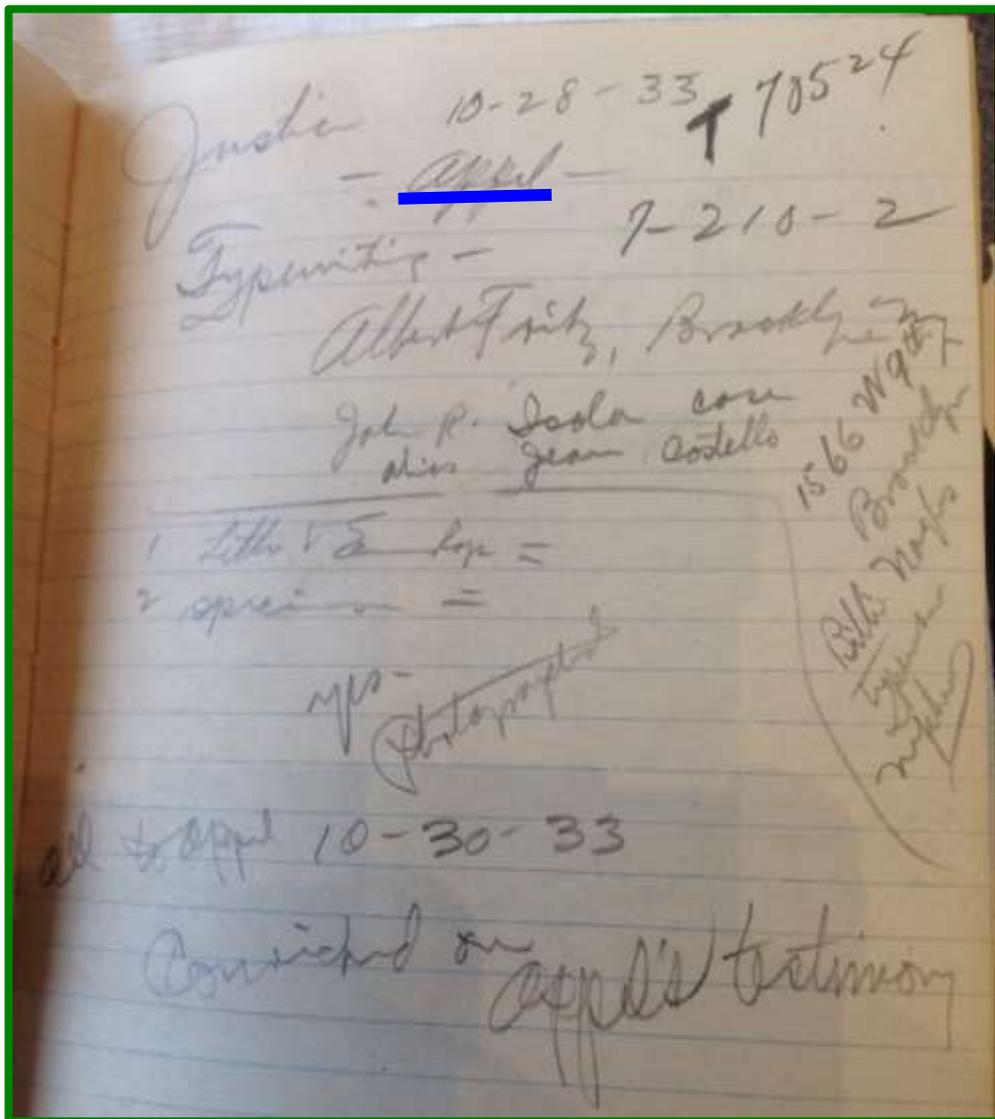
First employee of FBI Technical Laboratory
Charles A. Appel, Jr.
(FBI: 1924-1948)

1942 photo of Special Agent Charles Appel (courtesy of his son Ed Appel)

Conducting Casework in the Background…

A page from one of Wilmer Souder's notebooks (rediscovered June 2015)

Typewriting casework received from the Department of **Justice** – Charles **Appel** (first FBI Laboratory employee) on October 28, 1933 (10-28-33)

All [material returned] **to Appel** on October 30, 1933 (10-30-33)

Convicted on Appel's testimony

FBI Laboratory Began Operations
November 24, 1932 with Assistance of Dr. Wilmer Souder

Page 47: "**The development of the [FBI] Laboratory has been carefully planned by the Division with the assistance and advice of Dr. Wilmer Souder**, a well-known and recognized authority in the field of scientific endeavor. Dr. Souder, who is at present acting in an advisory capacity in the further development of the Laboratory, has been engaged as a scientist by the Bureau of Standards for a period of eighteen years and has devoted the principle portion of his time to handwriting, typewriting and ballistics identification. **His advice and experience have rendered invaluable service to the Division in the training of the Laboratory personnel and in obtaining equipment which is considered the most desirable and essential for the performance of its work**."

