



# FORENSICS @ NIST

#NISTForensics

Forensics@NIST 2018

7 November 2018

Gaithersburg, MD

# Are We on the Right Side of the Equation?

**John M. Butler, PhD**

*NIST Fellow & Special Assistant to the Director for Forensic Science*

National Institute of Standards and Technology

**NIST** FORENSIC  
SCIENCES

DAY1 KEYNOTE ADDRESS

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

# NIST Disclaimer

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

Certain commercial entities 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 entities identified are necessarily the best available for the purpose.

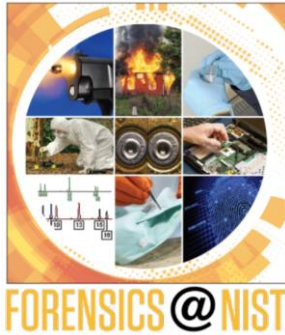
# NIST Forensic Science Activities

## Conduct Research and Collaborate

### Intramural Research

**Why we are here for this meeting...**

DNA  
Digital  
Fingerprints  
Firearms  
Footmarks  
Statistics  
Toxins  
Trace



### Extramural Research

funding a NIST Center of Excellence in Forensic Science (CSAFE: since 2014)

1920s - present

## Partner with Community to Strengthen Policies and Practices

### National Commission on Forensic Science (NCFS) with DOJ

2013 - 2017



2013 - present

## Convene Meetings to Examine Issues



FORENSIC SCIENCE  
ERROR MANAGEMENT  
INTERNATIONAL  
FORENSICS SYMPOSIUM  
JULY 20-24, 2015 • WASHINGTON, DC



Research Innovation to Implementation in Forensic Science Symposium



NIST / Gaithersburg, MD / June 19-20, 2019 / NIST.GOV/RI2I

Human Factors Working Groups (with NIJ)

2009 - present

## Explore Scientific Foundations

Initial efforts with DNA mixture interpretation and bitemark analysis

NISTIR 8225 DRAFT

NIST Scientific Foundation Reviews

**Public comment period: September 24, 2018 through November 19, 2018**

This publication is available free of charge from: <https://doi.org/10.6028/NIST.IR.8225-draft>

September 2018



U.S. Department of Commerce  
Wilbur L. Ross, Jr., Secretary

National Institute of Standards and Technology  
Walter Copan, NIST Director and Undersecretary of Commerce for Standards and Technology

2017 - present



# What Has Happened in the Past Two Years since Forensics@NIST 2016?



# Detective X Film awarded an Emmy® this year!

Previewed at Forensics@NIST 2016



<https://www.nist.gov/video/detective-x-re-discovering-wilmer-souder>

Article: <https://www.nist.gov/featured-stories/who-was-detective-x>

For more information on Wilmer Souder, see June 2016 colloquium:

<https://www.nist.gov/video/nist-colloquium-series-detective-x-wilmer-souder-and-early-history-forensic-science-national>

Awarded June 23, 2018 by the National Academy of Television Arts & Sciences: National Capital Chesapeake Bay Chapter



NIST staff members Leon Gerskovic, Robin Materese and Jose Garcia show off their Emmy® Award for "Detective X: (Re) Discovering Wilmer Souder."  
*Credit: J. Stoughton/NIST*

# Wilmer Souder Notebooks (Special Collection)

<https://nistdigitalarchives.contentdm.oclc.org/digital/collection/p16009coll67/search>

## NIST Digital Archives

Digital Collections of the  
National Institute of Standards and Technology

### Notebook #2 (Oct 1933)

Justice 10-28-33 70524  
- Appl -  
Typewriter - 7-210-2  
Albert Fritz, Brooklyn  
John P. Sada son  
Miss Jean Costello 1566 W 99th St  
1 letter to S. L. =  
2 spec. =  
mfs -  
Photographed  
all to appl 10-30-33  
Convinced on appl's testimony

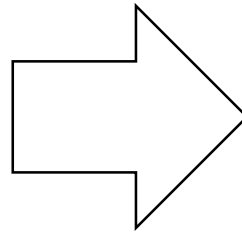
### Notebook #5 (July-Oct 1930)

7-27-30 Mr. Clegg } Dept.  
11 Am Mrs. Cowley } Justice  
Shall you be tak  
to Gaddard - mfs - on with m  
to determine  
7-29-30 Mrs. Glitt  
Dep Shelly Lt. Fowler  
Lt. Kelly Mrs. Callahan  
no Hardy + 1 man  
in hallway mfs.  
7-29-30 Campbell (But with to see  
Phone 3 P. on with Glitt & Shelly.  
7-27-4P - Lt. Fowler - (Hard)  
take in 2 Gaddard  
7 photos mac. appx 20, = record  
(1 mag - red)  
8-1-30 Verified by Gaddard  
Case closed so far as 1378  
concerns.  
10-14-30 to Dir Atty Office  
McCellis  
criticism of Hamilton's work  
10-15-30 ditto  
10-16-17-18-20 compiled re photost.  
10-20 all material to Lt. Fowler mfs. - 3112 3

