



SAA NEWSLETTER

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Founding President: Churchill Eisenhart (1913–1994)

June 2016

What's Up at NIST?

The guest speaker at the annual SAA Spring Luncheon was Dr. Willie May, Director of NIST and Undersecretary of Commerce for Standards and Technology. In a wide-ranging presentation entitled “What’s Up at NIST,” Dr. May provided an overview of the state of NIST programs, budget, facilities, and recent news headlines.

Dr. May opened his presentation with comments that he was pleased to be able to speak to the SAA members. He said that he had flown home on a red-eye the previous night to be sure he could make it to the luncheon.

NIST is well known around the world and he is very proud to be its director. He said that he has come to realize that the NIST brand has a greater value than NBS ever had—“Congress sees who we are” and what we do; and the Visiting Committee now includes business leaders as well as technical leaders.

NIST is a “world class scientific and technical agency” and there is “no one close to us” in terms of an “excellent staff who are totally loyal to the organization.” NIST has “a great and unique mission.” It is “a key player on the Administration’s Innovation Team; it is the nation’s go-to-agency for measurements, standards and technology; and it is receiving bipartisan and bicameral support...Since our inception as the National Bureau of Standards in 1901, in addition to maintaining the more traditional national physical measurement standards, we have also focused a significant portion of our resources and measurement activities on addressing contemporary societal needs.”

In 1901, NBS supported the industrial revolution—interoperability of fire-hose screw threads, light-bulb standards, standards for iron and steel works, and cooperation with the ICC to reduce railroad accidents.

Today, NIST is a leader in advanced communications, advanced manufacturing, bioscience and health, climate assessment, cyber-physical systems, cybersecurity, disaster resilience, forensic science, and quantum science. Some groups are pushing for NIST to take on a more reg-

ulatory role, but NIST strives to be the pre-eminent expert, not the cop and Dr. May believes it should remain so.

Staffing

In filling the position of the NIST Principal Deputy and Associate Director for Laboratory Programs the search focused on someone who: (1) truly understands NIST and its Mission; (2) is open-minded and outcome oriented; (3) has demonstrated a willingness to lead strategically; (4) is an excellent communicator; (5) is an advocate for continual improvement of support functions; (6) has well recognized technical chops; and (7) has experience with “crisis management.” There were six persons interviewed. Dr. Kent Rochford was selected for the position (see the March *SAA Newsletter*,

Facilities and Staffing

NIST has two large research campuses—Gaithersburg: 62 buildings, 578 acres and Boulder: 26 buildings, 262 acres. It has partnerships in every state—60 Manufacturing Extension Services and ten Joint Institutes/Centers of Excellence. NIST staff numbers 3,400 federal employees and 3,700 Guest Researchers and Associates (64 percent domestic and 36 percent foreign) from academia, industry and government. Over 400 NIST staff participate on about 1000 standards committees.

Budget and Programs

The FY2016 appropriations of \$964M provide \$690M for the NIST labs, \$155M for Industrial Technology Services, and \$119M for construction of research facilities. Additional 2016 funding for the labs includes about \$120M in other agency funding and another \$50M from reimburseable services. Thus, the FY2016 funding for the NIST Laboratory programs totals about \$860M. The seven NIST Laboratories address three major areas:

- Metrology (MML and PML),
- Technology (EL, ITL, CTL), and
- National User Facilities (CNST, NCMR and part of CTL).

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For the past several years during the budgetary growth spurt, the increase in STRS funds was more than sufficient to cover Congressional Priorities built into the funding. For FY2016, however, while there was an increase of about \$14.5M, Congress specified \$39M in congressional priorities. In addition inflationary costs across NIST will be about \$16.8M. The President has proposed significant increases for the FY2017 but at this point they are not expected to materialize. (see Management and Admin News on page 9 for the latest budget news).

The NIST Advanced Manufacturing Program is building a national network for manufacturing innovation. This year NIST is investing \$170M in advanced manufacturing research in areas including: advanced materials, "smart" manufacturing. 3D-printing/additive manufacturing, lightweighting, nanomanufacturing, synthetic biology/biomanufacturing, and digital thread.

The NIST Center for Neutron Research in 2015 had 2,436 research participants from 37 government labs and from 41 states, 50 corporations and 183 universities. The Center for Nanoscale Science and Technology has more than 2,000 research participants each year from over 450 collaborating organizations.

Joint Institutes and Centers for Excellence

NIST "more than doubles our research talent through on-campus research collaboration." The Joint Institutes and Centers For Excellence leverage the nation's best experts in science and technology.

The **National Cybersecurity Center of Excellence** is a new model of cooperation that is accelerating the deployment and use of secure, standards-based technology. The Center, a partnership between NIST, Montgomery County, the State of Maryland and 22 industry partners is located about three miles from NIST's Gaithersburg campus. (see page 21 of the March *SAA Newsletter*.)

The **National Forensic Science Center of Excellence**, hosted by Iowa State University held its kickoff meeting in Ames, IA last October. Other partners in the Center are Carnegie Mellon University, the University of California, Irvine, and the University of Virginia.

The five other Joint Institutes are: (1) [Joint Institute for Laboratory Astrophysics](#), (2) [Institute for Bioscience and Biotechnology Research](#), (3) [Hollings Marine Laboratory](#), (4) [Joint Quantum Institute](#), (5) [Joint Center for Quantum Information and Computer Science](#); and (6) [Joint Initiative for Metrology in Biology](#).

There are two additional Centers of Excellence: [Center for Hierarchical Materials Design](#); and [Center for Risk-Based Community Resilience Planning](#).

This newsletter is published quarterly by the Standards Alumni Association for its membership and the staff of the National Institute of Standards and Technology. Its content is the responsibility of the SAA and contributors to the newsletter. The newsletter is not a publication of the U.S. government and should not be taken as reflecting either policies of NIST or opinions of the NIST management and staff members unless explicitly so stated. Items taken from NIST publications have been edited to comply with the newsletter's editorial policies on staff recognition, brevity and language usage.

Security

The explosion in Building 236 (Gaithersburg campus) on July 18, 2015 (see *SAA Newsletter*, September, 2015) and its aftermath resulted in a major investigation of NIST police by the House Science Committee that is having an impact on the security environment on both the Gaithersburg and Boulder campuses.

As reported in the March *SAA Newsletter*, the group of three highly respected security experts convened in September to review NIST security policies produced a report that identified six areas that need to be addressed: (1) authorities, (2) culture, (3) risk, (4) organization, (5) resources, and (6) strategic planning.

The turnstile security gate between Building 101 and the adjacent laboratory building was already being planned because of all of the conference attendees in Building 101 who could easily walk into the restricted lab areas in the adjoining buildings. Dr. May commented that it is unfortunate that we are living in a different world than a few years ago. But it is clear that, besides doing what is necessary, if we don't take the proper steps to manage and protect our sites there are "lots of folk" who would be glad to "help." The turnstile has been the source of some debate and complaints since its installation, but the question which must be addressed is what if anything needs to be done to improve the use, not whether or not there should be security to limit access at that location.

Another step that has been taken recently that flows from the security report is the updating of email addresses to include designations for staff, contractor, international contractor, associate and international associate. The findings in the security report are currently being considered and discussed in collaboration with the DoC Office of Security and an action plan is being developed.

Dr. May then discussed the unauthorized access to facilities on the Boulder campus that occurred on April 16. At approximately 5:30 a.m. a manual fire alarm was activated in Bldg. 81 in Boulder (the Katharine Blodgett Gebbie Laboratory). A DoC Police officer on patrol encountered an intruder in his mid-30s. The individual had no identification and was not an authorized user of the laboratory. The man apparently entered an open window on the third floor of the building and spent an undetermined length of time wandering about the building, including the clean room.

As a result of this incident, NIST has notified the Secretary of Commerce that it is determining cost and timing for the installation of a perimeter fence, "on an urgent basis," and will let a contract to do so as soon as possible. The Boulder campus has traditionally been an open campus that is frequently traversed by walkers and hikers. The security fence, when built, will restrict non-NIST employees from accessing the campus except through a security gate. Discussions will be held with the community to try to work out acceptable alternatives, but it is clear that free and open access to the Boulder campus will end. Other steps that will be taken for the Boulder campus will be (1) to shore up

IMPORTANT NOTICE

A new printed copy of the SAA Membership Directory is being prepared. It will be sent to each Member via U.S. Mail in the near future.

Watch for it in your mailbox!

surveillance around the site—especially construction site scaffolding, (2) to require vigilance with respect to keeping doors and windows closed during off hours, and (3) to require PIV Card use for entrance.

Because of these two incidents, and the subsequent attention from Congress and the public that has been generated by them, Dr. May said that we will have no choice but to "tighten up security on both campuses."

A question and answer session followed Dr. May's presentation.

—Roger Martin

1. PRESIDENT'S MESSAGE

I am back as your president. I had hoped to preside over the first *SAA Newsletter* with a centerfold but the editor said that it would be better to provide as a separate mailing. You will receive an updated Membership Directory in the near future.. We are planning on providing an updated directory to all members every year or two. Please send us corrections and changes to your information.

This past quarter we bade farewell to NYMEO, the credit union. NYMEO was the successor to COMSTAR which in turn was the successor to the NBS-HDL Federal Credit Union. NYMEO is moving across Quince Orchard Boulevard to a building on Bank Street and is scheduled to open in June. We also bade farewell to Dr. Barbara Basuk who was the physician in the Health Unit for the past sixteen years.

These two leave-takings remind me of others from the basement of the Admin Building: the police station, the bank, the blind stand, the beauty shop, the barber shop, Printing and Duplicating, and the mail room with its public mailbox. The basement of Admin is very quiet these days.

I encourage you to write articles for the newsletter telling us about your life and interests.

I want to thank all of the SAA volunteers, past and continuing, for their efforts.

And now, a quiz. Do you know what oobleck is? If you'd like to find out see <<http://www.nist.gov/mml/msed/a-crack-in-the-mystery-of-oobleck-friction-thick-ens-fluids.cfm>>.

—Jeffrey Horlick

2. JULY 21 - QUARTERLY MEETING

The Subject: “The Evolution of Metrology in Biology”

The Speaker: Dr. Laurie E. Locascio

Director of MML

Date: Thursday, July 21, 2016

Time: 1:30 PM

(PLEASE NOTE CHANGE IN TIME)

Place: Bldg 101, Lecture Room A

NIST’s first bioscience division was established in the early 1990s and was way ahead of its time. In the 25 years since then, the field of bioscience has emerged from a largely qualitative or observational field to a field where new quantitative measurement tools rapidly develop and become quickly outdated by the next generation of technological advances. As the field has progressed, so has NIST’s program to the point where NIST is shaping the discussion on biometrology around the globe. The complexity of biology is daunting—but the overlay of new metrology tools can help to break down the problem of interpreting biological data and enable us to understand complicated issues such as disease and wellness.

Our speaker, Dr. Laurie E. Locascio, is the director of the Material Measurement Laboratory which has more than 1,000 staff members and visiting scientists and an annual budget of more than \$174M. Dr. Locascio previously served as chief of the Biochemical Sciences Division in MML.

She received her B.Sc. in chemistry from James Madison University, M.Sc. in bioengineering from the University of Utah, and Ph.D. in toxicology from the University of Maryland School of Medicine. She has published more than 100 scientific papers and holds eight patents in the fields of microfluidics, biosensors and sensor/flow systems. Some of her honors and awards include the *Silver Medal Award*, *Bronze Medal Award*, ACS Division of Analytical Chemistry *Arthur F. Findeis Award*, the NIST Applied Research Award, and she is a Fellow of the American Chemical Society.

—Bill Gadzuk

3. APRIL 28 - ANNUAL MEETING REPORT

Fifty-two members and guests attended the 2016 Annual Meeting and Spring Luncheon at the Golden Bull Grand Café in Gaithersburg on April 28, 2016.

In the business portion of the meeting, outgoing president, Jim Schooley, announced the results of the annual election of the Standards Alumni Association officers. The new SAA officers, who have terms that run from April 2016 to April 2017, are:

President: Jeffrey Horlick

VP: Bettijoyce Lide

VP: William Ott

Director: Herbert Bennett

Director: Harry Hertz

Director: William Kirchoff

Director: Michael Kurylo

Before turning over the gavel, Jim told the members present that this was his last gig and it was time to retire. He said, “I have enjoyed so much being part of the SAA Board and my turn as President,” and commented that he “will have trouble staying away.” He then turned the meeting over to Jeffrey Horlick.

Sheldon Wiederhorn (Awards Committee Chair) was unable to attend the meeting so Richard Wright announced the SAA Awards for 2016 (see page 35 for a list of the awardees).

Our distinguished after-luncheon speaker was NIST Director Willie May, who provided an interesting and informative discussion on “What’s Up at NIST?” (see the front page article in this newsletter for details).

The following members and guests attended the Annual Meeting:

| | |
|------------------------------|-----------------------|
| Karma Beal | Roger Martin |
| Betty & Scott Brown | Willie May |
| Michael Chernik | Janet Miller |
| Richard & Judith Christensen | Don Novotny |
| Jack & Rita Colwell | Hans Oser |
| Edmund DiMarzio | Daniel Pierce |
| Eugene Domalski | Kenneth Pratt |
| Robert Dragoset | Richard Raybold |
| Anna Fraker | Joe & Evelyn Reader |
| Cita Furlani | Dick Rhorer |
| Bill Gadzuk | Mike Rowe |
| Jim Harris | Joan Schneider-Wilson |
| Harry Hertz | Ralph Schofer |
| Jeffrey & Faith Horlick | Jim Schooley |
| Shafique Khan | Lyle Schwartz |
| Bill Kirchoff | Lorna Sniegowski |
| Ralph Krause | Jeannette Todd |
| Allan Laufer | Sara Torrence |
| Suzanne Law | Vanda White |
| Barbara & Ira Levin | Jim Wilson |
| David Lide | Christoph Witzgall |
| Richard Lindstrom | Richard Wright |
| Paul Majewski | Mary Wykes |

—Roger Martin

4. NEWS FROM NIST

Technical News

Editor’s note: Most NIST technical news articles are now available as “NIST News Releases.” You can find a hyperlinked index of current and past NIST News Releases dating back to 1999 at <http://www.nist.gov/allnews.cfm?s=01-01-2016&e=12-31-2016>

Optomechanical Transducer Links Sound, Light and Radio Waves

NIST researchers have developed a “piezo-optomechanical circuit” to convert signals among optical, acoustic and radio waves.

As transistors shrink, heat and other factors begin to have magnified effects in circuits. To mitigate these effects, researchers are considering designs in which electronic components interface with physical systems that carry information in other ways (e.g. light and sound). Light is able to carry a lot of information and typically interacts less with its environment, hence with less waste heat. However, light is difficult to store for long periods and it can't interact directly with some components of a circuit. Acoustic-wave devices, on the other hand, are used in wireless communications technology since sound's lower speed makes it easier to store for long periods in compact structures.

To test transduction techniques needed to utilize both light and sound, Center for Nanoscale Science and Technology researchers and their collaborators¹ built a piezo-electric optomechanical circuit on a chip.

The heart of this circuit is an optomechanical cavity consisting of a suspended nanoscale beam. Within the beam are a series of holes that act as a “hall of mirrors” for light (photons). Photons of a very specific color or frequency bounce back and forth between these mirrors thousands of times before leaking out. At the same time, the nanoscale beam confines phonons (quanta of mechanical vibrations), at GHz frequencies. The photons and phonons exchange energy so that vibrations of the beam influence the buildup of photons inside the cavity and the buildup of photons influences the size of the mechanical vibrations. The strength of this mutual interaction, or coupling, is one of the largest reported for an optomechanical system.

A major innovation is the joining of these cavities with acoustic waveguides. By channeling phonons into the optomechanical device, the motion of the nanoscale beam can be directly manipulated. Because of the energy exchange, the phonons can change the properties of the light trapped in the device. Piezoelectric materials, which deform when an electric field is applied to them are used to generate the sound waves. A structure known as an “interdigitated transducer” (IDT), which enhances this piezoelectric effect, was used to establish a link between radio frequency electromagnetic waves and the acoustic waves. The strong optomechanical links enable the optical detection of this confined coherent acoustic energy down to the level of a fraction of a phonon.

The research team also observed controllable interference effects in sound waves by pitting electrically and optically generated phonons against each other. According to **Kartik Srinivasan** the “piezo-optomechanical circuit”

might allow detailed studies of these interactions and the development of phononic circuitry that can be modified with photons.

Source: [NIST News Release, March 28, 2016](#).