Challenges Faced in Forensic Science

…and some Urban Legends

Some Significant Needs in Forensic Science

More critical thinking is needed in forensic science
at the bench level and in management

| Problem	Needs and NIST Efforts
More advanced methods for DNA mixture interpretation	DNA Technical Leader Summit *(planned for Nov 2013)*
Growth in mobile & computer forensic needs	Continue work to collect comprehensive software set
Keeping up with emerging synthetic drugs	Reference materials, mass spectral libraries, IR spectra prediction
Quantitative fingerprint evaluations	Large data sets needed for fingerprints and other pattern matching disciplines to train new matching algorithms

Important Observations

- The National Research Council 2009 (**"NAS Report"**) **called for changes** to strengthen forensic science (with 13 recommendations) but these are not really new issues

- **The criminal justice system**, where forensic science only plays a small part, **is not perfect**; there have been individuals wrongly convicted for a variety of reasons

- Despite a few well-publicized examples (e.g., Annie Dookhan), **forensic scientists** generally want to do a good job and **are trying to do their best**

- **Many forces are at play** to either change things or to maintain the status quo ➔ *which changes are needed?*

Culture Clash: Science and Law

Tension exists between science and the law:

- The legal community **looks to the past** (precedence is desired)

- The scientific community **looks to the future** (evolving improvement is desired)
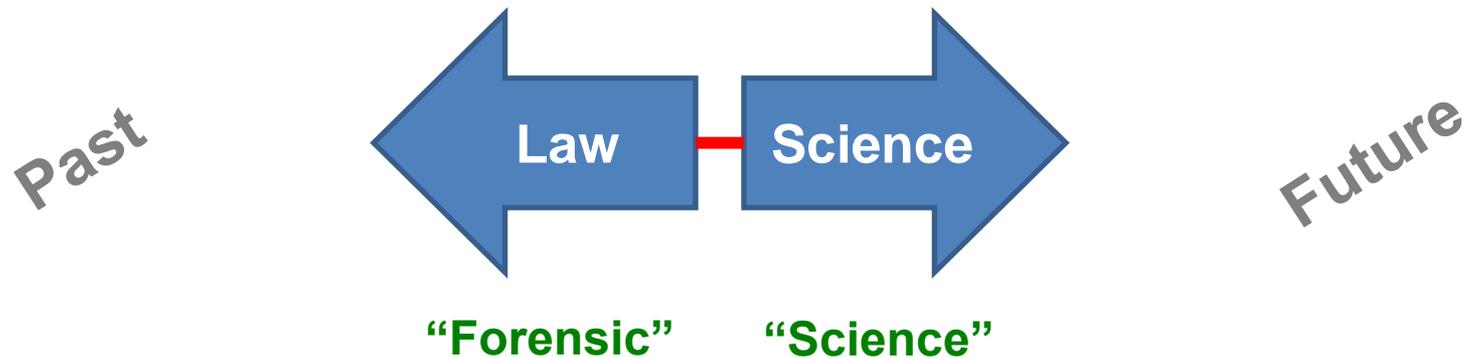
Past

Law — Science

Future

"Forensic"   "Science"

Culture Clash: Science and Law

Tension exists between science and the law:

- The legal community **wants finality and absolutes** (guilty or not-guilty court decisions)

- The scientific community **operates without certainty** (rarely with probabilities of 0 or 1)