### Notebook #9 (Sept 1950)

22  
HR 24 55446  
# 220575 15P + Po  
# 442178 920  
Sept 11 Paper report on 9-3-28 Carpenter above the room.  
Computer 2 P.S. (Ch. D) S. J. Smith - Pa.  
Singer & Daniel Cases - + 1 hr  
Sept 17 Carpenter finished 11 am - Red Pincus on teeth  
Closed up  
Reply to Lt Smith - to Cassidy -  
Study of data on cases - + 1 hr  
SEP 20 1950 Allday on identifiast of 3456  
Judge Dwyer ind. + 1 hr  
Sept 14 G 3456 Report abandoned 9 teeth - sep  
G 3436 Inst. Custom Exhibit & Report put  
+ 1 hr  
Sept 15 Exhibits & report  
Lecture Dr. Stickle Johnson mps  
Report to prof. Dwyer -  
Photostats - Report to Justice  
Dr. Stickle re-eggt.  
S.S. Annouler. Library + 1 hr  
Sept 18 Re: Report to James Carter  
Lecture exhibit -  
Foot Section at Navy Dental School  
expanded & placed on lantern slide  
Schur & difficulty - party -  
Dr. Holcath on Cases -  
Lit - ACS - See - G. J. Smith - Lt. ...

# New NIST Director



**Then NIST Director Willie E. May speaking at the Forensics@NIST 2016 meeting. He retired in January 2017 after 45 years at NIST.**

**Walter G. Copan, NIST Director since October 5, 2017**

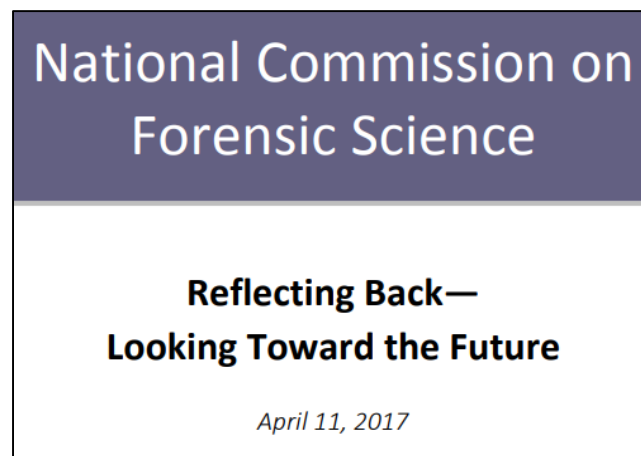
<https://www.nist.gov/people/walter-g-copan>

# NCFS Closed with Charter Expiration

- The Attorney General's National Commission on Forensic Science's (NCFS) charter expired on April 23, 2017
- **Completed two 2-year terms** involving **13 meetings** and approving **43 work products** (20 recommendations to the Attorney General and 23 views of the Commission)



<https://www.justice.gov/archives/ncfs>



See summary document (58 pages) describing what was accomplished and thoughts on what needs still exist

<https://www.justice.gov/archives/ncfs/page/file/959356/download>

NIST maintains video recordings of the NCFS meetings:

<https://www.nist.gov/topics/forensic-science/national-commission-forensic-science>



# National Commission on Forensic Science (NCFS)

operated for 13 meetings from February 2014 to April 2017

## Coordinating Government Efforts



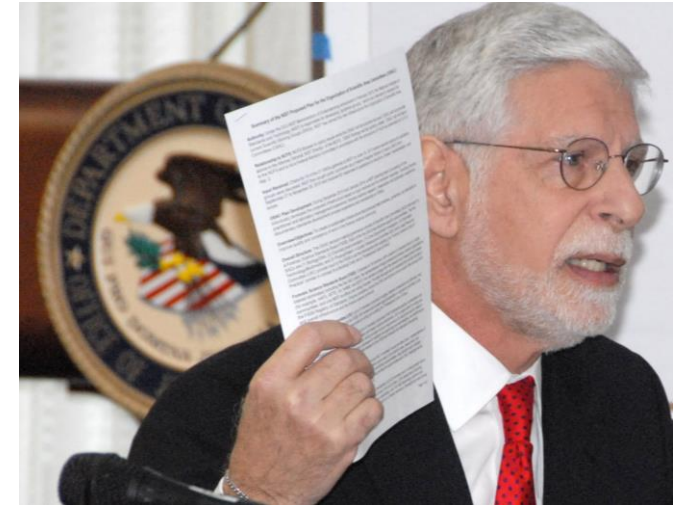
**NIST Director** (Patrick Gallagher), **Deputy Attorney General** (James Coles), and **the President's Science Advisor** (John Holdren) speak at the first National Commission on Forensic Science meeting in February 2014

## Learning from Previous Efforts



Judge Harry Edwards, who chaired the National Academy of Sciences committee that wrote the 2009 NAS Report, addressed the NCFS