New Tool for Breast Cancer Screening

Researchers in the Applied Physics Division have developed the first widely useful standard for magnetic resonance imaging (MRI) of the breast.²

“Phantoms” are artifacts that mimic the response of human tissue to help test the performance and comparability of medical imaging systems. NIST's new breast phantom can be used to compare MRI scanners, train operators, and standardize MRIs of breast tissue. The phantom supports quantitative MRI, which is increasingly used for breast cancer diagnosis, staging and treatment monitoring as well as for imaging other parts of the body.

NIST's prototype breast phantom was tested on MRI systems from two manufacturers in three configurations and produced accurate, quantitative images that could be used to evaluate common imaging procedures. The new phantom is already being used in clinical trials at the University of California San Francisco.

The NIST phantom is widely useful because it fits most major MRI scanner designs and meets a full range of common clinical imaging needs. In addition, like NIST's other MRI phantoms, the breast phantom generates image data that can be traced to international measurement standards.

The biggest design challenge was to create a lifelike mimic of both fat and fibroglandular tissue, says project leader **Katy Keenan**. The phantom has a flexible, modular design. The soft silicone shell (150 mm by 125 mm) enables fitting to different MRI scanners. Internal components are made of rigid polycarbonate to ensure regular geometry. The phantom has two basic types of internal arrangements, that can be paired for MRI scans.

One unit is designed for conventional MRI scans based on magnetic properties of hydrogen atoms. This unit contains four layers of small plastic spheres filled with tissue mimics—corn syrup in water to represent fibroglandular tissue and grapeseed oil to represent fat. Potential future options include solutions of modified spheres that would mimic either benign cysts or tiny bits of calcium called microcalcifications, which can signal cancer.

The second phantom unit is designed for the newer technique of diffusion MRI, which measures the motion of water molecules within the breast. This unit contains plastic tubes filled with varying concentrations of a non-toxic polymer (polyvinylpyrrolidone), similar to NIST's diffusion MRI phantom. The solutions are tuned to mimic

² K.E. Keenan, A.P. Peskin, L.J. Wilmes, S.O. Aliu, E.F. Jones, W. Li, J. Kornak, D.C. Newitt and N.M. Hylton, “Variability and bias assessment in breast ADC measurement across multiple systems,” *JMRI*, March 23, 2016. DOI: 10.1002/jmri.25237. < <http://onlinelibrary.wiley.com/doi/10.1002/jmri.25237/full>>

(continued on next page)

¹ K. Balram, M. Davanço, J. Dong Song and K. Srinivasan.

“Coherent coupling between radio frequency, optical, and acoustic waves in piezo-optomechanical circuits.” *Nature Photonics*. March 28, 2016. DOI: [10.1038/nphoton.2016.46](https://doi.org/10.1038/nphoton.2016.46).

the differing diffusion properties of malignant tumors versus benign tumors. A multi-site trial is planned to examine measurement variations at clinical imaging centers.

Sources: NIST News Release, [March 23, 2016](#)

New Rechargeable Battery Material

Chemically modifying and pulverizing a promising group of compounds may bring safer solid-state rechargeable batteries two steps closer to reality. The compounds, made from commonly available substances, are stable solid materials that don't pose the risks of leaking or catching fire typical of traditional liquid battery ingredients.

Since discovering their properties in 2014, a research team from the NIST Center for Neutron Research (NCNR), Japan's Tohoku University, the University of Maryland, and Sandia National Laboratories have sought to further enhance the compounds' performance in two key ways: (1) increasing the current-carrying capacity and (2) ensuring that they can operate in a sufficiently wide temperature range to be useful in real-world environments.³

The first advance came when the team discovered that the original compounds—made primarily of hydrogen, boron and either lithium or sodium—were even better at carrying current with a slight change to their chemical makeup. Replacing one of the boron atoms with carbon resulted in an order of magnitude improvement in the ability to conduct charged particles, or ions, which are what carry electricity inside a battery.

Perhaps more important was the second advance—clearing the temperature hurdle. The compounds conducted ions well enough to operate in a battery as long as it was in an environment typically hotter than boiling water. However, by the time they cooled to room temperature, the favorable chemical structure often changed to a less conductive form, substantially decreasing performance.

One solution turned out to be crushing the compounds' particles into a fine powder. The team had been exploring particles measured in micrometers, but as nanotechnology research has demonstrated time and again, the properties of a material can change dramatically at the nanoscale. They found that pulverizing the compounds into nanometer-scale particles resulted in materials that could still perform well at room temperature and far below.

"This approach can remove worries about whether batteries incorporating these types of materials will perform as expected even on the coldest winter day," said NCNR's **Terry Udovic**. "We are currently exploring their use in next-generation batteries, and in the process we hope to convince people of their great potential."

Source: NIST News Release, [April 1, 2016](#).

³ W.S. Tang, M. Matsuo, H. Wu, V. Stavila, A. Unemoto, S. Orimo and T.J. Udovic. Stabilizing Lithium and Sodium Fast-Ion Conduction in Solid Polyhedral-Borate Salts at Device-Relevant Temperatures. *Energy Storage Materials*, published online March 31, 2016. DOI: [10.1016/j.ensm.2016.03.004](https://doi.org/10.1016/j.ensm.2016.03.004).

Nanodevice Shifts Colors at Single-Photon Level

Converting a single photon from one color, or frequency, to another is an essential tool in quantum communication, which harnesses the subtle correlations between the subatomic properties of photons to securely store and transmit information. The Center for Nanoscale Science and Technology has developed a miniaturized version of a frequency converter, using technology similar to that used to make computer chips.⁴

The tiny device promises to help improve the security and increase the distance over which next-generation quantum communication systems operate. It can be tailored for a wide variety of uses; enables easy integration with other information-processing elements; and can be mass produced. The new nanoscale optical frequency converter efficiently converts photons from one frequency to the other while consuming only a small amount of power and adding a very low level of noise, namely background light not associated with the incoming signal.

Frequency converters are essential for addressing two problems.

First, the frequencies at which quantum systems optically generate and store information are typically much higher than the frequencies required to transmit that information over kilometer-scale distances in optical fibers. Converting the photons between these frequencies requires a shift of hundreds of terahertz (one THz is 10^{12} wave cycles per second).

A much smaller, but still critical, frequency mismatch arises when two quantum systems that are intended to be identical have small variations in shape and composition. These variations cause the systems to generate photons that differ slightly in frequency instead of exact replicas which may be required by the quantum communication network.

The new photon frequency converter, an example of nanophotonic engineering, addresses both issues. The key component of the chip-integrated device is a tiny ring-shaped resonator, about 80 μm in diameter (slightly less than the width of a human hair) and a few tenths of a μm in thickness. The shape and dimensions of the silicon nitride ring are chosen to enhance the inherent properties of the material in converting light from one frequency to another. The ring resonator is driven by two pump lasers, each operating at a separate frequency. In a scheme known as four-wave-mixing Bragg scattering, a photon entering the ring is shifted in frequency by an amount equal to the difference in frequencies of the two pump lasers.

Like cycling around a racetrack, incoming light circulates around the resonator hundreds of times before exiting, greatly enhancing the device's ability to shift the photon's frequency at low power and with low background noise. Rather than using a few watts of power, as typical in

⁴ Q. Li, M. Davanço and K. Srinivasan. Efficient and low-noise single-photon-level frequency conversion interfaces using silicon nanophotonics. *Nature Photonics*, 18 April 2016. DOI: [10.1038/nphoton.2016.64](https://doi.org/10.1038/nphoton.2016.64)

previous experiments, the system consumes only about a hundredth of that amount. Importantly, the added amount of noise is low enough for future experiments using single-photon sources.

Source: NIST News Release: [April 18, 2016](#).

New Insights into Nature's Self-Assembly

Debra Audus and **Jack Douglas** (Material Science and Engineering Division) and Francis Starr (Wesleyan University) have come up with a new approach for predicting the clustering behavior of particles in fluids, an environment in which self-assembly frequently occurs.

The three scientists added another layer of realism to a so-called “patchy” particle model, a popular tool for investigating how particles interact in liquids.⁵ These models are simplified representations that show how inter-particle forces steer self-assembly processes. They can streamline efforts to identify the basic principles at work, saving researchers from having to piece them together through trial-and-error experiments.

Typically, patchy particles are spheres whose surfaces are precisely “decorated” with several patches—each possessing a directional attractive force, or bond. The team additionally cloaked their five-patch particles with a pervasive, uniform force akin to the ubiquitous van der Waals forces arising from molecular interactions. Though feeble, these attractive forces exert significant influence on the ultimate shape of multi-particle structures.

Including both types of forces in the model set the stage for a dynamic competition that defined where cluster formation and self-assembly occur. Changing the size of the particle-encompassing attractive force altered how particles were distributed into differing density phases. As the uniform force increased, the temperature at which particles began to separate also increased, and the region where self-assembly took place decreased. These relationships were revealed through a computer-intensive random sample simulation of the complex systems. The complex calculations engaged multiple computers for nearly a month.

In analyzing the simulation results, the team determined that their five-patch particles behaved like swollen, branched polymers, a well-studied class of materials. They also identified the thermodynamic conditions under which self-assembly behavior will emerge, and have described methods for determining the average molecular weight of clusters and their size distribution.

Source: [NIST News Release, April 19, 2016](#).

⁵ D.J. Audus, F.W. Starr, and J.F. Douglas, “Coupling of isotropic and directional interactions and its effect on phase separation and self-assembly.” *Journal of Chemical Physics*, 144, 074901 (2016); <http://dx.doi.org/10.1063/1.4941454>.

Quantum Thermometer

Physicists from the Physical Measurement Laboratory and the Joint Quantum Institute have found a way to calibrate temperature measurements by monitoring the motions of a nanomechanical system that are governed by rules of quantum mechanics. While the method is not yet ready for commercialization, it reveals how an object's thermal energy can be determined precisely by observing its physical properties at the quantum scale.

The approach works over a wide temperature range encompassing cryogenic and room temperatures and is accomplished with a small, nanofabricated photonic device.

The approach arose from the team's efforts to observe the vibrations of a silicon nitride crystal using a narrow beam of laser light. Thermal energy makes the atoms and molecules in material vibrate; the warmer the object, the more pronounced the picometer vibrations. To observe these tiny perturbations, a small reflective cavity was carved into crystal. When a laser beam passes through the crystal, the light reflecting from the cavity has slight measurable shifts in color or frequency due to temperature-induced (thermal) vibrations of the cavity walls.

All objects possess a much more subtle quantum-mechanical property called “zero-point motion.” These intrinsic quantum fluctuations are independent of temperature and have a well-known amplitude that is thousands of times fainter than the thermal vibration. As a result they normally are lost in the noise of the thermal vibration.

The process of measuring the laser beam provides a method to distinguish the quantum and thermal fluctuations. When photons from the laser bounce off the sides of the beam, they give it slight kicks, inducing correlations that make the quantum motion more pronounced. By comparing the relative size of the thermal vibration to the quantum motion, the absolute temperature can be determined.

“Our technique allowed us to tease the quantum signals out from under the much larger thermal noise,” says **Tom Purdy**, a physicist in the Quantum Measurement Division. “Now we can directly connect temperature to the quantum mechanical fluctuations of a particle. It sets the stage for a new approach to primary thermometry.”⁶

The power of this new method, when fully developed, will come when the beam is paired with other much more sensitive on-chip photonic thermometers also under development at NIST. This quantum thermometer will act as an integrated temperature standard, ready to keep the other thermometer on track over long periods of time.

Source: [NIST News Release, March 15, 2016](#).

Monitoring Underground Sequestered Carbon

Capturing carbon dioxide (CO₂) gas and storing it underground is a promising strategy for reducing greenhouse gases in the atmosphere. Carbon sequestration involves

⁶ Purdy presented the team's results on March 16, 2016, at the American Physical Society March Meeting in Baltimore, MD.

(continued on next page)

removing CO₂ gas from large emission sources, capturing it and pumping deep into the earth and out of the biosphere. NIST, in collaboration with Harris Corporation and Atmospheric and Environmental Research (AER), has taken an important first step in validating a technique for monitoring CO₂ emissions from sequestration sites.⁷

Sequestered CO₂ must remain underground for centuries. If more than 0.1 percent of the gas leaks out per year, it's all for nothing. So scientists from around the world have been trying to develop an effective way to monitor sites for potential gas leaks.

One approach places a system of laser reflectors directly over a carbon storage site to scan for escaping gas. Traditional methods of scanning the region with a laser can reveal leaks. Collecting useful data, however, requires a half-hour period when the wind does not shift and the sampled atmosphere does not change. This isn't a common situation, and if the wind shifts, the data is ruined.

Harris and AER built a laser-based measurement system under a cooperative agreement with the DoE's National Energy Technology Laboratory. The system collected data over a mock storage site in Ft. Wayne, Indiana. The data was submitted to NIST for analysis. NIST developed a mathematical model to analyze the data. The model considers the change in shape of a gas leakage plume in the wind and factors out other CO₂ sources in the sequestration area. The practical upshot is that wind variables and other outdoor field conditions are no longer a constraint.

The results from their analysis surprised them, and not just because of the pleasing findings. They could now, according to their simulations, pinpoint a gas leak from the ground to within about 5 m (ten times more accurately than other approaches) and regardless of the wind conditions.

"What surprised us is that even though one of these experiments was meant to be one with no carbon source present, we found one anyway," said NIST physicist **Zachary Levine** (Sensor Science Division). "This was supposed to be the 'null set' that we were going to compare with data from another field that has an artificial carbon dioxide source buried beneath it. He added that "the approach means far fewer demands placed on the laser sensors, and much reduced worries about unrealistic wind conditions. It also means we can detect less intense leaks with far better spatial resolution."

Source: [NIST News Release, April 20, 2016](#).

Laser 'Combing' - Identifying Large Molecules

Using a laser cooling technique developed by their Harvard collaborators, JILA physicists have extended the

capability of their powerful laser "combing" technique to identify the structures of large, complex molecules of the sort found in explosives, pharmaceuticals, fuels and the gases around stars. The new spectroscopic techniques will improve the ability to study interactions between matter and light used for a wide range of applications.⁸

The tabletop-sized apparatus is based on a laser frequency comb.⁹ JILA researchers developed their original molecule-detection system a decade ago and have demonstrated the technique for many applications requiring molecular sensing and detection. In the combing method, molecules are placed in a hollow chamber, or cavity, in which the comb laser light bounces back and forth. A small fraction of the comb light is absorbed at specific frequencies at which the molecules rotate and vibrate. Each molecule's unique "fingerprint" is identified in the absorption patterns across the thousands of comb frequencies.

The method is sensitive and specific but, until now, has been limited to small, simple molecules made of fewer than 10 atoms. That's because even small molecules can exist in millions of rotation and vibration states, each with a different energy level, making their signals hard to pick out.

Previously, the JILA system probed molecules at room temperature. The upgraded system incorporates Harvard's helium buffer gas cooling method to chill the molecules to a few degrees above absolute zero, drastically slowing their speed and rotation. This simplifies and strengthens absorption signals and greatly boosts the ability to identify the molecules. The buffer gas system also enables the molecules to be probed for more than 10 milliseconds, a thousand times longer than other cold molecule research systems.

By probing many frequencies simultaneously, the combing method is a thousand times more efficient than traditional single-frequency laser spectroscopy. The comb's precision also makes the JILA method more accurate and sensitive than conventional broadband spectroscopy using white-light sources.

This enhanced system has been used to identify organic compounds with carbon-hydrogen bonds that can vibrate and rotate in multiple ways. The team has been able to quickly detect (30 minutes to several hours) the first high-resolution absorption patterns of multiple vibrations of carbon-hydrogen bonds in four complex molecules containing seven to twenty-six atoms—nitromethane, naphthalene, adamantane and hexamethylenetetramine.

⁷ Z.H. Levine, A.L. Pinar, J.T. Dobler, N. Blume, M. Braun, T.S. Zacheo and T.G. Pernini. "The detection of carbon dioxide leaks using quasi-tomographic laser absorption spectroscopy measurements in variable wind." *Atmospheric Measurement Techniques*, <<http://www.atmos-meas-tech.net/9/1627/2016/>>, April 13, 2016.