Absolutes Desired

Law — **Science**

Uncertainty Exists

"Forensic"   **"Science"**
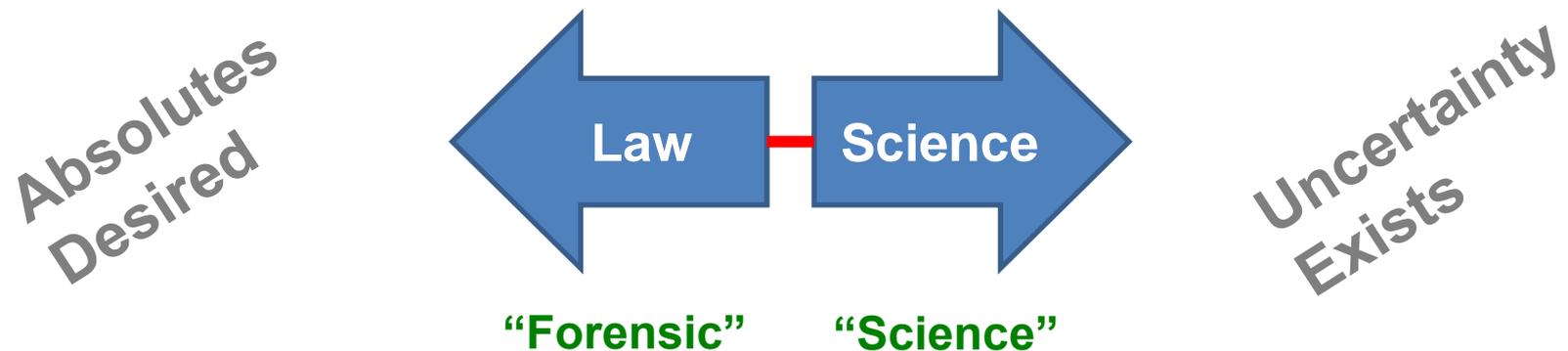
Nomenclature Challenges

- We often talk past each other (scientists and lawyers or scientists and scientists) because we do not appreciate a subtle or significant difference in the meaning of a word or phrase

- Examples: "validity" or "validation" can mean something very different to lawyers than to scientists and forensic practitioners

- "A reasonable degree of scientific certainty…" (a legal crutch that has no scientific meaning)

Different Statistical Approaches Exist

Bayesian approach

Combines LR with prior odds (or prior probability)

Bayes' Theorem

Likelihood Ratio (LR)

$$\text{Prior Odds} \times \left[\frac{\Pr(E \mid H_1)}{\Pr(E \mid H_2)} \right] = \text{Posterior Odds}$$

Frequentist approach

Considers only a single hypothesis (e.g., $\Pr(E \mid H_2)$ = profile probability) or the LR involving two mutually exclusive hypotheses

Data Quality Issues

- Forensic samples often involve working with a partial data pattern
  - In DNA, not doing the entire genome and sometimes not even the entire attempted profile
  - In latent prints, typically not looking at the entire print

- A theoretical model may not fit casework data…
  - George Box: "All models are wrong – but some are useful"

William Thomson, **1st Baron Kelvin, aka Lord Kelvin**

- "**When you can measure what you are speaking about, and express it in numbers, you know something about it**, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts advanced to the stage of science."

- "There cannot be a greater mistake than that of looking superciliously upon practical applications of science. **The life and soul of science is its practical application...**" [PLA, vol. 1, "Electrical Units of Measurement", May 3, 1883]

NIST Efforts are usually in Pasteur's Quadrant

Donald E. Stokes,
Pasteur's Quadrant –
Basic Science and
Technological Innovation,
Brookings Institution
Press, 1997.

Applied and Basic research

		Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
Quest for fundamental understanding?	**Yes**	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
	No	Lawyers	Pure applied research (Edison)
		No	**Yes**
		Considerations of use?	

Urban Legend

- a modern story of obscure origin and with little or no supporting evidence that spreads spontaneously in varying forms and often has elements of humor, moralizing, or horror (dictionary.com)

Top Ten… Urban Legends of Forensic Science

10. I do my work the same every time – why do I need to write down my method and results?

9. More money will solve all of our problems

8. I am not "biased" (and what does "bias" mean anyway?)

Top Ten… Urban Legends of Forensic Science

7. Courtroom decisions validate science (i.e., my method is correct because the jury found the defendant guilty)

6. I can only rely on people that agree with me and who work in my specific discipline (i.e., no one else can understand my problems)

5. It is not my fault if the people in the courtroom don't understand my testimony

Top Ten… Urban Legends of Forensic Science

4. Defense lawyers are evil and should not have access to my data

3. I have never made a mistake – therefore MY error rate is zero!

2. DNA is problem-free – so says the NRC! (NAS 2009 report, p. 7)

1. Let's give this problem to the statisticians – **they will all agree** on an appropriate solution!

American Academy of Forensic Sciences
Jurisprudence Section
Orlando, FL
February 20, 2015

http://www.cstl.nist.gov/strbase/pub_pres/Butler-DNA-interpretation-AAFS2015.pdf

Why DNA Interpretation Has Become More Challenging in Recent Years

John M. Butler, Ph.D.