## Introducing New Efforts



Mark Stolorow introduced NIST plans for OSAC at the first NCFS meeting

**140 presenters spoke to the NCFS in its 13 meetings**

# Mark Stolorow Has Announced Plans to Retire

**NIST**

← **TAKING MEASURE** Just a Standard Blog

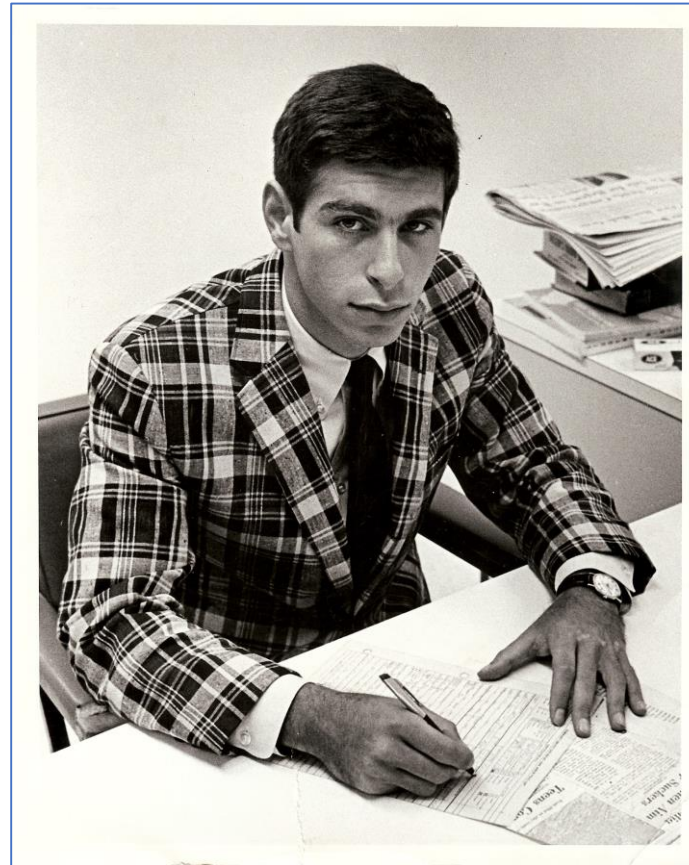
## Forensic Science is in My DNA

September 18, 2018  
By: [Mark Stolorow](#)

<https://www.nist.gov/blogs/taking-measure/forensic-science-my-dna>

**50 years in  
forensic science!**

Michigan and Illinois State Police  
Crime Labs, Cellmark, NIST



**He started in 1968**  
as a beat cop in  
Ann Arbor, Michigan



**Mark will retire in  
January 2019**  
as Deputy Director of the  
NIST Special Programs  
Office and Director for  
OSAC Affairs

# NIST Has Organized Multiple Meetings to Assist the Community since Forensics@NIST 2016



Coming Next Summer...

Research Innovation to Implementation in Forensic Science Symposium



NIST / Gaithersburg, MD / June 19-20, 2019 / NIST.GOV/RI2I

June 19-20, 2019

FORENSIC SCIENCE  
ERROR MANAGEMENT



INTERNATIONAL  
FORENSICS SYMPOSIUM



July 24-27, 2017 @NIST, Gaithersburg, MD

<https://www.nist.gov/topics/forensic-science/conferences-and-events>



# Lots of Great NIST Research... and (Rich) Press Coverage

This is why we are here for Forensics@NIST 2018

**Rich Press**  
[richard.press@nist.gov](mailto:richard.press@nist.gov)  
(301) 975-0501

**21 articles**  
**since 2016**

## Trace



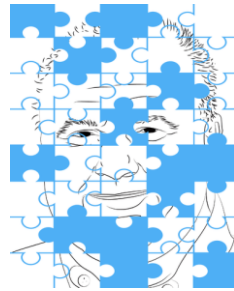
**Trace Evidence Databases: A Force Multiplier for Forensic Investigators**  
November 7, 2016

## Trace



**Sniffing Like a Dog Can Improve Trace Detection of Explosives**  
December 1, 2016

## DNA



**NIST Research Enables Enhanced DNA "Fingerprints"**  
December 15, 2016

## Digital



**Database of Software "Fingerprints" Expands to Include Mobile Apps**  
December 15, 2016

## Feature Story



**Who Was Detective X?**  
February 9, 2017

## OSAC Update



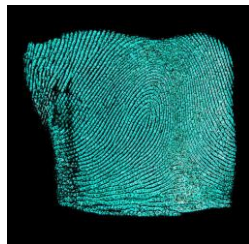
**Standard for Sampling Seized Drugs Approved for OSAC Registry**  
April 3, 2017

## Trace



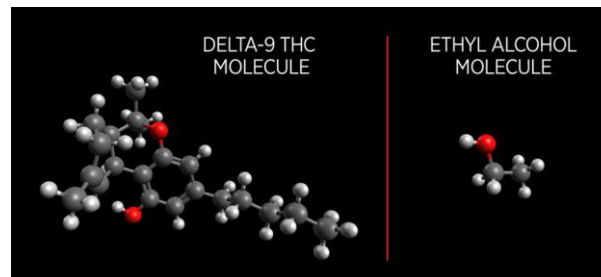
**Fentanyl Can Sicken First Responders. Here's a Possible Solution.**  
May 9, 2017