⁸ B. Spaun, P.B. Changala, D. Patterson, B.J. Bjork, O.H. Heckl, J.M. Doyle and J. Ye. 2016. "Continuous probing of cold complex molecules with infrared frequency comb spectroscopy." *Nature*. published online May 4. <<http://dx.doi.org/10.1038/nature17440>>

⁹ <http://www.nist.gov/public_affairs/releases/frequency_combs.cfm>

NIST Appropriation Status

(Dollars in thousands)

| | | | FY 2016 | | | FY 2017 | |
|--------------------------------------|---|--------------------|------------------|----------------|------------------|--------------------|---------------------|
| | | FY 2015 Enacted | Request | Enacted | Request | House Committee | Senate Committee |
| <u>Discretionary Accounts</u> | | | | | | | |
| STRS | NIST Laboratory Programs | \$675,500 | \$754,661 | \$690,000 | \$730,533 | \$680,000 | \$700,000 |
| ITS | Hollings MEP | 130,000 | 141,000 | 130,000 | 141,991 | 130,000 | 130,000 |
| | Advanced MTC ¹ | 8,100 | 15,000 | 0 | | | |
| | NNMI ¹ | | <u>150,000</u> | <u>25,000</u> | <u>47,000</u> | <u>5,000</u> | <u>25,000</u> |
| | | <u>138,100</u> | <u>306,000</u> | <u>155,000</u> | <u>188,991</u> | <u>135,000</u> | <u>155,000</u> |
| CRF | New Construction | 0 | 0 | 60,000 | 40,000 | unspecified | 60,000 ² |
| | Safety, Capacity, Maint. & | <u>50,300</u> | <u>59,000</u> | <u>59,000</u> | <u>54,995</u> | <u>unspecified</u> | <u>59,000</u> |
| | Major Repairs | 50,300 | 59,000 | 119,000 | 94,995 | 50,000 | 119,000 |
| NIST Discretionary Total | | 863,900 | 1,119,661 | 964,000 | 1,014,519 | 865,000 | 974,000 |
| <u>Mandatory Accounts</u> | | | | | | | |
| NNMI | National Network for Manufacturing Innovation | | | | 1,890,000 | | |
| CRF | Construction & Major Renovations | | | | 100,000 | | |

KEY: MEP-Manufacturing Extension Partnership
MTC-Manufacturing Technology Consortia
NNMI-National Network for Manufacturing Innovation

1 With the FY 2016 appropriation, Congress directed that activities related to the Advanced Manufacturing Technology Consortia (Am-Tech) program be merged into the National Network for Manufacturing Innovation (NNMI) program.

2 Report language indicates \$60M is provided for Building 245 renovation. This presentation assumes that the balance is SCMMR.

JILA/NIST Fellow **Jun Ye** says the JILA instrument may help scientists probe and understand 60 atom structures such as buckyballs and may enable studies of new molecular species and real-time chemical reactions.

Source: [NIST News Release, May 4, 2016](#).

Management and Administrative News

Budget Update

FY 2016

Funding for NIST was included in the Consolidated Appropriations Act, 2016 (P.L. 114-113), which was signed by the President on December 18, 2015. For the Scientific and Technical Research and Services (STRS) appropriation, which funds the Laboratory Programs, the Congress provided an increase of \$14.5M or 2.15% over FY 2015, however, the associated Joint Explanatory Statement (114-39) specifies initiative areas and funding levels that exceed the total increase provided. NIST responded by proposing an alternative spending plan and in May finally received approval to allocate the initiative funds and start spending the money.

FY 2017

Commerce Secretary Penny Pritzker testified on the President's FY 2017 Budget request for DoC at Appropriations subcommittee hearings on February 23 (House) and March 3 (Senate)¹⁰. NIST Director Willie May testified on the NIST budget request at a hearing held by the House Committee on Science, Space, and Technology Subcommittee on Research and Technology on March 16.¹¹

Under existing law, the House and Senate are required to adopt a congressional budget resolution that sets overall spending levels which guide Appropriations subcommittee allocations. The House Budget Committee released its version for FY 2017 (H.Con.Res. 125)¹² on March 16, but

¹⁰ Video of the hearing is available at <<http://www.appropriations.senate.gov/hearings/hearing-on-the-fy17-budget-request-for-the-department-of-commerce>>.

¹¹ Video of the hearing is available at <<https://science.house.gov/legislation/hearings/subcommittee-research-and-technology-hearing-overview-budget-proposal-national>>.

¹² The committee report (H.Report 114-470) puts forth some interesting proposals, including eliminating the Department of Commerce, consolidating NIST and NTIA within NSF and moving NOAA's functions to the Dept. of the Interior. See page 101, under Budget Function 370 (Commerce and Housing Credit) <<https://www.congress.gov/114/crpt/hrpt470/CRPT-114hrpt470.pdf>>.

(continued on next page)

passage is unlikely, mainly because it is consistent with the unpopular deal made late last year which raised the budget caps (The Bipartisan Budget Act of 2015, P.L. 114-74). The Senate Budget Committee has issued spending levels that adhere to the budget agreement (but no resolution proposal), and the Senate Appropriations Committee has made its allocations to subcommittees. The Commerce, Justice, State, and Related Agencies (CJS) Subcommittee, which covers DoC, received an allocation of \$56.3B, which is a 1.1% increase over FY 2016.

On April 21, the Senate Appropriations Committee approved its version of the FY 2017 CJS bill (S. 2837, S. Report 114-239)¹³. It includes \$974M for NIST, an increase of \$10M or 1.04% over the FY 2016 enacted level. The increase is all in STRS; the marks for other appropriations remain at FY 2016 levels. NIST's mandatory appropriation requests were not addressed in the bill or report.

On May 24, the full House Appropriations Committee approved the NIST levels put forward by the CJS subcommittee in its May 18th version of the FY 2017 bill¹⁴. The bill includes \$865M for NIST, a decrease of \$99M or 10.3% from the 2016 enacted level. STRS is reduced by \$10M; the Industrial Technology Services appropriation is reduced \$20M (all in the National Network for Manufacturing Innovation, NNMI), and the Construction of Research Facilities appropriation is reduced \$69M.

The American Institute of Physics (AIP) has an excellent science appropriations tracking website which includes links to documents and hearings. See <<https://www.aip.org/policy/federal-science-budget-tracker>>.

Mikulski to Retire

Senator Barbara Mikulski (D-MD) will be retiring at the end of this year, after 40 years in Congress and 30 years with the Senate Appropriations Committee. She has either chaired or vice-chaired the CJS subcommittee since 2007. As AIP reports in a recent *FYI* (April 26, 2016, #49)¹⁵, "Colleagues on both sides of the aisle marked the occasion of her last committee meetings [on the FY 2017 budget] by heaping glowing praise on the vice chairwoman, who is the longest serving woman senator and who has made an indelible impact on American science and space exploration."

DoC is Heading to Shared Services

The Department's 2014–2018 Strategic Plan¹⁶ specifies five priority areas to help meet long-term goals and objectives – trade and investment, innovation, data, environ-

ment, and *operational excellence*. The last one—defined as “delivering better services, solutions, and outcomes that benefit the American people” and identified as a key priority—impacts them all. Secretary Pritzker charged leaders all across the Department to find new and innovative ways to deliver mission-enabling services in the areas of acquisitions, financial management, human resources, and information technology. Recognizing that subject matter experts in these service areas are spending a disproportionate amount of time and energy on issues relating to processing and transactional work—and unable to focus sufficiently on more strategic challenges and opportunities, they reached the conclusion that what was needed was a transformation of the way that mission—enabling services are delivered to customers across all organizations. The Shared Services Project is the planned solution.

In the near future, a new Shared Services Contact Center will be responsible for providing common, transactional services to DoC's 12 bureaus and Office of the Secretary. It will be managed by an executive director reporting to the deputy secretary and will be staffed by contractors and a small number of federal employees.

The Contact Center promises to deliver these services in a way that uses specialized staff and standardized processes and systems to improve service quality and customer satisfaction and to increase transparency and accountability. Bureau-specific services will be retained at each bureau.

There will be a three-year transition to the Shared Services model. Initial Shared Services related to acquisitions are expected to go live in October 2016 and will include the management of DoC-wide strategic sourcing contracts, affecting a small percentage of NIST acquisitions. More will follow, including contract closeout support and the procurement portal. In December 2016, HR requests for personnel actions and separations will go live.

Over time, the majority of NIST's transactional HR services will transition to the Contact Center. No NIST IT or financial management activities will move to Shared Services during 2016, but the future timelines are being worked on. Initially, only some travel and relocation activities will be going, with more to follow after the implementation of the Business Applications Solutions financial system modernization.

The transition to Shared Services will not involve workforce separations. Instead, affected mission-support employees will be freed to focus on more strategic activities that help to drive NIST's mission.

Sources: *NIST Connections*, October 2015 and May 2016; Shared Services *Inside NIST* internal website; and DoC All Staff e-mail from Deputy Secretary Bruce Andrews, July 30, 2015.

NBS Summary Technical Reports Online

As part of an ongoing effort to digitize over 100 years of NBS/NIST publications, more than 900 NBS Summary

¹³ See <<https://www.congress.gov/bill/114th-congress/senate-bill/2837>>.

¹⁴ Bill number not available when newsletter went to print. Press release and links to the bill and report are at <<http://appropriations.house.gov/news/documentsingle.aspx?DocumentID=394567>>.

¹⁵ See <https://www.aip.org/fyi/2016/senate-appropriations-committee-advances-spending-bill-nasa-nsf-nist-and-noaa>.

¹⁶ FY 2014–FY 2018 Commerce Strategic Plan (PDF) (updated June 18, 2015)

Technical Reports (STRs) have been added to the NIST Digital Archives.¹⁷

STRs were typically brief summaries of NBS research, developments, and test activities. Report topics were chosen for their importance to contemporary scientists, engineers, and industry. Published by the NBS Office of Public Information, the reports were sometimes included in the NBS Technical News Bulletin. The series began in 1946 as the NBS Technical Reports and was changed to the NBS Summary Technical Reports in 1953. The series was discontinued in 1975.

Source: Information Services Office *Inside NIST* internal website posting, April 13, 2016.

New at the NIST Museum

ISO has put 30 new historic NIST photos from the archives on display as a rotating slide show on the kiosk at the entrance to the museum in Gaithersburg. The photos range in time from 1981 to 1980 and highlight important research projects of the past, including work on socks, snow, and beer.

If you are on the SAA membership list, it is easy to gain access to the site to see this and other interesting new exhibits at the museum. SAA members just need to stop at the front gate Visitor's Center to get checked in.

Source: Information Services Office *Inside NIST* internal website posting, April 12, 2016.

Just a Standard Blog¹⁸

NIST officially joined the blogosphere on January 14, 2016, with the initial post to *Taking Measure*¹⁹ by Director Willie May. The new blog features posts by NIST researchers, staff, and special guests on a wide variety of topics related to measurement and standards, NIST history, news you can use, and slices of life from inside and outside the lab. For example:

- An interesting posting made close to National Periodic Table Day (February 7) by Charles Clark²⁰ explores NIST's connections to the table of the elements.
- National Inventor's Month is celebrated in a May 5 post by Mark Esser. The piece is a tribute to Jacob Rabinow.

There are three other blogs managed by NIST components:

- *Blogrige – the Official Baldrige Blog* - <http://nistbaldrige.blogs.govdelivery.com/>

- *Manufacturing Innovation Blog* - <http://nistmep.blogs.govdelivery.com/>
- *NSTIC Notes Blog* - <http://nstic.blogs.govdelivery.com/>.

NIST staff members also are frequent contributors to the blog at the Department of Commerce: <https://www.commerce.gov/news/the-commerce-blog>.

Internet Time Service Serves the World

The Internet Time Service operated by NIST has customers around the globe. According to detailed data about the service published in March²¹, during one month of study, just two of the 20 NIST servers that supply time information to Internet-connected devices received requests from 316 unique Internet Protocol (IP) addresses. This represents at least 8.5 percent of devices on the entire Internet!

The 20 timeservers are located at 12 sites around the country, including NIST campuses in Gaithersburg and Boulder. The servers are linked to the NIST time scale, an ensemble of atomic clocks that maintain the U.S. version of Coordinated Universal Time. The time scale is calibrated by the NIST-F1 and NIST-F2 cesium fountain atomic clocks, the U.S. civilian time standards. The Internet Time Service provides a reliable source of time independent of the satellite-based Global Positioning System. Demand may increase with the growth of the Internet of Things, in which more devices will be connected to the Internet without any direct human intervention.

NIST has operated the Internet Time Service since 1993. It is just one of the ways NIST distributes time-of-day information (other methods include NIST radio stations, telephone call-in services, and <http://time.gov/>).

Source: [NIST News Release, March 8, 2016](#).

Phased Retirement – Finally

The Congress authorized phased retirement almost four years ago (Section 100121 of P.L. 112-141²², enacted July 6, 2012), allowing eligible federal employees to partially retire while remaining on the job on a reduced schedule to mentor other workers and pass along valuable institutional knowledge. It took two years for OPM to finalize its regulations on the program, which were posted in the Federal Register²³ in August 2014. Agencies were given discretion in deciding how and when to implement a phased retirement program that would meet their mission needs and deal with collective bargaining agreements.

¹⁷ See <http://nistdigitalarchives.contentdm.oclc.org/>

¹⁸ A blog (short for “weblog”) is a discussion or informational site on the Internet that includes distinct entries (“posts”) and usually allows others to leave comments.

¹⁹ Check it out at <http://nist-takingmeasure.blogs.govdelivery.com/>

²⁰ As the post credits point out, “Charles W. Clark, aka Carbon Tungsten Chlorine Argon Potassium, is among a select group of NIST staff whose surnames can be spelled with the chemical symbols of consecutive elements of the Periodic Table.”

²¹ See J.A. Sherman and J. Levine, “Usage Analysis of the NIST Internet Time Service,” *NIST Journal of Research*, March 8, 2016, <http://nvlpubs.nist.gov/nistpubs/jres/121/jres.121.003.pdf>.

²² See <https://www.gpo.gov/fdsys/pkg/PLAW-112publ141/pdf/PLAW-112publ141.pdf>.

²³ See <https://www.federalregister.gov/articles/2014/08/08/2014-18681/phased-retirement>.

Another almost two years later, DoC has issued its policy²⁴, and NIST recently announced a limited phased retirement “kickoff” which will start October 2, 2016. Interested eligible employees who have the support of their supervisor were to have submitted their requests to OHRM by June 1. Depending on the position, agency approval would be by OU director, NIST associate director, or DoC CFO/assistant secretary for administration. Phased retirement is not a right or entitlement.²⁵

Employees approved to participate in the NIST phased retirement program will continue their federal service for a period of time (increments of up to one year, up to a maximum of two years) on a half-time schedule (40 hours per pay period) during which they must spend a minimum of 20% of their time devoted to employee development and knowledge-transfer activities. They will also begin receiving approximately half of what their retirement annuity payments would have been (not including credit for sick leave and not reduced for survivor annuity). They will earn annual and sick leave, and they can maintain their federal benefits at the same rate they were paying as a full-time employee and continue to contribute to the Thrift Savings Plan. Their continued service will count toward their future full retirement.

Following evaluation of the kickoff program, phased retirement will be an option for eligible, approved NIST employees in 2017.

Sources: *NIST Connections*, May 2016 and DoC website.

Expanded Health Unit Services

Under a new, cost-saving contract that started May 2, the Gaithersburg Health Unit is now staffed by a full-time physician assistant (PA) who specializes in emergency medical care and a certified occupational health nurse. NIST has also arranged for a visiting audiologist to manage work-related hearing, balance, and other auditory disorders. The PA, who will work under the supervision of an on-call physician, will provide wound care, comprehensive on-site medical treatment, and follow-up for work-related injuries, illnesses, and medical emergencies. Under the new contract, the Gaithersburg Health Unit also will provide flu vaccine free of charge to 1,000 NIST employees on a first-come, first-served basis. Other Health Unit services, such as the popular health and wellness events and speakers, will continue.

Source: Office of Safety, Health, and Environment *Inside NIST* internal website posting, May 2, 2016.

²⁴ See <http://hr.commerce.gov/s/groups/public/@doc/@cfoasa/@ohrm/documents/content/prod01_010592.pdf>, dated March 21, 2016..

²⁵ Employees must meet applicable CSRS or FERS retirement eligibility requirements and must have been in a full-time position for at least the three years immediately prior to entering phased retirement status.

NIST Exhibits

In April, NIST participated in two major outreach events. During the weekend of April 15-17, NIST had a booth at the well-attended 2016 USA Science and Engineering Festival, a grassroots effort to advance STEM education and inspire the next generation of scientists and engineers. The biannual event was held at the Washington Convention Center.