NIST Fellow & Special Assistant to the Director for Forensic Science

National Institute of Standards and Technology

Gaithersburg, Maryland

5 Reasons that DNA Results Are Becoming More Challenging to Interpret

1. **More sensitive DNA test results**

2. **More touch evidence samples** that are poor-quality, low-template, complex mixtures

3. **More options exist** for statistical approaches involving probabilistic genotyping software

4. **Many laboratories are not prepared** to cope with complex mixtures

5. **More loci being added** because of the large number of samples in DNA databases

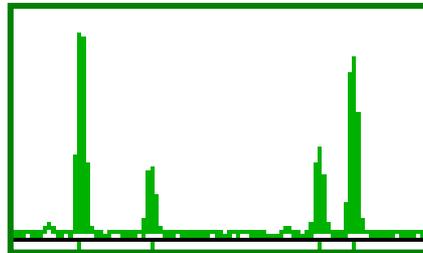# Math Analogy to DNA Evidence

$$2 + 2 = 4$$

$$2x^2 + x = 10$$

$$\int_{x=0}^{\infty} f(x)\,dx$$

Basic Arithmetic
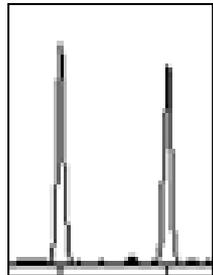
Algebra

Calculus

Single-Source DNA Profile

(DNA databasing)

Sexual Assault Evidence

(2-person mixture with high-levels of DNA)
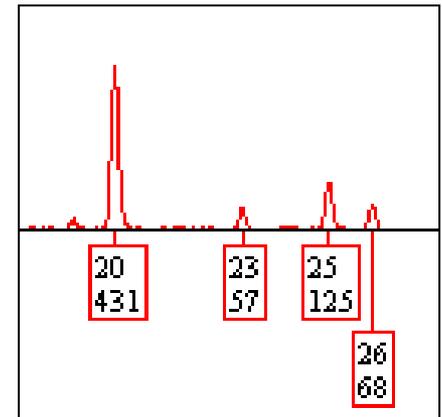
Touch Evidence

(>2-person, low-level, complex mixtures perhaps involving relatives)

Many laboratories are not prepared
to cope with complex mixtures

- Have **appropriate validation studies** been performed to inform proper interpretation protocols? (curriculum & classroom instruction)

- Are **appropriately challenging proficiency tests** being given? (graded homework assignments)

- **Would we want to go into a calculus exam only having studied algebra and having completed homework assignments involving basic arithmetic?**

Why are we where we are today?

- The incredible success of DNA has lead to more sensitive methods and more samples being provided which has led to more complex mixtures (we are pushing the envelope)
  - Lower template DNA profiles have more uncertainty associated with them in terms of allele peak height variation

- Statistical interpretation techniques have not kept pace with the methodology improvements
  - Much of the forensic DNA community is effectively using a 1992 statistical tool (CPI) on 21st century data

Thoughts on Potential Improvements

Know the literature

Know the question being asked

Know the limits of what you can do

Know the Literature…

- We must do our homework – and read the literature!

- A brief bibliography is included with this workshop:
  - http://www.nist.gov/itl/iad/ig/forensic_biblio.cfm

- **AAFS 2016 workshop**
  - **Information Does Exist Beyond the First Page of Your Google® Search!:**Tools and Strategies for Forensic Science Literature Searching and Use
  - Search tools and strategies are described
  - Slides available at http://www.cstl.nist.gov/strbase/training/AAFS2016_Literature Workshop.htm