## Fingerprints



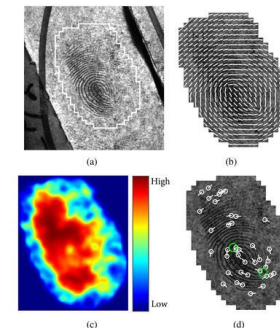
**Do You Have What It Takes to be a Forensic Fingerprint Examiner?**  
May 18, 2017

## Toxins



**Scientists Lay the Groundwork for a Reliable Marijuana Breathalyzer**  
July 5, 2017

## Fingerprints



**Scientists Automate Key Step in Forensic Fingerprint Analysis**  
August 14, 2017

## Meeting Summary



**Speaking of Error in Forensic Science**  
September 5, 2017

# Great NIST Research...and (Rich) Press Coverage (cont.)

21 articles  
since 2016

## Scientific Foundations



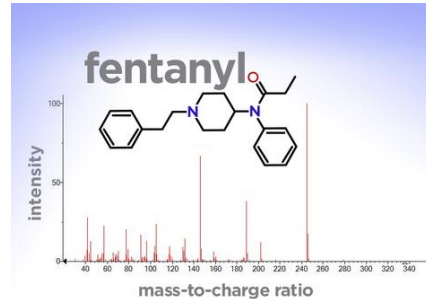
**NIST to Assess the Reliability of Forensic Methods for Analyzing DNA Mixtures**  
October 3, 2017

## Firearms



**How Good a Match is It? Putting Statistics into Forensic Firearms Identification**  
February 8, 2018

## Toxins



**Free Software Can Help Spot New Forms of Fentanyl and Other Illegal Drugs**  
March 7, 2018

## Digital



**Drone Forensics Gets a Boost With New Data on NIST Website**  
June 5, 2018

## Toxins



**Data-Sharing Website May Speed Response to New Illegal Drugs**  
July 5, 2018

## Scientific Foundations

## DNA



**NIST Builds Statistical Foundation for Next-Generation Forensic DNA Profiling**  
July 23, 2018

## Digital



**Database of Software "Fingerprints" Expands to Include Computer Games**  
September 10, 2018

## Firearms

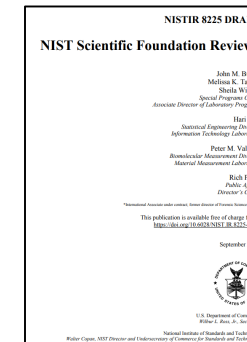


**NIST Updates Forensic Standard Reference Materials**  
September 19, 2018

## DNA



**NIST details plans for reviewing the scientific foundations of forensic methods**  
September 24, 2018



## Trace



**New Protocol for Measuring Background Levels of Drugs in Crime Labs**  
September 25, 2018

# A Brief History of the Forensics@NIST Meetings



- **2010** (December 6-8): *limited to NIST and NIJ staff*
  - Keynotes: Dr. Patrick Gallagher, NIST Director and Dr. John Laub, NIJ Director
- **2012** (November 28-30)  
Keynote: **Dr. Tjark Tjin-a-Tsoi**, [Netherlands Forensic Institute](#) CEO,
  - “Trends, Challenges and Strategy in Forensics”
- **2014** (December 3-4)  
Keynote: **Judge Jed Rakoff**, [U.S. District Court Justice](#),
  - “Are Judges Losing Confidence in Forensic Science?”
- **2016** (November 8-9)  
Keynote: **Professor Jules Epstein**, [Professor of Law at Temple University](#),
  - “Forensic Evidence: Thoughts of an Accidental Tourist”
- **2018** (November 7-8)  
Keynotes: Dr. John Butler (Nov. 7) & Dr. Sheila Willis (Nov. 8)



# Previous Keynote Speakers

## 2012 Dr. Tjark Tjin-a-Tsoi



34 slides



MOU signed between NFI and NIST

## 2014 Judge Jed Rakoff



12 pages of text

[Plenary Speech at National Institute of Standards and Technology Conference on Forensics, December 3, 2014]

Are Judges Losing Confidence In Forensic Science?

by Jed S. Rakoff

When I first went on the bench nearly 20 years ago, it was virtually unheard of for any judge to question the admissibility or reliability of such familiar forensic disciplines as fingerprint analysis, toxicology, firearms and toolmark analysis, arson analysis, and much more. Indeed, we judges - acutely aware