From April 25-29, NIST participated in Hannover Messe in Germany, the world's largest trade show for industrial technology. Established in 1947, Hannover Messe attracts attendees from 70 countries. For the first time in the Fair's history, the U.S. was a partner country, providing American businesses and economic development organizations an unprecedented opportunity to be prominently featured in U.S. exhibition halls and during special events. DoC hosted the U.S. Investment Pavilion, a centerpiece of the fair which highlighted state and local economic development organization exhibitors.

Source: *NIST TechBeat*, March 30, 2016.

NIST Construction News

National Fire Research Laboratory

After more than six years of planning, design, and construction, and another year of instrumentation and commissioning, the significant facility expansion and upgrades to the National Fire Research Laboratory (NFRL) are finally complete. NIST's World Trade Center investigation²⁶ highlighted a need for a new facility that could test in controlled laboratory conditions the performance of real-scale structural systems under actual load and realistic fire conditions. The NFRL is now that facility²⁷.

The expansion, which adds 1,965 m² of floor space to the existing laboratory, will allow scientists and engineers to conduct once-impossible large-scale experiments. The new lab can contain and make real-time measurements on structural fires that burn at intensities (heat release rates) of up to 20 megawatts for durations of up to four hours. Twenty megawatts is the amount of energy released by the flames of a small home totally engulfed by fire and is double the heat-release rate capacity of NIST's previous fire laboratory. The new laboratory space accommodates 9 meter-high (2 story x 2 bay x 3 bay) structural systems or components, such as portions of office buildings, hospitals, or bridges. Mechanical loading can be applied using controlled hydraulic actuators or fixed loads.

The test area consists of a 486 m² strong floor with multiple anchor points and a strong wall with anchor points on the same grid as the strong floor. The strong wall acts to stabilize a test specimen to prevent uncontrolled failure, provide lateral restraint, or to laterally load a structure (e.g., to simulate earthquake damage).

²⁶ See <<http://www.nist.gov/el/disasterstudies/wtc/>>.

²⁷ See <http://www.nist.gov/el/fire_research/nfml/project_nfmlmetops.cfm>.

The construction project included doubling the lab's exhaust gas scrubbing capacity. Smoke and hot gases are captured using a large exhaust hood over the test area, allowing characteristics of the fire to be measured accurately, and the smoke and combustion byproducts are contained and treated to meet strict environmental requirements.

Just in case a fire gets out of control, the area under the new canopy hood is protected by eight fire-hose nozzles capable of dousing the area with 1,000 gallons of water per minute, and the area immediately around that is covered by a deluge sprinkler system.

The capabilities of the new facility will make it possible for building designers and fire researchers to learn how to build fire resistance into structures in smarter, more cost-effective ways; construct large buildings that occupants will have sufficient time to exit in the event of a fire – and that first-responders can more safely enter; and make better, scientifically-informed decisions on whether fire-damaged buildings can be repaired or if they need to be demolished.

Sources: *NIST Connections*, May 2016; NIST Management Resources *It's Your Business* newsletter, December 2014; EL Office and website.

Visiting Committee on Advanced Technology (VCAT) *VCAT Annual Report*

The VCAT reviews NIST's strategic direction, performance, and policies, and each year it provides the Secretary of Commerce, Congress, and other stakeholders with its assessment of the value and relevance of NIST's programs to the U.S. science and technology base and to the economy. Its 2015 Annual Report²⁸, which was submitted to Congress on March 10, discusses the committee's review efforts, observations, and recommendations relating to its 2015 areas of focus – (1) NIST's current portfolio of activities in the biosciences and in information technology/cybersecurity; (2) the diversity and depth of NIST partnership arrangements; (3) recruiting and retaining a world-class staff; and (4) NIST's safety systems and culture. The report also comments on NIST's Three-Year Programmatic Plan (2017-2019)²⁹, appropriations, and budget request.

Source: NIST VCAT website <<http://www.nist.gov/director/vcat/>>.

Recent Congressional Testimony

On March 16, 2016, NIST Director Willie May testified before the House Committee on Science, Space, and Technology Subcommittee on Research and Technology. His testimony was entitled "An Overview of the Fiscal Year 2017 Budget for the National Institute of Standards and Technology".

²⁸ The VCAT 2015 Annual Report is available at <<http://www.nist.gov/director/vcat/upload/2015-VCAT-Annual-Report.pdf>>.

²⁹ See <http://www.nist.gov/director/planning/upload/3_year_plan_2017-19_web_ready2.pdf>.

Source: Office of Congressional and Legislative Affairs <<http://www.nist.gov/director/ocla/>>.

Staffing Changes

Steven Choquette has been selected as the director of the Office of Reference Materials, following the retirement of Bob Watters on January 3. Choquette had been heading MML's Biosystems and Biomaterials Division. He graduated from Santa Clara University in 1980 with a B.S. in chemistry and electrical engineering, and he holds a Ph.D. in analytical chemistry from Virginia Polytechnic Institute and State University. Choquette began his career at NBS/NIST in 1987 as a post-doctoral researcher in the Analytical Chemistry Division. He has published more than 40 scientific papers, has two patents, and is responsible for the development of seven unique optical SRMs in near-infrared and Raman spectroscopy.

Source: Material Measurement Laboratory Office website.
—**Janet Miller**

Standards and Technology News

DoC 2015 Technology Transfer Report

The annual [Technology Transfer Report](#)³⁰ provides comprehensive statistics on the technology transfer activities of the three DoC laboratories: NIST, NOAA, and the Institute for Telecommunication Sciences (ITS) of NTIA.

In Fiscal Year 2015, DoC filed 61 invention disclosures and 30 patent applications and was issued 20 patents. Of the 44 active patent licenses, 31 generated a total \$164,456 in income. DoC staff engaged in 364 traditional collaborative research and development agreements (CRADAs) and published 3,205 scientific and technical papers in peer-reviewed journals.

FY 2015 innovations coming from NIST included technologies to combat cyber terrorism; a method to identify, quantify, and locate methane leaks; and standards for testing and scoring the performance of trace explosives for security applications.

NOAA released a hurricane and storm-surge modeling technology called H*Wind and a downloadable flat-screen version of its popular Science On a Sphere® (SOS), known as SOS Explorer™. This technology provides a new way to display the dynamics of Earth's weather and climate, plate tectonics and more. IST contributed to the development of several critical telecommunications standards, engaged in a CRADA to test and demonstrate light detection and ranging (LIDAR) technologies, and assisted with the development of new technologies, tools and standards for transmitting video.

The report highlights the important role technology transfer plays in DoC's mission to promote job creation,

³⁰ see <<http://www.nist.gov/tpo/publications/upload/FY2015-DOC-Tech-Trans-Report-FINAL-4-5-16.pdf>>

(continued on next page)

economic growth, sustainable development and improved standards of living for all Americans. The programs and partnerships highlighted in the report also support the department's goal of promoting innovation and its "Open for Business" agenda. The report can be found on the [NIST website](#), along with information on licensing technologies and how to work with NIST.

Source: [NIST News Release, April 18, 2016](#).

Proposed SBIR Reauthorization and MEP Improvements

Two separate pieces of legislation aimed at providing financial and technical assistance to small and medium-sized manufacturers and tech firms have been introduced in the U.S. Senate.

Jeanne Shaheen (D-NH) and David Vitter (R-La.) have introduced *The SBIR/STTR Reauthorization Act of 2016*, which would permanently authorize the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. The two programs are currently scheduled to expire on September 30, 2017 after a six-year extension.

"To keep America on the cutting edge of innovation, we should act now to ensure that the SBIR and STTR programs are here to stay," Shaheen said. The SBIR and STTR programs dedicate a percentage of federal research and development funding to allow small businesses to work with federal agencies in areas such as public health and national security.

Senators Kelly Ayotte (R-NH), Chris Coons (D-DE), and Gary Peters (D-MI) have introduced the *Manufacturing Extension Partnership Improvement Act*, which would expand and improve the MEP program. Among the bill's provisions:

- Permanently adjust the federal MEP cost share to one-to-one.
- Strengthen and clarify the MEP center review process and require re-competition of MEP center awards every 10 years.
- Authorize MEP centers to support the development of manufacturing-related apprenticeship, internship and industry-recognized certification programs.
- Increase the MEP program authorization level to \$260M per year through 2020.

Require the MEP program to develop open-access resources describing best practices for America's small manufacturers.

Source: [New Hampshire Business Review, April 29, 2016](#).

You Can Make It If You Try!

Mark Esser (NIST Public Affairs Office) published a May 5 essay in the *Taking Measure* blog for National Inventor's Month. The following is excerpted from that essay³¹.

³¹ To read the entire article see <<http://nist-takingmeasure.blogs.govdelivery.com/national-inventors-month-keep-making/>>

In celebration of National Inventor's Month and Public Service Recognition Week, which also happens to be in May, I'd like to introduce you to [Jacob Rabinow](#) (1910-1999), one of the most creative and prolific inventors ever to work for the United States government."

Rabinow was born in Kharkov, Ukraine, in 1910. During the Bolshevik Revolution in 1917, he and his parents fled first to Siberia and then to China in 1919. When his father died in 1921, the family immigrated to New York.

After earning a master's degree in electrical engineering from the City College of New York, Rabinow joined NBS as a junior mechanical engineer. At NBS, his inventive genius found a nurturing and supportive environment. Rabinow played critical roles in the development of wartime inventions such as the [non-rotating proximity fuze](#) and the "Bat" [guided missile](#). He received his first patent in 1947 for a camera able to record the flight path of airplanes. By the end of his life he held 230 U.S. patents and 70 foreign patents.

In addition to his technical work, Rabinow delivered hundreds of talks on technologies and inventions. He was a Regent's Lecturer at the University of California, Berkeley, a frequent guest on radio and television programs, and an author of many papers. His full-length book, *Inventing for Fun and Profit*, was published in 1989 by San Francisco Press.

The *Jacob Rabinow Applied Research Award*, an annual internal NIST award first presented in 1975, is granted to employees for outstanding achievements in the practical application of the results of scientific engineering research. Chemical engineer **Richard Gates** was the 2015 recipient of this prestigious award for his work with the U.S. Mint.

So, to all you inventors out there, it doesn't matter if you succeed or fail, keep dreaming, keep doing, and know that you are keeping company with some of the greatest minds in history. We can't all be Jacob Rabinow or Richard Gates, but you'll never invent anything unless you keep trying.

Belinda Collins was privileged to represent NIST at the ceremony when Jacob Rabinow was inaugurated into the Inventor's Hall of Fame, class of 2005. The NIST library created a Rabinow exhibit featuring objects, patents and photos.

Source - [Taking Measure Blog, May 5, 2016](#).

Standard Reference Data Enhancement Program

Dr. Robert J. Hanisch, Director, Office of Data and Informatics, in the NIST Material Measurement Laboratory announced four successful proposals in the Standard Reference Data Enhancement Program in an email to NIST staff on March 22, 2016. The 16 proposals were submitted in total requested approximately five times the available funding. A peer review panel consisting of two representatives from PML, MML, EL, and ITL carefully evaluated the proposals and reached consensus recommendations.

The proposals to be funded are:

- *Fire Model Validation Database*, **Anthony Hamins** (EL), principal investigator, **Randall McDermott** (EL), **Kevin McGrattan** (EL), and **Paul Reneke** (EL), co-investigators.
- *Next Steps for the NIST Digital Library of Mathematical Functions: Standardized Mathematical Information for the Digital Age*, **Barry Schneider** (ITL) and **Bruce Miller** (ITL), principal investigators and **Howard Cohl** (ITL) and **Daniel Lozier** (ITL), co-investigators.
- *Biotherapeutic Protein Reference Data: A New NIST Paradigm for SRD*, **John Schiel** (MML), principal investigator and **Steve Stein** (MML) and **John Marino** (MML), co-investigators.
- *Interactive Database and Tools for Laser Induced Breakdown Spectroscopy*, **Yuri Ralchenko** (PML), principal investigator, and **Alexander Kramida** (PML) and **Karen Olsen** (PML), co-investigators.

—Belinda Collins

Extramural Program News

Baldrige Performance Excellence Program

Baldrige Executive Fellows

The Baldrige Executive Fellows Program is a one-year, nationally-recognized leadership development experience for an elite group of senior executives and rising senior executives. Using the Baldrige Excellence Framework as their foundation, they study how world-class organizations and their senior leaders achieve strategic and operational excellence and stimulate innovation. Within a collegial environment, the Fellows have a unique opportunity to compare the perspectives of executives across sectors, share candid advice on leadership challenges, and use the insights they gain to address a strategic challenge or opportunity within their own organizations.

The 28th annual Quest for Excellence® conference (April 3–6, 2016) marked the graduation of the 15-member fourth cohort of Fellows, who presented their capstone projects at the event, and the beginning of the journey for the new 18-member 2016–2017 class. Information on those selected and their year-long schedule is available at <http://www.nist.gov/baldrige/2016-fellows-cohort.cfm>.

Applications for the 2017–2018 cohort are now being accepted. Information on the Fellows program is available at <http://www.nist.gov/baldrige/fellows/index.cfm>.

Source: NIST News Releases, [March 17](#) & [April 25](#), 2016

Hollings Manufacturing Extension Partnership

MEP Partners with DoE

On May 12, a new partnership between DoE and NIST was announced at the American Energy and Manufacturing Competitiveness Northeast Regional Summit at the City College of New York. The Manufacturing Innovation

Through Energy and Commerce (MITEC) pilot program is being launched in Georgia, Michigan, Ohio, and Virginia and will provide small businesses access to the advanced tools, technology transfer expertise, and research capabilities of the DoE's national laboratories and to the technical assistance and business development resources of MEP. The new interagency partnership strives to broaden the commercial impact of DoE's national labs and equip American entrepreneurs and businesses with the resources and support that they need to develop new products, commercialize clean technologies, and expand into global markets.

MITEC will use the network of MEP Centers to connect small- and medium-sized companies with the vast array of R&D programs in DoE's Office of Energy Efficient and Renewable Energy. This support will help manufacturers to address technical barriers to commercial scale-up and provide them with the advanced research capabilities of the participating national labs at every stage of the product development cycle. The initial phase of the pilot will focus on sustainable energy, such as solar power and additive manufacturing.

Source: DoE news release, May 12, 2016.

—Janet Miller

Information Technology Research News

Cybersecurity “Rosetta Stone”—Two Years of Success

In February 2014, NIST released a document designed to help strengthen cybersecurity at organizations that manage critical national infrastructure such as banking and the energy supply. Produced after a year of intensive collaboration with industry, the [Cybersecurity Framework](#) is now a tool used by a wide variety of public and private companies and organizations, from retail chains to state governments.

[Executive Order 13636](#) called for NIST to work with stakeholders to develop a voluntary framework based on existing cybersecurity standards, guidelines and practices to reduce risks to the nation's critical infrastructure. Through an intense schedule of meetings across the country, NIST convened organizations large and small and from a variety of industries to shape the framework in just a year.

As soon as the framework was published, the NIST team began traveling throughout the U.S. and internationally to share how it can help organizations manage their cyber risk. The framework is now used by 30 percent of U.S. organizations and that number is projected to reach 50 percent by 2020.

These users include critical infrastructure giants Bank of America, U.S. Bank, and Pacific Gas & Electric, as well as Intel, Apple, AIG, QVC, Walgreen's and Kaiser Permanente. Universities and other organizations also rely on its guidance. In addition to private organizations in other countries, other governments, such as Italy, are using it as the foundation for their national cybersecurity guidelines.

(continued on next page)

The framework operates as a “Rosetta Stone” that helps translate sector-specific risk-management jargon and “creates a common understanding amongst the sectors around various risk management terms and phrases.” “Chief Information Security Officers have been using it to communicate ideas and achieve ‘buy-in’ for various cybersecurity initiatives. Externally, institutions are using it to communicate expectations and requirements to non-sector vendors and third parties.”³²

The framework is a risk-based approach to managing cybersecurity. Its foundation relies on more than a decade of NIST guidance in cybersecurity and on international standards. The framework’s core ideas—identify, protect, detect, respond and recover—help users evaluate their cyber risk and develop plans to manage it. It can guide them as they determine the cyber controls they choose, with consideration of any regulation or standards that may apply to their particular industry sector.

The document is also “a merger of business sense and cyber-logic,” said **Matt Barrett**, NIST’s program manager for the Cybersecurity Framework. “It allows organizations to choose controls and processes that work for their particular risk levels and mission or business needs.”

Source: [NIST News Release, February 8, 2016](#).