Steps in Forensic DNA Analysis

Understanding Results Obtained & Sharing Them

Gathering the Data

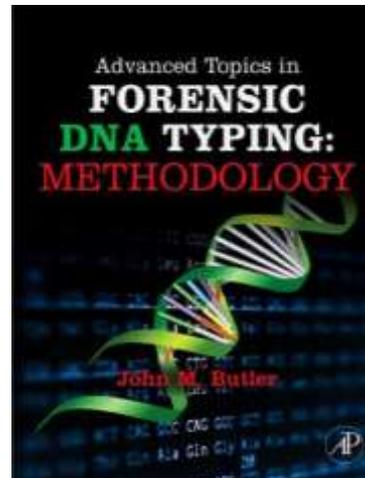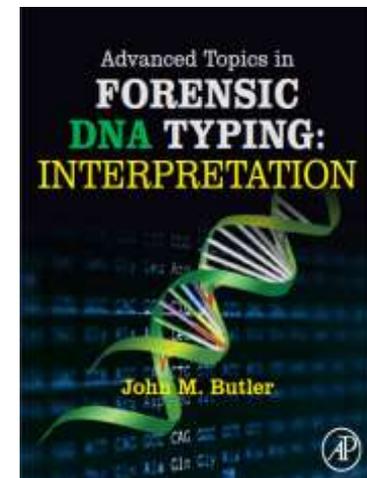| Collection/Storage/ Characterization | Extraction/ Quantitation | Amplification/ Marker Sets | Separation/ Detection | Data | Stats | Report |

Interpretation

Advanced Topics: Methodology

Advanced Topics: Interpretation

>1300 pages of information with >5000 references cited in these two books

Advanced Topics in FORENSIC DNA TYPING: METHODOLOGY — John M. Butler

August 2011

Advanced Topics in FORENSIC DNA TYPING: INTERPRETATION — John M. Butler

October 2014

Know What Question You Are Trying to Answer

David Balding
University of Melbourne
Professor of Mathematics
and Statistics

"…**Focus on the relevant question**. Many misleading statistical approaches [turn] out to be providing valid answers to the wrong questions."

– David Balding, Interpreting DNA evidence: can probability theory help? In J.L. Gastwirth (ed.) *Statistical Science in the Courtroom* (pp. 51-70) New York: Springer, 2000

Different Calculations
Answer Different Questions

Method used	Questions being answered
Profile probability (random match probability, RMP)	What is the rarity of a specific DNA profile given the alleles observed? **What is the chance that a particular profile exists** in a population based on allele frequencies?
Match probability	Given that a particular profile has been seen (in the crime scene evidence and in the suspect), **what is the chance of it occurring again?**
Database match probability	How often would a DNA profile match the relevant forensic sample in a database of size N?

Ian Evett on Interpretation

"The crucial element that the scientist brings to any case is the *interpretation* of those observations. This is the heart of forensic science: it is where the scientist adds value to the process."

Evett, I.W., et al. (2000). The impact of the principles of evidence interpretation on the structure and content of statements. *Science & Justice, 40,* 233-239.

Know the Limits of What You Can Do

- I have advocated for development of a "complexity (or uncertainty) threshold" with DNA evidence interpretation

New Scientist article (August 2010)

- **How DNA evidence creates victims of chance**
  - 18 August 2010 by Linda Geddes

- From the last paragraph:
  - **In really complex cases, analysts need to be able to draw a line** and say "This is just too complex, I can't make the call on it," says Butler. "Part of the challenge now, is that every lab has that line set at a different place. But the honest thing to do as a scientist is to say: **I'm not going to try to get something that won't be reliable**."

Perhaps We Should Slow Down with Some of the DNA Mixtures That We (Scientists and Lawyers) Are Taking On…

Poor Quality Conditions

Large Numbers of Contributors

Slick, mountain road

Curve, poor visibility

Foggy, wet conditions

Wet surface leads to hydroplaning

Lessons from History

Why does this matter?

"Those who don't know history are doomed to repeat it."

— Edmund Burke (Irish statesman in 1700s who supported American colonies' independence)

A June 5, 1929 Presentation by **Wilmer Souder** at the National Conference on Weights and Measures (NCWM) Launched the NBS Identification Laboratory

REPORT OF THE TWENTY-SECOND NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

HELD AT THE BUREAU OF STANDARDS, WASHINGTON, D. C., JUNE 4–7, 1929

IDENTIFICATION BY PRECISION METHODS OF COMPARISON AND MEASUREMENT

By WILMER SOUDER, *Bureau of Standards*

Introduction

Identifications by comparisons have been made with more or less success for centuries. The application of precision-measurement methods for these purposes is of recent origin and is not generally understood. This lack of understanding of the principles upon which the science is based is responsible for the confusion so often resulting from evidence introduced in courts of law.

Usual Methods

We are so accustomed to the usual methods of description, which are only approximate and by virtue of these approximations are susceptible of no precise interpretations, that we fail to recognize the extreme accuracy of indentifications made by precision measurements.