## 2016 Professor Jules Epstein



60 slides and 45 minute video

**FORENSIC EVIDENCE:  
THOUGHTS OF AN  
ACCIDENTAL TOURIST**

PROFESSOR JULES EPSTEIN  
NIST, NOVEMBER 2016

# 2012 Dr. Tjark Tjin-a-Tsoi

## “Trends, Challenges and Strategy in Forensics”

- The challenges of **backlogs** can be addressed with (1) service level agreements, (2) process redesign, and (3) speed focused R&D
- More **objective interpretation** can be obtained with (1) research, (2) defragmentation of forensic disciplines, and (3) improved training & education





# 2014 Judge Jed Rakoff

## “Are Judges Losing Confidence in Forensic Science?”

- “There remains a tendency...to admit forensic evidence because it is traditional to do so.”
- “The many highly responsible forensic specialists who have devoted years of their time and skill to one or another forensic discipline should not be defensive about this growing judicial uncertainty, but should instead see it as **an invitation and opportunity to help their chosen fields become more rigorous and reliable.**”
- “...give your attention to what can be done to make forensic science a more useful tool of justice...”



# 2016 Professor Jules Epstein

## “Forensic Evidence: Thoughts of an Accidental Tourist”

- “Daubert’s ‘evidentiary’ reliability test does not necessarily mean ‘accurate’” and “Frye’s ‘general acceptance’ test varies with the community.”
  - “Daubert is applied far more stringently in civil cases than in criminal ones, and even in criminal ones, Daubert serves a more effective screening role for filtering out flawed defense expert testimony than weak prosecution and police-generated forensic science.”
- Problems from his perspective:
  1. “We still permit **risky evidence**” – bitemark matching and 2014 study of odontologists
  2. **Ethics** – “honestly communicate with all parties” when “permitted by law *or agency practice*”
  3. **Communicating Results** – example testimony: “[a match is] probable...I’m 100% confident with that opinion”
  4. “Do we yet know **how reliable experts are?**” – what data exists?
  5. “**When is enough enough?**” – when trying to conclude that two items have a common origin if their marks are in “sufficient agreement” – what does that mean?

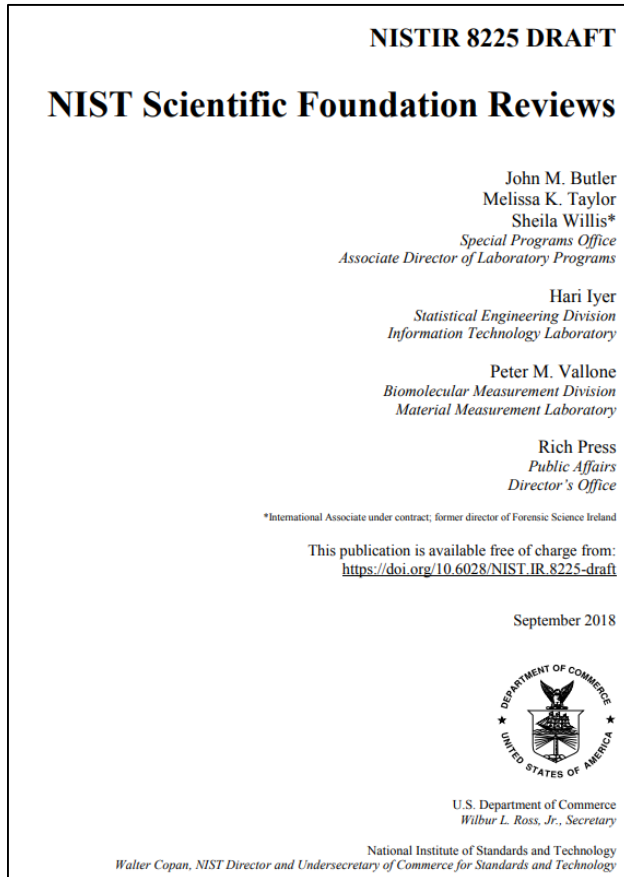
# Are We on the Right Side of the Equation?



# Perspective gained from focused thinking about scientific foundations this past year:

## Are We Check-List Focused or Outcome Focused?

- **Do we understand principles** behind how things work and why things are done?
- **Do we regularly step back and critically consider our performance** with activities we are involved in as researchers or practitioners?
- **What data demonstrate what we think we know** about the performance of a particular methodology or interpretation approach?



# Are We on the Right Side of the Equation?

*Systems Thinking is Looking at the Big Picture and How Inputs Impact Outputs...*

*Left Side*

**Task-  
Driven**

*Right Side*

**Performance-  
Based**

**Component(s) + Process(es) = Outcome**

*What?*

*How?*

*How well?  
So what?*

# Accreditation & Audits:

## Are we considering the right side of the equation?

### Austin (TX) Police Department (APD) DNA Laboratory Accreditation Timeline and Discussion March 2004--May 2016

#### Summary of Audits and Findings 2004-TFSC Audit

TYPE	TOTAL # OF AUDITS/ ASSESSMENTS	ZERO FINDINGS	ONE FINDING	MORE THAN ONE FINDING
<i>QAS</i>	5	3	1	1
<i>ASCLD/LAB</i>	4	2	2	
<i>Internal</i>	6	4	1	1
<i>CODIS</i>	1	1		
<i>Serology Readiness</i>	1	1		
TOTALS	17	11	4	2
<b>Two-thirds of the APD audits had zero findings</b>		<b>65%</b>	<b>23%</b>	<b>12%</b>