Protecting Credit Cards and Health Information

For many years, when you swiped your credit card, your number would be stored on the card reader, making encryption difficult to implement. Now, after nearly a decade of collaboration with industry, a new computer security standard published by NIST not only will support sound methods that vendors have introduced to protect your card number, but the method could help keep your personal health information secure as well.

NIST Special Publication (SP) 800-38G³³, “Recommendation for Block Cipher Modes of Operation: Methods for Format-Preserving Encryption,” specifies two techniques for “format-preserving encryption,” or FPE. The publication addresses a longstanding issue in many software packages that handle financial data and other forms of sensitive information: How do you transform a string of digits such as a credit card number so that it is indecipherable to hackers, but still has the same length and look—in other words, preserves the format—of the original number, as the software expects?

According to author **Morris Dworkin**, the new techniques are more suitable for this purpose than NIST’s previously approved encryption methods, which were designed only for binary data. Financial software used in card readers and billing, for example, often expects a credit card number to be the typical 16 digits long. Encountering

a lengthier encrypted number might cause problems in the software. The new FPE method works on both binary and conventional (decimal) numbers—in fact, sequences created from any “alphabet” of symbols—and it produces a result with the same length as the original.

“An FPE-encrypted credit card number looks like a credit card number,” Dworkin says. “This allows FPE to be retrofitted to the existing, installed base of devices.”

The two FPE techniques, called FF1 and FF3 in the new publication, were vetted during public comment periods on the standard in 2009 and 2013.

While the main commercial impetus for developing these techniques is credit card number encryption, another potential application is the “anonymizing” of personally identifiable information from databases, particularly those containing sensitive medical information. Databases of this sort are invaluable for researching the effects of different treatment methods on diseases, for example, but they often use social security numbers to identify individual patients and can contain other personal information. FPE encryption could handle this problem as well, though Dworkin stresses that in this case the approach would not necessarily be foolproof.

“FPE can facilitate statistical research while maintaining individual privacy, but patient re-identification is sometimes possible through other means,” he says. “You might figure out who someone is if you look at their other characteristics, especially if the patient sample is small enough. So it’s still important to be careful who you entrust the data with in the first place.”

Source: [NIST News Release, March 29, 2016](#)

Defending Encrypted Data from Quantum Computer Threat

If a quantum computer is invented that could break the codes we depend on to protect confidential electronic information, what will we do to maintain security and privacy?

NIST Internal Report (NISTIR) 8105³⁴: “Report on Post-Quantum Cryptography” details the status of research into quantum computers, which would exploit the often counterintuitive world of quantum physics to solve problems that are intractable for conventional computers. If such devices are ever built, they will be able to defeat many modern cryptographic systems, such as the computer algorithms used to protect online bank transactions. NISTIR 8105 outlines a long-term approach for avoiding this vulnerability before it arises.

“There has been a lot of research into quantum computers in recent years, and everyone from major computer companies to the government want their cryptographic algorithms to be what we call ‘quantum resistant,’” said NIST mathematician **Dustin Moody**. “So if and when someone does build a large-scale quantum computer, we want to have algorithms in place that it can’t crack.”

³² From a [report](#) by the Financial Services Sector Coordinating Council (FSSCC). <<https://www.fsisac.com/>>

³³ NIST SP 800-38G is available online at <<http://dx.doi.org/10.6028/NIST.SP.800-38G>>.

³⁴ Available online at <<http://dx.doi.org/10.6028/NIST.IR.8105>>.

The report shares NIST's current understanding of the status of quantum-resistant cryptography, and details what the agency is doing to mitigate risk in the future. One overall recommendation for the near term is that organizations focus on "crypto agility," or the rapid ability to switch out whatever algorithms they are using for new ones that are safer.

Creating those newer, safer algorithms is the longer-term goal, Moody says. A key part of this effort will be an open collaboration with the public, which will be invited to devise and vet cryptographic methods that—to the best of experts' knowledge—will be resistant to quantum attack. NIST plans to launch this collaboration formally sometime in the next few months, but in general, Moody says it will resemble past competitions such as the one for developing the SHA-3 hash algorithm, used in part for authenticating digital messages.

"It will be a long process involving public vetting of quantum-resistant algorithms," Moody said. "And we're not expecting to have just one winner. There are several systems in use that could be broken by a quantum computer—public-key encryption and digital signatures, to take two examples—and we will need different solutions for each of those systems."

Many current algorithms rely on the difficulty that conventional computers have with factoring very large numbers, a difficulty that a quantum computer can overcome. Defenses that rely on different mathematical approaches might stymie a quantum computer, and there is worldwide research interest in developing them.

While no one has yet come close to building a quantum computer that could threaten the systems we currently use, Moody says it is important to think about the future before it arrives, as it will take years to vet the candidates.

"Historically, it has taken a long time from deciding a cryptographic system is good until we actually get it out there as a disseminated standard in products on the market. It can take 10 to 20 years," he said. "Companies have to respond to all the changes. So we feel it's important to start moving on this now."

Source: [NIST News Release, April 28, 2016](#).

—Cita Furlani

5. NIST STAFF HONORS AND AWARDS

Tom Bruno (Chemical Sciences Division) received the Colorado American Chemical Society Section Award for excellence in research in November 2015. The award is given to a Colorado chemist with an extensive and impactful career in chemistry.

Donna Dodson, Chief Cybersecurity Adviser and Director of ITL's National Cybersecurity Center of Excellence, was named by [MeriTalk](#) as one of the top women in government IT for her management of ITL's cybersecurity

research program and her ability to develop relationships with academia, industry, and government agencies to brainstorm cybersecurity best practices.

W. Stuart Dols, **Steven Emmerich** and **Brian Polidoro** (all from the Energy and Environment Division) have been named by the [Federal Laboratory Consortium for Technology Transfer](#) as the recipients a *2016 Excellence in Technology Transfer Award* for development of a [CONTAM](#), a multizone indoor air quality and ventilation analysis computer program that predicts indoor airflows and contaminant concentrations for evaluating indoor air conditions, building energy use and potential exposures of occupants to airborne contaminants.

Chris Hunton (Grants Management Division) is the latest recipient of the NIST Director's *Special Recognition for Excellence in Mission Support* award for providing exemplary service in working with OUs to craft, review and complete federal funding opportunity announcements; publishing them on grants.gov in an exceptional, timely way; and assisting applicants on a daily basis at any time but especially close to the application deadlines. The director noted in his ALLSTAFF email of March 9 that Hunton's "responsiveness and creativity ensures we receive competitive applications for NIST."

Dan Hussey (Radiation Physics Division) has been honored with a 2015 *Arthur S. Flemming Award* for his pioneering work in neutron imaging for his efforts developing a highly sensitive neutron phase imaging technique, which has applications in a range of research areas including semiconductors, biology, geology, and alternative energy.

Laurie Locascio (MML Director) was elected a Fellow of the American Institute for Medical and Biological Engineering "for outstanding contributions to the fields of microfluidics and biosensors for applications in biomedical sciences and engineering."

Willie May, director of NIST, has been awarded the *Laboratory Director of the Year Award* by the [Federal Laboratory Consortium for Technology Transfer](#). May was recognized for his overall support of technology-transfer activities by NIST laboratories, including: efforts to develop the [NIST Science and Technology Entrepreneurship Program](#) to promote the utilization of NIST-owned inventions; fostering entrepreneurial activities and collaborative partnerships; and conceptualization of a new partnership with the state of Maryland to provide grants to former NIST postdoctoral fellows to fund commercialization of technologies they developed during their NIST appointments.

Ronald Ross (NIST Fellow) and **Adam Sedgewick** (ITL Senior Advisor) have been selected by *GovInfoSecurity* for the [List of Top Ten Influencers of 2016](#). Ross was recognized as one of the world's leading risk management authorities. Sedgewick was selected for his contributions to the NIST Cybersecurity Framework.

John R. Sieber has been selected as a recipient of the 2016 *ASTM International Award of Merit* following his nomination by Committee E01 on Analytical Chemistry of

(continued on next page)

Retirements – January through March 2016

| <u>Name</u> | <u>Organization</u> | <u>Date</u> |
|------------------------|--|-------------|
| Judith L. Barnard | 773 Computer Security Division, ITL | 1/02/16 |
| Lilian H. Cassells | 610 NIST Center for Neutron Research, NCNR | 2/29/16 |
| Michael Frenkel | 647 Applied Chemicals and Materials Division, MML | 1/09/16 |
| Michele M. Krebs | 680 Physical Measurement Laboratory Office, PML | 1/09/16 |
| Bonnie J. Miller | 770 Information Technology Laboratory Office, ITL | 3/01/16 |
| Juanita M. Morgan | 672 RF Technology Division, CTL | 2/19/16 |
| Robert Lee Osborne | 193 Gaithersburg Facility Maintenance Division, OFPM | 2/01/16 |
| William M. Pitts | 733 Fire Research Division, EL | 2/29/16 |
| Katherine M. Pagoaga | 182 Customer Access and Support Division, OISM | 1/09/16 |
| Angel L. Roman | 192 Facilities Services Division, OFPM | 2/20/16 |
| Jeri S. Roth | 645 Biomolecular Measurement Division, MML | 1/23/16 |
| Michael O. Shneier | 735 Intelligent Systems Division, EL | 2/29/16 |
| John S. Suehle | 683 Engineering Physics Division, PML | 1/01/16 |
| Thomas P. Tucker | 142 Grants Management Division, OAAM | 1/03/16 |
| Barbara Ann Uglik | 450 Baldrige Performance Excellence Program Office, BPEP | 1/02/16 |
| Robert L. Watters, Jr. | 640 Office of Reference Materials, MML | 1/03/16 |
| Vanda R. White | 601 Standards Coordination Office, LP | 1/23/16 |
| Stephen A. Wise | 646 Chemical Sciences Division, MML | 1/03/16 |

Metals, Ores and Related Materials. The *Award of Merit*, established in 1949, is the highest award granted by the Society to an individual member for distinguished service and outstanding participation in ASTM International committee activities. Each recipient is elected as a Fellow of the Society. In 27 years as a research chemist in the Chemical Sciences Division, Sieber's prior awards from ASTM include the *B. F. Scribner Award* (2005) and the *John L. Hague Award* (2013), plus Awards of Appreciation in 2000 and 2012. Both Bourdon Scribner and John Hague were chemists at NBS in the 1930s through the 1970s.

Stephen A. Wise has been selected as the recipient of the 2015 *Hillebrand Prize* awarded annually by the Chemical Society of Washington for original contributions to the science of chemistry. The prize is named for William F. Hillebrand (1853-1925), former Chief Chemist at NBS. Wise is recognized for career achievements in separation science, and for contributions to the NIST Standard Reference Materials (SRMs) Program in support of an accurate national measurement system for chemistry. Wise retired in January from the Chemical Sciences Division after 40 years of government service.

Paul Witherell (Systems Integration Division) was recently accepted into the ASME 2016-2017 ECLIPSE Program (Early Career Leadership Intern Program to Serve Engineering). He is assigned to the ASME Standards and Certification Sector where he will be given the opportunity for placement in highly visible and productive roles within ASME and expected to make significant contributions to sectors/boards/committees while continuing leadership training and volunteer tracking.

PECASE Winners. On February 18, President Obama named the following NIST researchers as recipients of the *Presidential Early Career Awards for Scientists and Engineers* (PECASE), the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their research career.

- **Adam Creuziger** (Materials Science and Engineering Division) for his impact on U.S. automobile manufacturing because of his expertise in the measurement and analysis of materials being evaluated for lightweighting vehicles.
- **Tara Lovestead** (Applied Chemicals and Materials Division) for her extensive application of new methods to rapidly and inexpensively detect trace levels of chemicals in vapors, enabling advances in homeland security, forensics, and food safety.
- **Andrew Ludlow** (Time and Frequency Division) for his leadership in the field of optical atomic clocks and his team's demonstration of the most stable atomic clocks in the world, with future impacts on advanced communications and a broad range of precision measurements.

Sources: *NIST Connections*; internal laboratory websites.

—Roger Martin

6. BOULDER BABBLE

The Local Scene

Boulder is a community that is having trouble accepting its own success. When the Chamber of Commerce bought the present NIST site and donated it to the Federal Government to attract NBS to Boulder in the early 1950s,

the very successful fund-raising campaign used the slogan “prosperity insurance.” The city gradually became a mecca for high-tech enterprise, which brought an influx of well-paid people and a need for more housing, conflicting with the desire of many residents (including the newcomers) to preserve Boulder as the nice little town it had been. This desire led to various measures to limit the growth of the city, such as the open space program; the denial of city water service above a certain altitude on the hills to the west; a 55-foot limit on the height of buildings; and the declaration of “historic districts” in which existing buildings cannot be replaced or even significantly modified. The result is that houses are very expensive, and many people who work in Boulder, and many students at the University, cannot afford to live here. So there is endless discussion of “affordable housing”, which has shown no tangible result. There is even a tight limit on the number of unrelated people who may occupy a house in a residential neighborhood, and stiff opposition to loosening it, which is particularly hard on the students. And meanwhile we have traffic jams several miles long at commuter times.

As a way of doing something about traffic, the City Council is constantly trying to promote cycling. Indeed we have a very good bike path system as a result, but the latest project was not accepted graciously at all. It was called “right sizing” and was applied to some of our streets that have four lanes of traffic, multiple intersections with no left turn lanes, and a moderately high speed limit. This is well known to be a dangerous arrangement, so the lines were repainted to provide only two lanes, with left-turn lanes and wider bike lanes protected by plastic posts. This provoked a storm of angry protest, with motorists complaining passionately about a few seconds delay, so “right sizing” was hastily undone.

We have had one real improvement to the local transportation scene, with the opening of a rail line connecting Denver International Airport (DIA) with Union Station in Denver. In many places around the world this would have been done at the same time as the airport was built, but better late than never. DIA is a long way out from Denver, in what used to be remote farm land. When it was being built there was a local rumor that one would need four-wheel drive to get there.

Colorado didn’t do too well in the primary election process. Several years ago we did have proper primary elections, but they were dropped to save money, and replaced by caucuses. Both major parties had trouble with these this year. The Democrats were swamped by the unexpected turnout, and many people who showed up were not able to get into the venues, let alone register their choices. The Republicans didn’t record opinions at all at the caucuses, leaving the choice of candidates to the State convention, which was attended by far fewer people. So, the State Legislature started working on a bill to restore primary elections, but came to a deadlock over how to handle uncommitted voters and will probably not get done before the session ends.

NIST Devices Help in the Search for Dark Matter

The standard model of cosmology estimates that about 85 percent of all the mass in our universe consists of dark matter. It is called dark matter because it does not emit, absorb, or interact with any form of electromagnetic radiation, ranging from radio waves through visible light to gamma rays. Its existence is inferred from its various gravitational effects on the motion of visible matter.

Galaxies are held together by the presence of this dark matter and its gravitational force. The matter we are familiar with and can see with electromagnetic radiation consists of protons, neutrons, electrons, and their collection into atoms and molecules. This normal matter is referred to as “baryonic” matter. However, this visible matter makes up only 15 percent of our universe. Where is the rest and what is it like?

The search for and the understanding of this dark matter has been the focus recently of much research in astronomy and in nuclear physics. It is presumed to surround and pervade galaxies like an invisible halo, flowing through everything and everybody all the time. Two new hypothetical particles that may constitute dark matter are called weakly interacting massive particles (WIMPs) and axions. It is postulated that at any instant of time there are hundreds of WIMPs passing through our bodies with essentially no interaction with the normal body material. “Massive” in this case simply means that the particle is massive compared with a proton. The axion was first postulated in the 1970s as a way to account for a nagging theoretical problem in nuclear physics, but it also turns out to have the right characteristics to be a dark matter candidate—if it exists and can be detected.

The Department of Energy and the National Science Foundation are funding several experiments that are trying to detect dark matter, and two of these rely on Superconducting Quantum Interference Devices (SQUIDS) developed by **Gene Hilton** and colleagues in the Quantum Electromagnetics Division. A search for WIMPs is the goal of an experiment known as the Super Cryogenic Dark Matter Search (SuperCDMS) located deep underground in a Minnesota mine. The experiment is underground to shield it from the effects of cosmic ray interactions with the germanium crystal detectors (each 600 g) kept at a low temperature of only 10 mK. The ground has little effect on the passage of WIMPs from outer space. An occasional weak interaction of a WIMP with a germanium crystal nucleus may produce a vibration particle called a phonon that could be detected by very sensitive superconducting detectors and amplified by a NIST SQUID amplifier.