When we say we are looking for a man 6 feet tall of rather heavy build, with dark hair, with a scar on one hand and with some gold teeth in his mouth we should not be surprised to find several hundred citizens of the United States who meet the description. If we increase the precision of the description to a man 72½ inches tall, weighing 207 pounds, index finger of left hand amputated at the second joint, and with gold crowns on left cuspid and right bicuspids, we may feel sure there is not more than one man in the entire country who will meet the specifications, and having found this one, further search can not be justified without the introduction of some unusual condition.

Justification from Probability

The justification for this definite conclusion of positive identification is based on the "law of probability." Briefly, and in nontechnical terms, this law is interpreted from the fraction which represents the ratio of the number of times a specific characteristic appears divided by the maximum number of appearances possible,

74737—29——5

Wisdom of Wilmer Souder
National Bureau of Standards (1911-1913, 1917-1954)

"The honest expert never looks upon the outcome of his work as a result of luck, the reward of a game, or victory in a battle of wits. He has built his qualifications through hard work. He establishes his conclusions through exacting procedures; he presents his testimony in the face of keen opposition and asks no favor beyond an honest consideration of the facts disclosed. Having done so, he has fulfilled the high obligations of his profession.

"Justice is sometimes pictured as blindfolded. However, scientific evidence usually pierces the mask."

- **Wilmer Souder**, "Effective Testimony for Scientific Witnesses", *Science* (1954) 119: 819-822

Forensic Scientists Should Represent the Data – Not a Particular Side in the Courtroom Drama
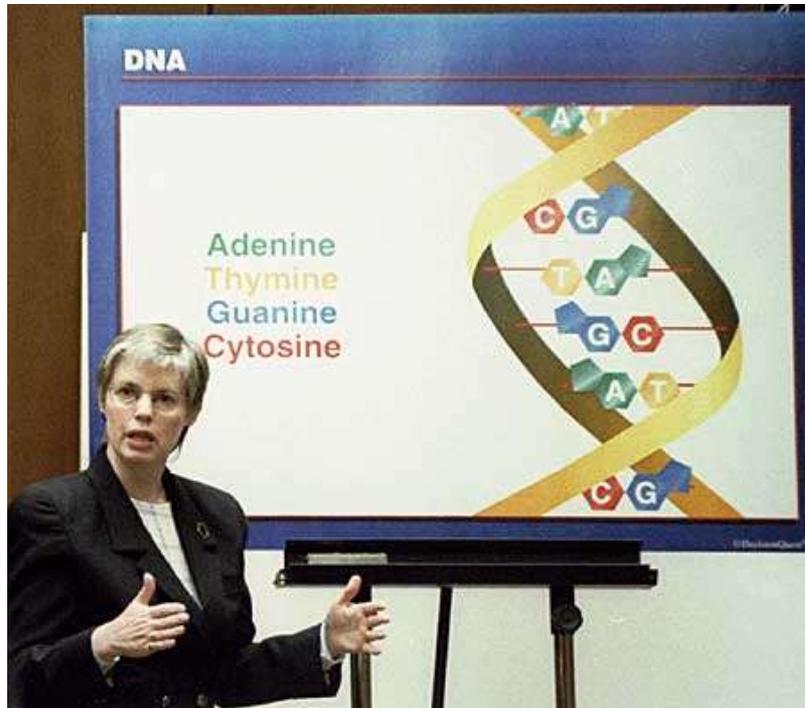
Dr. Robin Cotton testifying in the O.J. Simpson case (May 1995)

Dr. Robin Cotton speaking about the role of forensic scientists in court:

"***You are the voice of the data!*** You are not a voice for the victim, which is what some prosecutor's describe their role as. …You just cannot behave like you are on their side. You cannot let that feeling influence how you behave, how you speak, and most importantly, how you look at the data. … It is the prosecutor who is supposed to worry about the consequences of the trial. **If you represent the data accurately in a scientific sense, then it is hard to go wrong**."