- Austin, Texas PD DNA Laboratory was **shutdown** in May 2016 **over concerns with DNA testing protocols**
- They passed 17 audits over a 13 year time span
- In response to TX FSC concerns raised, a representative of the accrediting body stated “there is no consensus on what is acceptable in the DNA community” and “we [ANAB] do not establish the scientific foundation, but we assess to that. **We expect the technical community to be establishing what scientifically needs to be done.**”

Texas Forensic Science Commission Meeting August 18, 2017  
[https://www.youtube.com/watch?v=-p\\_30-20kQI](https://www.youtube.com/watch?v=-p_30-20kQI)  
(at 4:03 of 5:45)

Slide courtesy of Lynn Garcia (presentation to the Texas Forensic Science Commission, August 18, 2017)

# Validation Studies:

Are we considering **the right side** of the equation?

**A common claim is that a check-list of criteria have been met:** “validation of the [DNA test kit] was carried out in accordance with guidelines ...issued by the Scientific Working Group on DNA Analysis Methods (SWGDM) and a series of tests ...were conducted.” (FSIG 27:67-73)

Left side of  
the equation

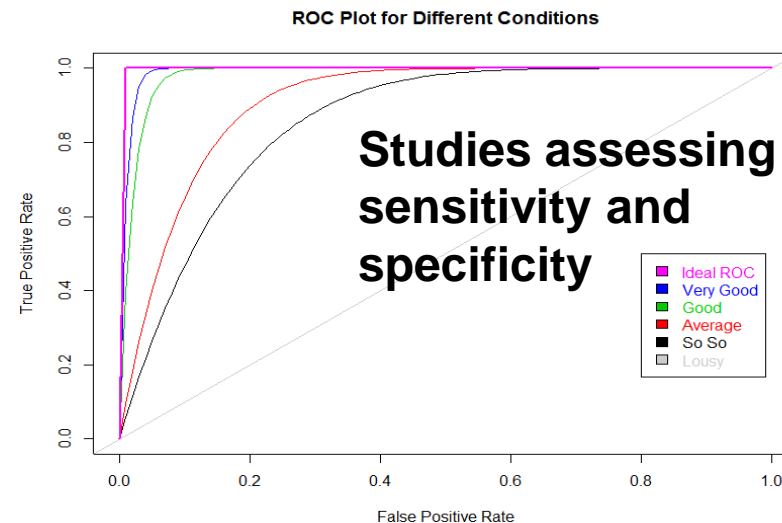
Task-driven

SWGDM Validation Guidelines for DNA Analysis Methods (2016)

- ✓ 4.1 Known and nonprobative evidence samples
- ✓ 4.2 Sensitivity and stochastic studies
- ✓ 4.3 Precision and accuracy: repeatability
- ✓ 4.3 Precision and accuracy: reproducibility
- ✓ 4.4 Mixture studies
- ✓ 4.5 Contamination assessment
- ✓ *4.4 Mixed DNA samples that are representative of those typically encountered by the testing laboratory should be evaluated*

Performance-based

Right side of  
the equation



ANSI/ASB Standard 020, First Edition  
2018

Standard for Validation Studies of DNA Mixtures, and  
Development and Verification of a Laboratory's Mixture  
Interpretation Protocol



Initially developed by  
OSAC in 2016 (Biological  
Data Interpretation and  
Reporting Subcommittee)

**ANSI/ASB approved  
in September 2018**



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410 North 21st Street, Colorado Springs, CO 80904, asb.aafs.org.

## A new standard that proposes working from the right side of the equation

*Foreword:* “Following development, it is critical for a laboratory to **verify that the interpretation protocols work as designed.**” (i.e., to be **performance-based rather than task-driven**)

“**4.3** The **data** from the validation studies performed by the laboratory **shall be the basis for the interpretation parameters and protocols developed** by the laboratory and shall provide guidance for the types of mixed DNA profiles that will be interpreted by the laboratory.”

“**4.4** The laboratory shall **verify and document** that the **mixture interpretation protocols developed** from the validation studies **generate reliable and consistent interpretations and conclusions** for the types of mixed DNA samples typically encountered by the laboratory.”





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

One of Our Nation's First Forensic Laboratories



Physics PhD, University of Chicago (1916)

**Worked more than 800 forensic cases from 1929 to 1953**

Handwriting, typewriter identification, and ballistics analysis

**Helped set up the FBI Laboratory (1932)**

Testified as a handwriting expert in the Lindbergh baby kidnapping case (1935)

<https://www.nist.gov/featured-stories/who-was-detective-x>

# Perspectives from History:

## Are we on the right side of the equation?

In his 1933 talk to the International Association of Chiefs of Police entitled “**Beware the Amateur Expert**”, Wilmer Souder from the National Bureau of Standards states:

- “Today **many workers are operating without the least supervision or concern as to what is correct scientific procedure**. Too often their enthusiasm outruns their training and ability. Some serious complications naturally develop under such conditions.” He continues: “**Success comes from skill in selecting the proper method and following it through in its correct application**.” And later: “The safe investigator has standards to be observed.” He concludes: “I hope this bold admission of our lack of standards in what should be a highly scientific field will not discourage you.”