The other dark matter experiment using a NIST SQUID amplifier is the Axion Dark Matter Experiment (ADMX), a multi-institutional collaboration based at the University of Washington in Seattle. The experiment aims to detect the very weak conversion of dark matter axions into microwave photons. Axion conversion into photons is stimulated by an apparatus consisting of an 8 T superconducting

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magnet and a high-Q tunable microwave cavity cooled to about 4 K. When an axion is present in the magnetic field and is excited by radio waves at the precise frequency corresponding to its mass, the axion will decay into extremely faint microwave photons. The microwave power released at that moment is expected to be only 10^{-24} W. The detection of such a low-power microwave signal could only be accomplished by the use of the NIST extremely low-noise SQUID amplifier. Such amplifiers have noise levels about 100 times lower than the best conventional amplifiers.

Laser Welding Program

Welding with a beam from a high-power laser (about 10 kW beam) is a relatively new welding technique that allows for narrow, deep welds and high welding rates. It is more energy efficient than conventional arc welding techniques and is frequently used in high volume applications, such as in automotive manufacturing. The narrow beam size, which ranges from fractions of a millimeter to a few millimeters, and high power density of about 1 MW/cm² results in a small heat-affected zone and high heating and cooling rates. It results in a high weld quality, similar to that of electron-beam welding, but it can be performed in air rather than in a vacuum.

Welding is an enabling technology for a large percentage of the U.S. economy. It is used for the creation of a diverse range of goods. Despite its long history and wide-spread use, there are aspects of welding that are still poorly understood, resulting in increased costs and time for many industries. Because it is relatively new, laser welding has many unknowns. A joint program begun on the NIST Boulder campus aims to help industry better understand and use laser welding in many manufacturing applications. The program is being co-led by **Marla Dowel** (Applied Physics Division) and **James Fekete** (Applied Chemicals and Materials Division). In this program researchers are applying state-of-the-art metrology to develop a fundamental understanding of the weld process and connect process parameters to weld quality through advanced material characterization techniques. According to Dowel, “the end goal of the program is to develop a predictable welding process, thus avoiding costly, time-consuming destructive techniques after the fact.”

The new NIST Welding Facility contains a set of spectroscopy instruments to provide measurements of the atoms leaving the metal during the weld, which will help researchers understand local metal composition. PML physicist and project leader **Paul Williams** has developed a process to measure the radiation pressure to give them an absolute reading of the laser’s power in real time, which has not been done before. MML’s **Ann Chiaramonti Debay** is using a suite of instruments in the NIST Precision Imaging Facility to obtain a three-dimensional picture of the chemical composition of a weld’s cross-section with resolution ranging from atomic to centimeter scale. **Jeff Soward** of MML uses the Mechanical Testing Facility to explore weld

fatigue and fracture characteristics at both microscopic and macroscopic scales. The Boulder PML/MML team is also working with **Dan Hussey** on the Gaithersburg campus to use the Neutron Scattering Facility. Neutrons can see “through” metals and create images that show areas of stress and strain. The team is also partnering with the Auto/Steel Partnership (AS/P), a consortium whose members include GM, Ford, Chrysler, and several North American steel manufacturers, to perform a comparison of arc and laser welding.

Distant Transfer of Quantum Information

The development of a quantum information network will require two essential technologies. First is a method to generate and manipulate quantum bits (qubits). A qubit stores and processes information in a quantum computer and can exist in a “superposition” of two values at the same time, unlike a conventional bit used in classical computers that can exist in only one of two states (e.g. 0 or 1). The superposition property of qubits greatly increases the power of a quantum computer. The second technology required for quantum information networks is a method to move the quantum information from one network node to another distant network without destroying their fragile quantum states. Each of these technologies will most likely require very different physical processes.

For example, qubits can be created and controlled dependably by using extremely cold superconducting circuits with electrical outputs at microwave frequencies. However, the use of microwave signals to transfer qubit information over long distances is not as reliable as the use of light over fiber optic lines at ambient temperature. It is this conversion of microwave signals to light and vice versa that is the focus of research by **Konrad Lehnert** and colleagues of the Quantum Physics Division and JILA. Their team is also collaborating with Cindy Regal of JILA. The intermediary medium between light and electrical signals being studied by this team is that of micromechanical oscillators, or extremely small mechanical “drumheads.” Coupling between the microwave signal and the drumhead is accomplished by making the drumhead in the form of a two-plate capacitor, the top plate of which is free to vibrate. In the current configuration the top plate is a square membrane of silicon nitride only 0.5 mm on a side and a few tens of molecules thick. The electromagnetic information is then transferred noiselessly into mechanical motion.³⁵ The mechanical oscillator must be kept at 4 K or colder to reduce the thermal noise that would destroy the fragile quantum superposition information.

The coupling of the mechanical motion to light is accomplished by placing the drumhead in an optical cavity. The drumhead motion transfers its information to the

³⁵ R.W. Andrews, A.P. Reed, K. Cicak, J.D. Teufel, and K.W. Lehnert, “Quantum-enabled temporal and spectral mode conversion of microwave signals,” *Nature Communications* 6, 10021 (2015).

light by modulating the frequency of the light. Recently, the team has demonstrated that quantum information can be transferred from microwaves to light and from light to microwaves via the drumhead. However, further improvements are needed to be really useful. Of particular importance is the need to reduce the operating temperature of the superconducting circuit to about 100 mK in order to further reduce its thermal noise and achieve the quantum ground state. Achieving the ground state also requires the use of higher frequencies that can be achieved only by reducing the size of the drumhead further.

—Ray Radebaugh and Bob Kamper

7. OBITUARIES

Ann C Abrams*, 96, died March 14, 2016. Ann worked at NBS from 1971 to 1987. She joined the SAA in 1994.



Born October 31, 1919, Ann grew up with three older brothers. She attended Boston State College where she was an English major and received a degree in Education, but decided that she hated teaching. Ann also studied and taught ballet, which probably led to her strict regimen of healthy eating and her pursuit of physical fitness. She traveled extensively and learned to drive when she was 50.

Ann worked at Harvard for Associate Dean F. Karl Willenbrock and in 1967 followed him to the University of Buffalo where he served as Provost and she became Assistant Provost for Engineering. Three years later, she followed him once again, this time to NBS. However, when he left in 1976, she remained.

At NBS/NIST, Ann served first as Special Assistant to the Director of the Institute for Applied Technology and next as Special Assistant to the Director of the National Engineering Laboratory. During this time, Ann filled many dynamic and leadership roles, especially as the technologies encompassed by IAT and NEL became more varied and complex. She made good use of her English and Education studies by becoming the *de facto* editor of most IAT and NEL publications during this period. Ann relentlessly pursued the goal of introducing clarity into scientific publications and was known for wielding a ruthless red pen.

Ann was an active member at the Gaithersburg Sport and Health Club for over 30 years, having been a charter member when the club opened as the Athletic Express. She worked out several times a week, stopping only when she had to give up driving at age 92. She stayed strong by attending a strength class for many years and by walking the treadmill for five mile treks. She was an exercise dynamo despite her small stature.

Ann stayed well read throughout her life, while saving time for a daily crossword puzzle. She was a big force in the Java Readers book club, an outgrowth of the gym class. The other members, all younger than their revered sage, were in awe of her keen insight and vast vocabulary. The respect by her friends at the gym and book club was reflected by their decision to organize a donation to the Montgomery County Literacy Council in Ann's honor.

Ann suffered no fools and would be pleased to be remembered for her quick wit and ribald sense of humor.

A longtime resident of Montgomery Village, MD, she was interred in Roxbury, MA. Survivors include: a son, Carl Abrams, of Connecticut, his son, and a 4 year old great-granddaughter; and a daughter, Lisa Faye Abrams of Buffalo, NY. Ann was pre-deceased by her husband Nathan P. Abrams.

Sources: Sam and Marie Kramer, and Jan Hauber.

John Russell Ambrose of Gainesville, FL died while cruising the Mediterranean on October 8, 2015 at the age of 75.

John was born on February 25, 1940 to Eugene Russell Ambrose and Lydia Mary Mac Lennan. He graduated from Washington and Lee University in 1961 with a B.S. in Chemistry and went on to complete his Ph.D. in 1972 at the University of Maryland.



Ambrose joined the NBS Metallurgy Division, Corrosion Section, as a research scientist in 1967. He left NBS in 1978 and moved to Gainesville, FL to teach in the Department of Materials Science and Engineering at the University of Florida. He retired from the University of Florida in 2007 and continued consulting and providing expertise on issues related to Materials Science and Engineering.

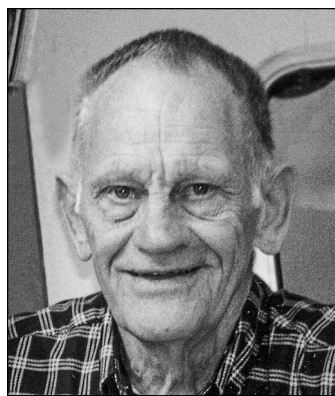
John was an avid photographer and longtime Gator Fan. He was a generous individual who loved to fish, to cook and to travel. He was also passionate about music, especially jazz, and loved the performing arts.

He is survived by his wife, Linda Bell; children John Jr. (Sandra), Pamela Norring, and Christopher (Lisa), three grandchildren and two great-grandchildren. He was preceded in death by his former wife, Linda Lee-Ambrose.

Source: [Gainesville Sun](#), Nov. 8, 2015

Thomas H. Bremer was born in 1924 to Edward and Otilia Bremer of Johnstown, Pennsylvania. After graduation from high school in 1942 he served in General Patton's 5th Armored Division in WWII and was wounded in the Battle of Huertgen Forest for which he received the Purple Heart. He also received the American Theatre Service

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Medal, the European Service Medal with two bronze stars, the Good Conduct Medal, and the Victory Medal. Following the war he attended two years of trade school in Pennsylvania.

In the mid-1950's Tom began working for the Electron Tube Branch in the Diamond Ordnance Fuze Lab. About 1960, attracted by the skiing

opportunities in the Colorado mountains, he moved to Boulder as a technician in the Radio Standards Engineering Division.

Tom worked at the NBS as an electronics technician in the Electromagnetics Division in various capacities until his retirement in 1983. His last effort was in the noise group involved with the measurement of electronic noise, an important parameter which determines the ultimate sensitivity of various electronic systems including communications, radar and remote sensing.

Tom loved to talk to people and seemed able to strike up a conversation with anyone. Sometimes he combined his hobbies with his ability to meet people. An avid photographer and bicycle racing fan he would often take action pictures at races and show up the next day with an enlargement of a particularly thrilling shot, often taken at the finish line. The racers, of course, were thrilled and he often scored an autographed jersey or program. He sometimes followed a stage race from venue to venue. One time he followed the Coors Classic from California to Colorado and another time the Tour duPont in the eastern states. His younger daughter Barbara was often his traveling companion.

Tom had very wide ranging interest in sports, both as a fan and as a participant. He was an excellent skier, and also loved backpacking, long distance cycling, tennis and golf among others. An avid Denver Broncos fan he and his wife Eunice held season tickets for many years.

As an artist and craftsman, he was a painter and a builder of intricate models. He built elaborate doll houses for his daughters. He collected many works of art and music was a passion. He had an extensive collection of recordings both classical and jazz. He was accomplished at jazz improvisation on the piano and could often be seen jamming with other players at parties. He also sang bass in various local choruses.

Tom died November 24, 2015 in Boulder, CO at the age of 91. He was married in February 1964 to his wife Eunice. Tom is survived by Eunice, two daughters: Nancy Bremer and Barbara Clark, and three grandchildren.

Sources: Roger Clark, NBS colleagues and the *Boulder Daily Camera*, Nov. 29, 2015.

—Carl Stubenrauch

James W. Butters*, was an active member of the SAA for many years (1990–2016), serving as a Director (1996–98), auditor (1998–2002), representative on the NIST Museum Committee, and speaker in the SAA “Life After NBS/NIST” series. Jim died in his home on April 25, 2016. He was 90.

James Butters was born in Minneapolis, MN on November 19, 1925. He joined the Navy (1944) after graduation from high school. He served as a radar operator with the amphibious forces in the western Pacific. Off Okinawa in 1945, he witnessed the use of the VT Proximity fuze developed at NBS in the war against Japan. At war's end he was with forces training for the “Operation Olympic” invasion of Kyushu; landed with the occupation forces at Sasebo in September 1945; and survived the typhoon of October 1945 which damaged many units of the U.S. Navy.

After the war, Jim attended the University of Minnesota majoring in Political Science and History. While working at the University Hospitals he met Shirley who was in the Nursing School. It was a campus romance. After graduation in 1954, Shirley took a job nursing at the Clinical Center at NIH in Bethesda. Jim soon followed her to the DC area and took a job working for the Department of the Army. They were married in July 1955.

Jim worked for the Corps of Engineers at Walter Reed Army Medical Center before joining NBS in July, 1963. He worked as Administrative Officer successively in the Heat Division, the Center for Analytical Chemistry, and the Center for Building Technology. While with the CAC, he was detailed for 15 months to the Budget Division during the period when NBS was one of the first agencies to use the personal computer for management tasks. There he worked in the Budget Systems Group which developed and tested the MIRADS system—the first computerized management information system used at NBS.

Jim was an avid, life-long U.S. history buff and a founder of the Historical Miniatures Gaming Society. He was a collector of some 200 historical war games, and an accomplished computer player of historic battlefield simulations. When he “retired” from NBS in January, 1986 he expanded his life-long hobby into a second full-time career. In 1990 he made an 18000-mile trip to the battlefields of the South Pacific—Guadalcanal, the Solomon Islands, Tulagi, Rabaul, and New Guinea.

A lover of classical music, in his “spare” time Jim was a volunteer for the Baltimore Symphony concerts in Frederick, MD. He was preceded in death by his wife, Shirley. He is survived by their son, Douglas (Marilyn) Butters, and granddaughter, Sara (Scott) Wajda.

Sources: *The Frederick News-Post*, April 27, 2016, NIST Archives, and SAA Archives.



Clyde Duckworth, despite receiving a diagnosis of cancer, continued to faithfully report for duty as a NIST police officer for two more years, until his retirement in August 2015. Following his retirement, he was hospitalized for treatment, but succumbed to his illness on February 29 at the age of 62.

Acting NIST Police Chief, AJ Washington, who served as Duckworth's supervisor, said "Clyde was very committed and dedicated to the NIST Police. Even when it was obvious that he was in pain, and probably should have stayed home, he came in to work his shift. He always said that when he was at work he felt like he had a purpose. He will be greatly missed."

Duckworth graduated from the Federal Law Enforcement Training Center in Georgia shortly before coming to NIST, where he worked the overnight shift from March 2002 to August 2015. He was promoted to the rank of corporal in 2010 and also served as firearms instructor at NIST for a time.

Even prior to joining NIST, Duckworth's career was a testament to his commitment to public service. Between 1976 and 1980, he served in the Navy on the aircraft carrier USS John F. Kennedy. After active duty, he continued in the Navy Reserves for 18 years while working in private security.

When not on the job, Duckworth enjoyed water sports, especially snorkeling and scuba diving. He took regular vacations with his wife to enjoy these hobbies, and he was also a certified scuba instructor.

Duckworth is survived by his mother, Annie; wife, Charlene; and daughter, El-Tonya.

—Fran Webber

Source: *NIST Connections*, April 2016.

Donald G. Fletcher,* an SAA member since 1986, was born May 19, 1922 in Rushville, Indiana. He earned a B.S. in chemistry from Clark College in 1950.

Don joined NBS in 1951 as a chemist after completing studies at Howard University (1950–1951). He was hired by Dr. Emanuel Horowitz and assigned to the Paper Section of the Organic and Fibrous Materials Division.

His work involved the formulation requirements for the production of experimental papers in the NBS pilot plant paper mill. This included the specification of pulps, fillers, dyes, and other paper components. In 1958, he received a



Superior Performance Award in recognition of his technical contributions.

In the late 1950s/very early 1960s, Don became involved with the activities associated with the Fibrous Systems Section, which was then under the leadership of Robert Hobbs. Circa 1966, Don assumed the role as Chief of the Section. The technical requirements and complexities of the Section's responsibilities increased significantly. In recognition of his services Don received the *Silver Medal Award* in 1970 for "exemplary management skills and project leadership under difficult operating conditions".