National Commission on Forensic Science (NCFS):
www.justice.gov/ncfs

Organization of Scientific Area Committees (OSAC):
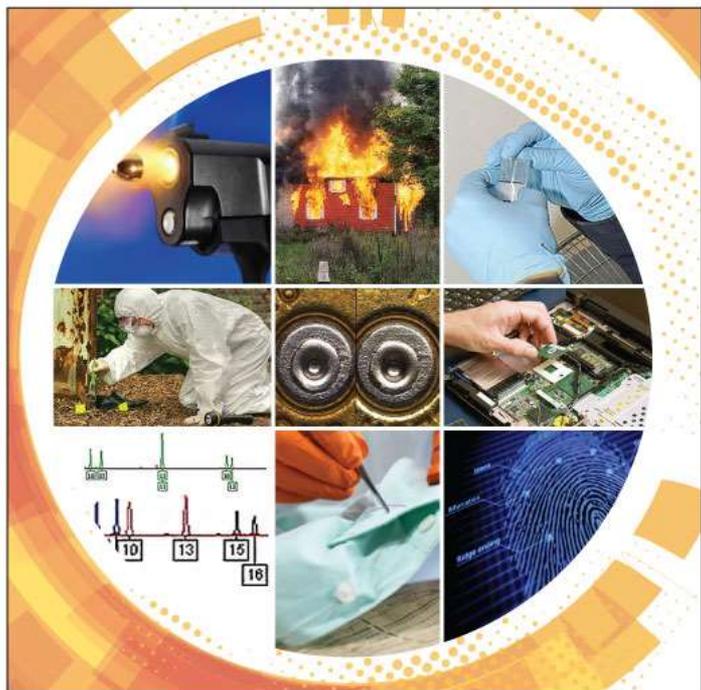www.nist.gov/forensics/osac/index.cfm

NIST FORENSIC SCIENCES
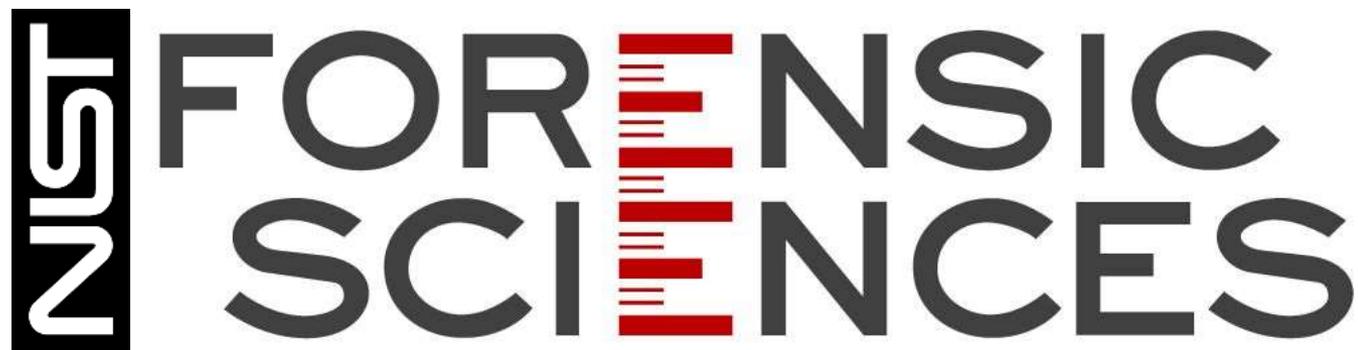
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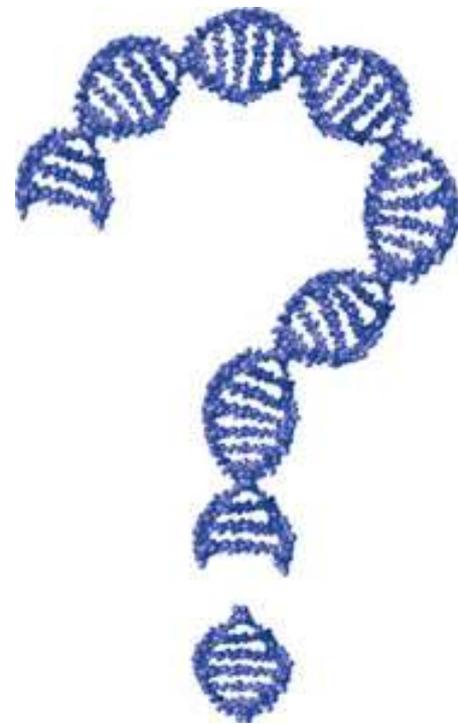
301-975-4049   john.butler@nist.gov

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November 28-30, 2012 at NIST

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http://www.nist.gov/oles/forensics-2012.cfm

http://www.nist.gov/forensics/forensics-at-nist-2014.cfm