In 1933 and 1934, Wilmer Souder spoke to the IACP. His remarks were reprinted in a 1977 book entitled “*Silent Witness: The Emergence of Scientific Criminal Investigations*”, which is the third volume of a Police History Series.

# Perspectives from History:

## Are we on the right side of the equation?

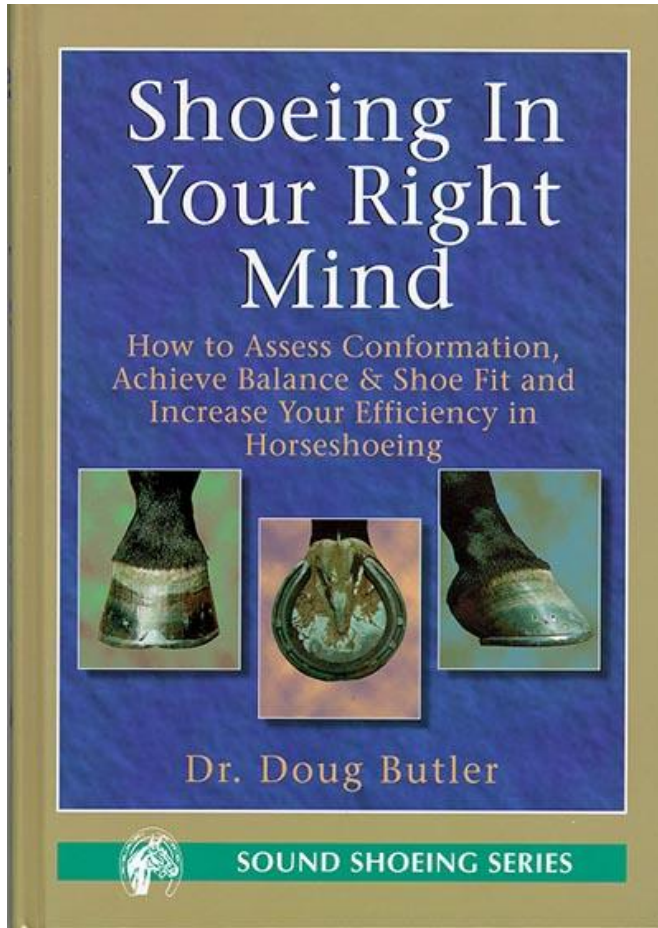
**L.J. O'Rourke of the U.S. Civil Service Commission spoke to the International Association of Chiefs of Police in 1936; his talk was entitled "Scientific Standards in Criminal Investigations":**

- **"...the use as a basis for evidence of instruments whose validity is not known will merely discredit investigation work."**
- He pleads **"for greater knowledge of validity of [scientific] methods and the development of more valid measures."**
- O'Rourke proposes setting up **"a National Bureau of Standards in Criminology** to conduct scientifically controlled experiments and to evaluate present practices." He emphasizes: **"To make better use of [scientific] methods, law enforcement agencies must be certain of their limitations as well as of their merits."**

His remarks were reprinted in a 1977 book entitled *"Silent Witness: The Emergence of Scientific Criminal Investigations"*, which is the third volume of a Police History Series.