In 1975, he received the *Gold Medal Award* for his excellence in the leadership of complex technical programs involving research in product and process development of paper, plastics, and textiles. The primary objectives of these programs concerned precise evaluation and determination of the component structure of these materials and the development of novel systems to fabricate laboratory or pilot-scale prototypes as required. To accomplish this, the Section was required to develop test methods for standards and to devise highly sophisticated analytical techniques for evaluating the properties of paper, plastic, and textile materials. Under Don's management and technical leadership, this program constantly was at the highest level of expertise and output.

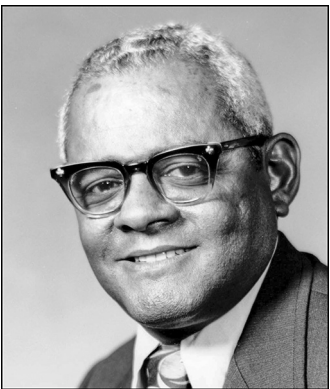
In 1968, NBS Director Allen Astin assigned Don to a special committee with the responsibility to receive any complaints of incidents of discrimination occurring on NBS grounds. Don served also on various panels for the NBS Personnel Division and was a member of the Personnel Committee of the Institute for Materials Research and the National Measurement Laboratory.

Other awards and recognitions that Don received included: NBS Supervisor of the Year (1965), DoC Science Fellow (1970–71), and the *Sandy Hill Award* (Papermaker Award) (1983). His professional memberships includes the Technical Association of the Pulp and Paper Industry, the American Association of Textile Chemists and Colorists, the American Chemical Society, and the Washington Academy of Sciences. He was a charter member of the Senior Executive Service (1985).

Don retired from NBS in 1985 after 34 years of distinguished service. In 1992 he inducted into the NIST Portrait Gallery "for his ground-breaking studies of plastics, textiles, and advanced types of paper."

Donald Fletcher, 93, died April 30, 2016. Willie May, Director of NIST, offered the following comments on his passing. "When I came to NIST/NBS in July, 1971, Don Fletcher was a legend within the African American community. He was known as that Super Grade guy who led "ground-breaking studies of plastics, textiles, and advanced types of paper" that neither he nor anyone else could say more about. As you might imagine, initially I was somewhat overwhelmed by NBS—the cutting edge research in such a broad array of areas; all the brilliant scientists in so many fields. Then there was the very large cost of living

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difference between the DC area and Alabama and Tennessee. I was seriously considering hanging around for a year or so, and moving on.”

“I personally met Fletch in early 1972 and he quickly took me under his wing. He introduced me to his family, other black professionals at NIST, other black scientists in the Baltimore-Washington area, and he also involved me with activities of our social fraternity (Kappa Alpha Psi). But far more importantly, he and Dick Milligan constantly assured me that while intimidating, and somewhat lacking in diversity, NBS was actually a scientific meritocracy... and that this was an environment where they thought I had the potential to not only survive, but thrive. Neither he, nor I, would have ever imagined that 44 years later, I would not only still be here, but would be Director! And I certainly would not be, had it not been for his friendship, encouragement and mentorship during those early days.”

Donald Fletcher was predeceased by his wife of sixty-three years, [Brady Jones Fletcher](#) who died in August 2013. He is survived by their children, Donald Bruce, Nathan (Alison) and Debra Patrice, and two grandchildren.

Sources: Willie May, NIST Archives, SAA Newsletters archives, and *The Indianapolis Star*.

Sidney Howard Greenfeld, 92, died March 1, 2016. Born April 25, 1923 in Baltimore, he received a B.S. in Chemical Engineering from the University of Delaware and an M.S. in Chemical Engineering from MIT.

Associated with NBS for over 25 years, Greenfeld specialized in research on roofing and its materials. He began working at NBS as a Research Associate in the Building Technology Division while employed by the Asphalt Roofing Industry Association (1949–1957 and 1959–1968). During the intervening years (1957–1959) he worked for the Chevron Research Corporation investigating the properties of asphalt and other petroleum products. In 1969 he officially joined NBS as a staff member with the Institute for Applied Technology, Office of Flammable Products.

He left NBS in 1973, going to Standard Oil of California for a brief time and then becoming a Technical Advisor for the Consumer Product Safety Commission. At CPSC he was instrumental in developing flammability standards for children’s sleepwear and for improved safety standards for flexible natural gas lines for use in movable appliances. He worked there until his retirement.

Greenfeld is survived by his wife of 68 years, Esther Frasher Greenfeld; sons John, Robert, James and Fred; four grandchildren and one great-grandchild.

Source: [The Washington Post](#), March 13, 2016.



Andrew Hamilton was the chief engineer for the NIST synchrotron ultraviolet radiation facility (SURF) and the head of the SURF operations team in the Photon Physics Group in the Optical Physics Division from 1988 until his retirement in 1999. He played a lead role in the 1997–98 upgrade of the facility to SURF-III, a project for which he received the 2001 *Judson C. French Award*.

The upgrade included replacement of the main pole magnets and their cooling systems with better materials; increasing the operating current (from a maximum of 200 mA to 1 A); increasing the accelerator energy (from 284 MeV to 380 MeV); extending the useful radiation coverage to shorter wavelengths (from 4 nm to 2 nm); adding two new beamlines; and otherwise improving SURF’s performance as a primary standard of spectral irradiance by a factor of ten or more in uncertainty.

Andrew was the only one of two SURF engineers ever hired from outside the NBS/NIST accelerator community in its 55 year history in Gaithersburg. The only other, his predecessor, lasted only one week after he saw how complex a job it was. Around the lab, Andrew was known for his joking nature that kept everyone in good spirits, his help with the daily crossword puzzle, and his love of Gary Larson’s *The Far Side* comic strip.

Andrew brought the facility into the age of the digital computer, using a local computer to monitor sensors, log parameters, and perform calculations onsite that previously required access to the central mainframe. He was a core member of the group that upgraded the facility to its current configuration and disassembled the previous one—a mammoth, year-long job. He designed sensors for monitoring system performance, provided computer interfaces for the measurement systems, installed a brand new storage ring power supply, and designed frequent work-arounds when legacy electronic systems would fail and replacement parts were no longer available. His job was to keep SURF working on a daily basis.

His customers were NIST metrologists (radiometric calibrations in the near and far ultraviolet) as well as astronomers and atmospheric scientists (radiometric calibration of spaceflight spectrometers) and optical engineers (reflectivity of multilayer mirrors used to focus soft x-ray radiation).

Born January 6, 1936 in Hempstead, NY, Andrew Donald Hamilton was the son of Harold D. and Ethel Donnelly Hamilton. After high school he attended the RCA Institutes and then enlisted in the U.S. Army, serving for three years active duty and eight years in the reserves.

He graduated from NYU with a B.S. and M.S. in Electrical Engineering and worked in various aerospace companies on Long Island. Seeking a change of pace, he earned a M.S. in Marine Environmental Sciences from SUNY (Stony Brook) University. There he calibrated, created, and maintained the scientific equipment used on the research vessel R/V Onrust and assisted on many scientific oceanographic cruises, including to the Gulf of Mexico and the coasts of Chile and Wales.

He was a charter member of the Huntington Community First Aid Squad, a member of the Power Squadron teaching celestial navigation, a voracious reader (especially of mysteries and history), and an enthusiastic gardener. His favorite use of time after retirement was volunteering at the National Museum of Civil War Medicine as a docent and researcher.

Andrew died February 27, 2016 after a long illness. He is survived by his wife, Mary Jane Hamilton, daughter Victoria Hamilton Waechter, and one grandson.

Sources: *The Frederick News-Post*, March 2, 2016; William R. Ott, Mitchell Furst, and Robert Vest.

Daniel Taylor Lilley, Jr., age 63, died February 3, 2016 after a tragic fall at his home the previous week. Dan was born October 21, 1952, in Kinston NC, to the late Dan Lilley, the longest-serving NC State Representative for Lenoir County and Imogene (Jean) Lilley.

Dan received his M.S. in Mechanical and Aerospace Engineering from NC State University, and held a MBA from the Kelley School of Business at Indiana University. He had an extensive background in manufacturing technology with a specialty in molded resins and high performance polymer composites. However, his technical expertise in audio design, acoustics and vibrations was his true passion and was unsurpassed. He was an inventor and held several design patents in consumer audio, automotive and aerospace industries.

In 2008, following a career as a Director for the North Carolina MEP, Dan joined NIST as Regional Manager of MEP's Southeast Region. He retired from NIST on December 26, 2014.

After his retirement he began two new entrepreneurial ventures, BassBeam and Ahead Acoustics. He served on a number of MEP advisory boards and was a board member for the Indiana School for the Deaf in Indianapolis and, most recently, the Visual Arts Exchange in Raleigh.

He is survived by his long-time domestic partner, John Reese, his sister, Eileen Daigle and her husband John.

Source: *The News & Observer*, February 7, 2016.

Keith Roger Lykke, leader of the Laser Applications Group in the Sensor Science Division, died suddenly in his home on March 30 at the age of 59.

Keith was a quiet, low-key guy. You wouldn't have guessed, from talking to him at least, that our nation's multibillion-dollar space programs depended on his and his NIST colleagues' work. Although he



Photo credit: Denease Anderson

was a scientist of the highest caliber, his co-workers describe him as easygoing, laid-back and unpretentious.

For Lykke, family came first, and he hated the spotlight, says his co-worker Steven Brown. Yet "for a recluse wannabe, Keith had an awful lot of good friends." One of those good friends, co-worker John Burnett, described Lykke as "conspicuously genuine and quintessentially Midwestern in character and spirit." He was, in Burnett's words, "personally very affable" and "a real pleasure to hang out and chat casually with."

Lykke came to NIST in 1997 after spending eight years as a scientist at Argonne National Laboratory and—before that—two years with Sandia National Laboratories. He had previously earned a Ph.D. in chemical physics from the University of Colorado in Boulder, where he studied laser spectroscopy and the dynamics of negative molecular ions under Carl Lineberger of JILA.

At NIST, Lykke distinguished himself, earning a promotion to leader of the Optical Sensor Group (now the Laser Applications Group) in 1998, and winning multiple awards, including the *Arthur S. Flemming Award* in 2004, a *DOC Gold Medal Award* in 2010 and a *Bronze Medal Award* in 2015.

"Professionally, Keith was unusually modest, despite his accomplishments and astonishing expertise in the nuts and bolts of laser science," Burnett says. "He was very generous with sharing his time and expertise in helping others on their projects as well."

Lykke is recognized worldwide for his leadership in the development of the NIST Spectral Irradiance and Radiance Responsivity Calibrations Using Uniform Sources (SIRCUS) facility, for which he received the *DOC Gold Medal Award* along with Steven Brown and George Epeldauer. SIRCUS and Traveling SIRCUS (a version of SIRCUS available for use away from NIST Gaithersburg) revolutionized the calibration and characterization of sensors installed on satellites and spacecraft. The two versions are the foundation for many of NIST's optical radiation standards.

Lykke also played a leading role in ensuring that the U.S. space program provides weather and climate measurements of the highest quality. His research often required long trips to places like New Mexico, Arizona, Hawaii and aerospace contractor sites to perform satellite sensor calibrations or measurements of the optical radiation from the moon or stars.

"Keith and I spent a lot of time at Mt. Hopkins in southern Arizona working on a project to calibrate the light from the star Vega," relates John Woodward, a co-worker in the Laser Applications Group. "The nights were long and the work difficult, but there was always a little time to look up at the spectacularly clear night sky, hunt for shooting stars and take in the beauty of the sky above and valley below."

Lykke's first love as a scientist was astronomy, says Jerry Fraser, chief of the Sensor Science Division. Lykke led the division's "NIST Stars" program on the absolute

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calibration of the optical radiation from stars, which has applications for astrophysics, cosmology and satellite remote sensing.

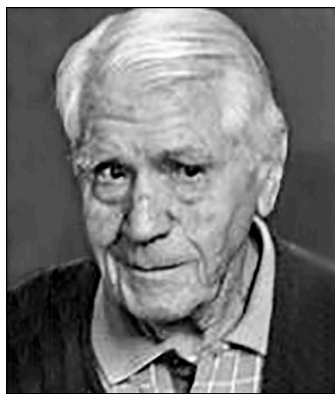
“His skills in astronomy and laser calibration of large telescopes greatly impressed the astronomers,” Fraser says. “He always wanted to have an article in *Sky & Telescope*, a popular magazine among amateur astronomers, on his CV, and he was hoping to achieve that goal through the NIST Stars program.”

Lykke was a devoted and proud father who enjoyed family outings to golf or hike. He was known for coming in early—around 5 a.m.—on Fridays so that he could go home mid-afternoon, leaving co-workers with his signature phrase “Have a weekend.”

Lykke is survived by his wife Gwendy; children Jason, Niels and Kristina; father Maurice; and brother Mark.

—Fran Webber

Source: reprinted from *NIST Connections*, April, 2016.



Leo Joseph Maloney

died two weeks short of his 96th birthday in his home in Boulder on December 8, 2015. Born in Jersey City, NJ on December 23, 1919, Leo fell in love with the West as a member of the Civilian Conservation Corps. After serving in the European theatre with the Army Air Corps during WWII, he returned to Colo-

rado and earned a degree in Electrical Engineering from the University of Colorado (CU). He met his future wife, Helene Joyce Gillis there. They married in 1950.

Leo began working for NBS in 1951 as a communications expert with the NBS Cheyenne Mt. Field Station in Colorado Springs. When the Bureau opened in Boulder he became part of the Radio Propagation Lab and worked there until the early 1970s.

He spent most of his working life developing and building communication systems in Southeast Asia and Europe. He had some memorable stories about his experiences — including catching a cobra in the Philippines!

Leo was a firm believer in giving back to the community. He helped co-found the NBS Credit Union (now Elevations) and was an active member of the Catholic Church and the Knights of Columbus in both Durango and Boulder. Following retirement, he was a devoted volunteer for jail and hospital ministries and the Durango soup kitchen.

He loved traveling. He lived for several years in Costa Rica, and with the help of his sons, constructed a house and farm in the topical forest of the Osa Peninsula. His preferred method of travel was by bus so that he could meet local people to learn about their culture and language.

Leo is survived by seven of his nine children: Michael (deceased), Mairi (Cliff), Margaret (Jon), Maureen (de-

ceased), Monica (Lyle), Matthew (Cheryl), Martin (Teresa), Murdoch (Melissa) and Melanie (David); 11 grandchildren; and six great-grandchildren.

Source: *The Durango Herald*, January 11, 2016.

Robert Wallace Medlock

was born on September 27, 1919 in Wagoner, South Carolina to the late John Henry Medlock and the late Emily Jane Joiner Medlock. He was the second youngest of 14 brothers and sisters.

Bob Medlock was the son of a sharecropper with a strong desire to become a doctor. At the age of 16 he enrolled in West Virginia State College (WVSC). His studies were interrupted by WWII when he served in the U.S. Army in France. He received a B.S. with honors in mathematics from WVSC in 1949.

After graduation, Medlock sought and was denied employment as a scientist with the federal government. At that point he began his career as an orderly at Walter Reed Army Hospital. He kept applying for professional jobs and eventually joined the NBS Atomic and Radiation Physics Division as a radiation chemist in 1953.

In 1957, Bob married the late Mamie C. Jackson (Curry) Medlock. They raised one son, Maynard and also their niece, Brenda.

Bob retired from NBS in 1976 to care for his ailing wife. From 1977 until 2007 he owned and operated New York Liquors in Washington, DC.

Robert Medlock died February 13, 2015 at age 95. He was predeceased by his wife, Mamie; their son, Robert; and their niece, Brenda. He is survived by four grandchildren, two great-grandchildren, and many nieces and nephews

Sources: Clifton Childers, Sr. and *The Washington Post*, February 19, 2015.

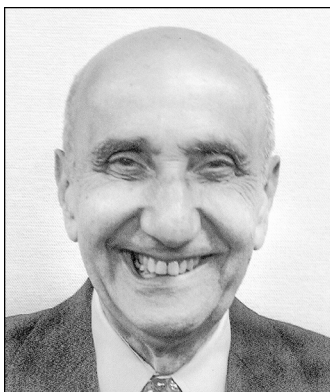
Editor's Note: Robert Medlock's obituary was submitted to the newsletter over a year ago in March 2015, but its was "lost" in the newsletter files. I apologize for the delay in getting it published.



Tawfik Meir Raby, was present at the first startup of the NIST Research Reactor (NBSR), and led the NBS/NIST Reactor Operations and Engineering Group until 2002. He created an organization which was broadly recognized as being at the forefront of research reactor operations worldwide, compiling an enviable safety, reliability and cost-effectiveness record. It was the basis for the successful development of the NIST Center for Neutron Research as the major neutron user facility in the United States.