# With What Mindset Do You Approach a Problem?



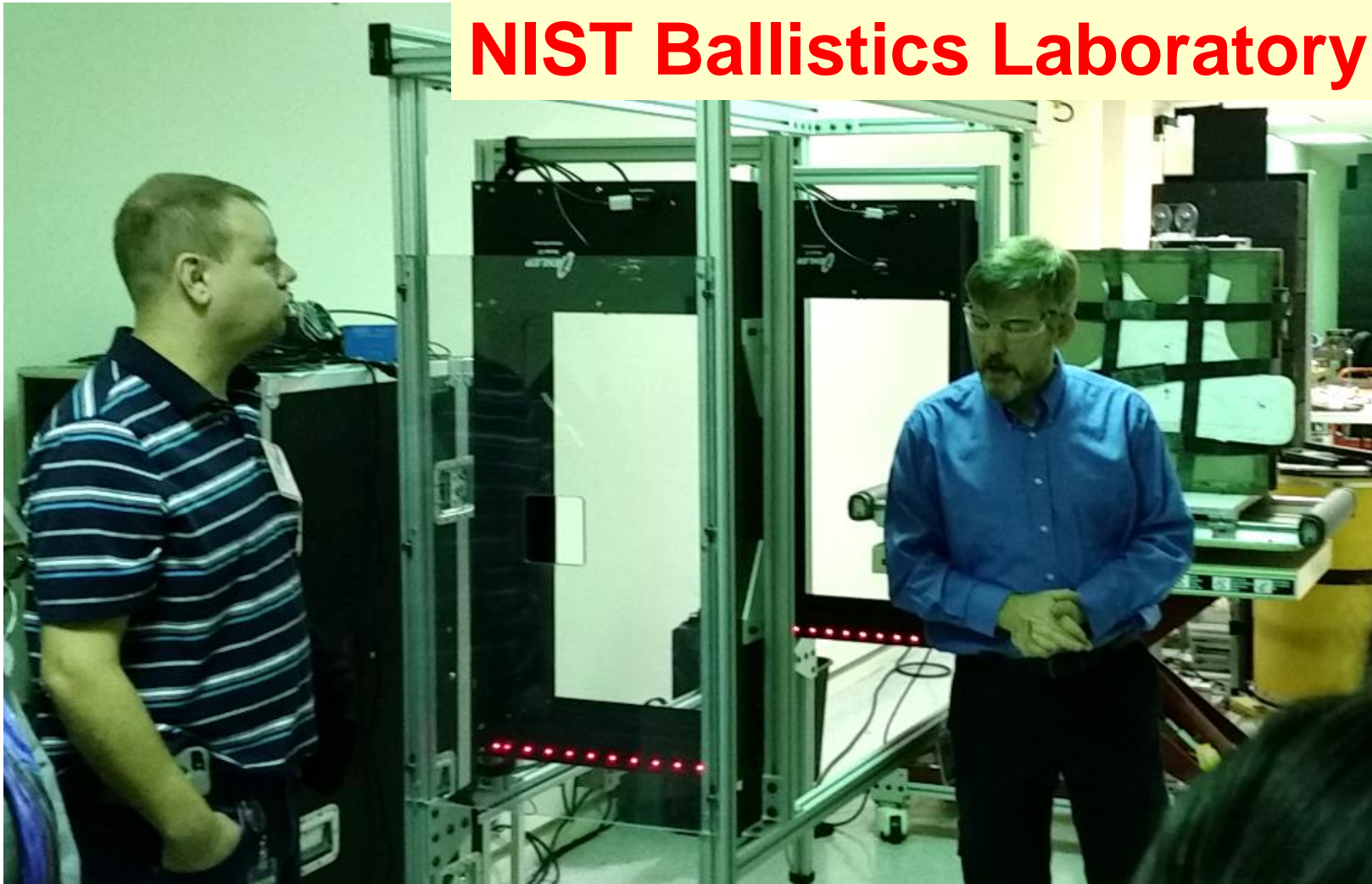
Published in 1998

- Are you using the left side or the right side of your brain in problem solving?
  - Left-side = linear, verbal, and sequential thinking
  - Right-side = spatial perception & creativity
  - *We need both sides to create the best solutions*
- Are we task-driven (left-side of the equation) or performance-based (right-side of the equation) in our work?
  - *We need both sides to create the best solutions in forensic science*
  - This applies to both researchers and practitioners



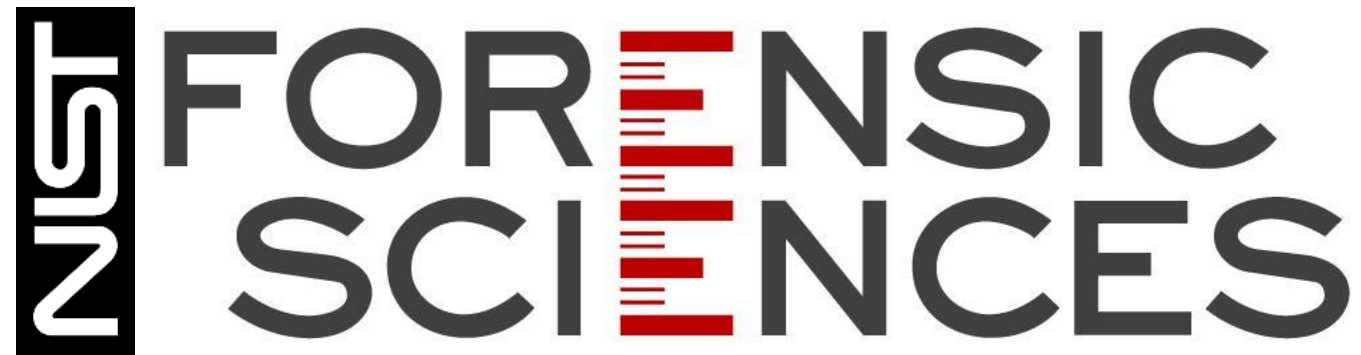
# Take Time to Go on a NIST Tour While You are Here...

## NIST Ballistics Laboratory



**NIST researcher Mike Riley** describing NIST test methods for evaluating body armor (bulletproof vests) to Forensics@NIST 2016 participants

# Thank you for your attention!



[www.nist.gov/forensics](http://www.nist.gov/forensics)

301-975-4049    john.butler@nist.gov