A recognized leader of the research reactor community, he played a leadership role in the creation of the National

Organization of Test, Research and Training Reactors (TRTR), which he chaired for many years. In this role, he served as a primary contact with the Nuclear Regulatory Commission for issues relating to research reactors, and made many contributions to standards for reactor operations and safety. As a result of his leadership in research reactor standards and service to the research reactor community, he was awarded the TRTR *Robert E. Carter* award for lifetime achievement.



Raby was born on November 11, 1928 in Baghdad, Iraq. The youngest of eight children, Raby left Baghdad in 1947 at age 18 when he received a scholarship to the University of California, Berkley. He earned a B.A. in physics and chemistry from UC-Berkley (1953), a Master's degree from the University of Utah (1956) and continued his studies at Columbia University.

Tawfik Raby joined NBS in 1967 and over a forty year career held positions as: a Nuclear Expert in the Reactor Radiation Division (1967); Reactor Operations Section Chief and Deputy Chief of the Reactor Radiation Division (1968–1989); and Chief, Reactor Operations and Engineering and Deputy Chief, Reactor Radiation Division (1989–2002). Raby was an NIST Fellow (2000–2005) and Senior Research Scientist (2005–2008).

Some of the many prestigious honors and awards he receive include: TRTR *National Distinguished Service Award* (2005), *DoC Silver Medal Awards* (1985 and 1989), *DoC Gold Medal Awards* (1990 and 1997), *Presidential Rank Award* (1993), the American Nuclear Society *Standards Service Award*, (1996); Adjunct Professor of Nuclear Science and Engineering, Rensselaer Polytechnic Institute (1965–1975); and a Registered Professional Nuclear Engineer (1976–2009). Raby was inducted into the NIST Gallery of Distinguished Scientists, Engineers, and Administrators in 2009.

Tawfik Mier Raby died March 30, 2016 at the age of 87. He is survived by his brother Albert (Suad) Raby, and many nieces and nephews.

Sources: [The Washington Post](#), April 2, 2016 and SAA Newsletter Archives.

John Howard Ring, 74, of Colonial Beach, VA, passed away August 5, 2015. John was born April 5, 1941, in New Kensington, PA. He joined the Navy out of high school and went to the Nuclear School before proudly serving as a submariner for six years.

On discharge from the Navy, he put his nuclear training from the Navy to use by joining the NBS Reactor Radiation Division. This was the beginning of 35-plus years

of service to NBS/NIST in the Nuclear Reactor Division and then the Center for Neutron Research. He was awarded a NIST *Bronze Medal Award* in 1994 for his contributions. Ring retired from NIST in the mid-2000s.

Cars were his passion. From a young age, he loved drag racing. He was a kind man with a very dry sense of humor. John loved having a few beers with friends at happy hour and discussing politics and sports. He was a lifetime member of the Knights of Pythias and a member of the VFW, American Legion and Moose.

He is survived by his wife, Roslyn; four daughters, Kim, Cheryl, Lauren and Barbara; two sons, John and Eric Ring; two stepchildren, Irwin Weinstein and Risa Weinstein; a brother, Richard; and numerous grandchildren.

Source: [The Valley News Dispatch](#), August 18, 2015.

Anne Yung-Kwai Rumfelt died Friday, October 30, 2015, in Eugene, Oregon. She was 91. Anne was born July 15, 1924, in Washington, DC, the daughter of Joseph Burnham Yung-Kwai of Washington, D.C., and Peggy Woodside of Pana, Illinois. (A brother, Conrad Yung-Kwai, preceded her in death.) She was a granddaughter of [Yung Kwai](#), of Xinhui, China, Counselor to the Chinese Embassy in Washington, and Mary E. L. Burnham of Springfield, Massachusetts.



She was a granddaughter of [Yung Kwai](#), of Xinhui, China, Counselor to the Chinese Embassy in Washington, and Mary E. L. Burnham of Springfield, Massachusetts.

Anne earned a B.S. in Physics from the University of Michigan in 1946. She worked as a physicist in the NBS Electronics and Optics Division from 1946 to 1950 when she returned to the University of Michigan to complete an M.S. in Physics.

In early 1954, Anne returned to NBS, eventually moving to the NBS Radio Standards Laboratory in Boulder, CO. Her work there included such efforts as the standardization of microwave attenuation measurements.

While at NBS, Anne met Ray Rumfelt of White Deer, PA who also worked in the Radio Standards Lab. They were married on October 6, 1956, in Pine, CO.

Anne "retired" for three years (1959–1962) but then returned to the Radio Standards Division, first working as a physicist on microwave low power measurement (1962–1969) and then as an electrical engineer on information storage and retrieval. She left NBS in the late 1960s but continued working in the Radio Standards Division until the late 1970s.

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In the early 1990s, Anne and Ray moved to Eugene, OR where, following Ray's death in 1994, Anne continued a quiet life, knitting and enjoying the company of her friends at her favorite restaurant.

Sources: *Eugene Register-Guard*, November 15, 2015 and NIST Archives

Douglas Edward Spencer, 59, of Frederick, MD, passed away on November 25, 2015 at his home. He was the husband of Sonya Marie Spencer who died nine months earlier in February 2015. Spencer was a veteran of the United States Air Force. After his honorable discharge, he went to work for NBS in 1979 where he worked in the Facilities Services Division for over 30 years until his retirement.

Doug enjoyed fishing, cheering on the Washington Redskins and drawing. He is survived by two brothers, John Warren Spencer and wife Jessica and their children, Lissa, Logan, Emma and Sloan; and his brother, Mark Alan Spencer and wife Myra, and their children, and Doug's godsons, Nathan and Tyler.

Source: *The Washington Post*, November 30, 2015.

We Also Note:

We have received word of the March 19, 2016 death of **Nancy Wiederhorn**. We extend our condolences to her family and especially to her husband, Sheldon Wiederhorn, a long time active member and former officer of the SAA.

Nancy Wiederhorn, 78, taught psychiatric nursing at George Mason University in the early 1980s. She was a consultant to Maryland Del. Marilyn R. Goldwater, who in 1985 chaired a state task force under Gov. Harry Hughes on licensed practical nursing.

Born in The Bronx on August 7, 1937, she was a 1961 graduate of the Columbia University School of Nursing. She was a public health nurse in New York City and Wilmington, DE where she taught nursing at Wilmington Memorial Hospital. In the early 1960s the Wiederhorns moved to Bethesda, MD where Nancy earned a master's degree and Ph.D. in psychiatric nursing from Catholic University.

—Roger Martin

8. TRIBUTES

William (Mickey) Haynes (1943–2016)

As readers of this Newsletter probably know, Dr. William (Mickey) Haynes, lead writer of the Boulder Babble column for many years, died in his home on February 26, 2016. Mickey's contributions to the NIST community spanned the years from 1970 to 2016; his leadership and personal traits are enduring legacies.

I met Mickey when I arrived at the NBS in 1982; grew close as a friend in the last two decades; followed his footsteps in a number of arenas; and consider him to be my personal and professional mentor. In this obituary and tribute, I want to share information about his life and career as well as contribute some reflections on his impact.

Mickey was born on February 8, 1943 in Martinsville, Virginia—a small city in the southern part of the state. He grew up as an athlete. As a star of the Martinsville High School basketball team, his buzzer-beating goal to win the 1961 State Championship remains a legend in the city. A letter writer to the local Martinsville newspaper, Phil Sparks, noted that Mickey's basketball career “changed a lot of people's lives....” and “inspired kids all over town... it was an omen of the life of excellence Dr. Mickey Haynes would enjoy as he continued to make winning shots for the rest of his life.”

Mickey often returned to Martinsville to visit family, coach, and friends, and typically joined the “old dawgs” high school reunion that takes place weekly. Family members recently informed us that winning the State Championship was among Mickey's proudest lifetime memories.

Basketball prowess led to an athletic scholarship to the University of Virginia, but after a year in the basketball program, Mickey was offered and accepted an academic award, and began in earnest his lifelong study of physics. He earned a B.S. in 1965, an M.S. in 1967, and his Ph.D. in 1970—all in physics and all at the University of Virginia. He remained a strong supporter of the University, following its sports teams and campus affairs throughout his life.

His thesis advisor at UVA was the late Prof. Jack Stewart, the Harvard and Princeton educated physicist who had studied under Nobel Laureate Percy Bridgman—high pressures and low temperatures were the subjects of their experimental research. Mickey measured the shear strengths of cryogenic methane and nitrogen, and developed a new type of magnetic suspension densimeter for fluids at low temperatures and high pressures. The very careful measurements, innovation in apparatus design, and meticulous attention to details from experimental design to final publication noted in this early work were hallmarks of his career throughout.

Dr. Haynes' thesis work at UVA led to the offer of an NRC Postdoc appointment at NBS. He moved to Boulder

in 1970 with his wife, Toni, and their dachshund, Nookie. Other than one extended stay in Gaithersburg and frequent domestic and international travel, Boulder became Mickey's home for the next 45 years. His early work at the NBS Boulder laboratories involved measurements and innovation in cryogenics, viscometry, and densimetry. This early work included development of new state-of-the-art apparatus, including a new generation of magnetic suspension densimeters and a torsional crystal viscometer, and careful property measurements of a variety of pure fluids and mixtures.

As part of the 50th Anniversary celebration of the NIST Boulder Laboratories, a collection of the most significant papers from the first half-century of the labs was compiled; three papers co-authored by Mickey were included. His reputation as a very meticulous metrologist, hard worker, and creative problem solver complemented that of a friendly, compassionate, and generous colleague. His efforts ultimately led him to his commanding position as a leader in the international thermophysics community.

With success in the laboratory, Mickey's career advanced at NBS/NIST. He became a permanent staff member in 1972, following completion of the postdoctoral appointment, and continued work on characterizing fluid behavior through thermodynamic and transport property measurements and analysis. In 1985 he began his ten-year tenure as leader of the Properties of Fluids Group in the Thermophysics Division, leading and coordinating programs in measurement, modeling, and data. He added the position of Deputy Chief to his resume in 1989, first with the Thermophysics Division and, with the 1996 reorganization, with the Physical and Chemical Properties Division. These divisions included activities on the Boulder and Gaithersburg campuses, and Mickey shared leadership responsibilities with Rich Kayser, currently the NIST Chief Safety Officer, with whom Mickey built a close friendship. Rich noted "I never worked with anyone who had more integrity, cared as deeply about people, and was as committed to quality work."

In 1999, Mickey was appointed to be the Chief of the Physical and Chemical Properties Division within the Chemical Science and Technology Laboratory. As Division Chief, Mickey led with respect and kindness and by example—his work ethic, hours, dedication, and attention to detail were unparalleled.

He instilled an era of integration of experimental, theoretical, modeling, and data approaches to every technical direction of the program. In this way, Mickey led success-

ful programs to assess the thermophysics of alternative refrigerants, slated to replace their ozone-depleting antecedents; the properties of natural gas systems, evolving as an energy carrier of choice in the international marketplace; and supporting advances in aerospace technology through metrological studies of the atmosphere and its components. These are just a few of the Division's major programs of that era, and in each case Mickey led the activities within the Division, interacted with programmatic leaders in other

governmental agencies, and ultimately wound up helping to coordinate international efforts to solve the global problems in these areas.

As a senior leader within CSTL, Mickey also worked closely with fellow division chief, Willie May, currently NIST Director. Willie recently commented "I valued Mickey's friendship for more than 20 years. We were baby boomers who grew up in the segregated South. We never discussed that—because it simply did not matter between us!"

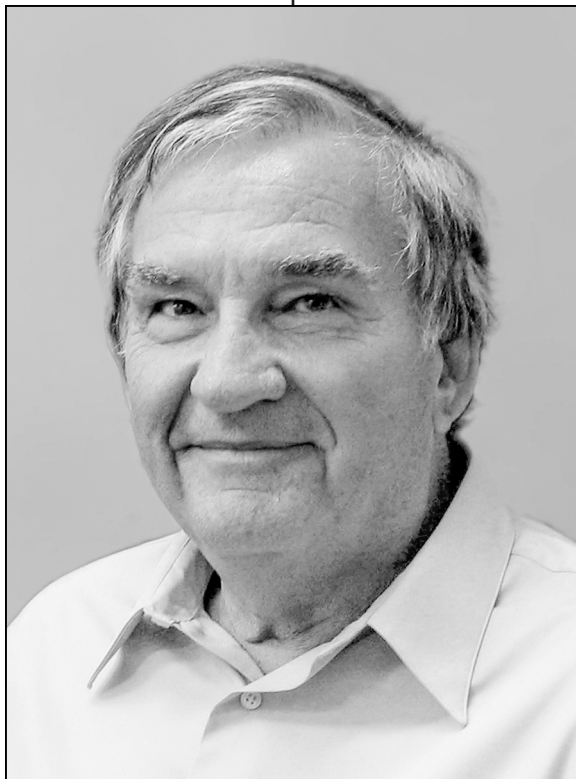
With the recognition of Mickey's technical excellence and programmatic leadership came the call for service to the global thermophysics community. Mickey responded with his usual dedication and supreme competence. This is typified by his activities related to conferences around the world.

He was active in the European and Asian Thermophysical Properties Conferences, having served on the International Organizing Committee of the former since 1998 (as the sole U.S. member asked to serve), and serving on various Scientific, Program, and International Advisory Committees for the latter at meetings held in China, Japan, and Korea. Mickey was a leader in the movement, decades ago, to coordinate the timing of the North American, European, and Asian Thermophysical Properties Conferences: they remain on a synchronous 3-year rotating schedule.

Within the U.S., and as part of his leadership roles within ASME, Mickey participated in the 1977 *Symposium on Thermophysical Properties* (Gaithersburg, MD); served on the Symposium organizing committees (ASME K7 and Joint ASME-AIChE Committee) since 1994; chaired/co-chaired/or organized the 13th and 14th Symposia on Thermophysical Properties; and advised the conference chairs at every triennial Symposium since 1991 up through the 19th Symposium on Thermophysical Properties held in June of 2015. Since the 1991 conference, the "permanent" home has been in Boulder, thanks in part to Mickey's influence.

Many of us fondly remember those post-Symposium parties, hosted by Mickey and his wife Toni at their east

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Boulder home. These backyard barbecues, included international and domestic luminaries in the thermophysics arena. They were an intimate forum for discussions of recent scientific advances, convivial personal interchanges, and planning for the direction of the global thermophysics enterprise. I warmly recall the lush backyard oasis itself: Mickey and Toni were also avid gardeners. That was the end of the Symposium week, which itself was crowded with technical sessions and social interactions.

The weeks leading up to the Symposium were always intense. Mickey was typically at the office until well past midnight, with teams of us examining every program entry and every page in the abstract book for errant commas, grammatical infractions, poor English usage, etc. His goal in every piece of paper offered by the Symposium, as with everything else he did, was never less than perfection. (Many of us remember the alarm, when a random examination of printed program books which had arrived just prior to one conference revealed that a full page was missing from the bound volume. Every carton was opened and book examined: that single book had the only such flaw in the printing!) Mickey set a high standard for the Symposium, and I, who succeeded Mickey in a chair's role, admit that the standard for contributors' writing is now a little bit lower.

Mickey worked closely with a number of journals in the field of thermophysics. He served on the Editorial Boards, at various times, of the *International Journal of Thermophysics* (IJT), *Cryogenics*, the *Journal of Chemical and Engineering Data*, and the *Review of Scientific Instruments*. His contributions in this realm were most prominent in IJT where he served as Editor-in-Chief from 1997 to 2014. In this time, not only did he increase the size and scope of the Journal, but he effectively led the research directions in thermophysics through his guidance of the Editorial Board. He was well known for his editor's eye, and publication in Dr. Haynes' journal was a milestone for researchers and engineers throughout the world. He read every manuscript, every page proof of articles that were accepted—he insisted that no comma, no figure axis label, and no reference could deviate from the established format of his journal. He would pore over the fractured English of non-native speakers, iterating multiple times with authors, and struggling to interpret significant scientific content for readers of his journal. As an Associate Editor, and now Senior Editor, I worked closely with Mickey—we strived for quality and consistency.

Mickey stepped down from leadership of the Physical and Chemical Properties Division in 2003, retiring from NIST after four particularly challenging years of trying to integrate research cultures on the Boulder and Gaithersburg campuses and to address myriad demands from the evolving NIST approach to serving the metrology needs of the Nation. He never left NIST, however, but served as a NIST Scientist Emeritus—typically at his NIST office seven days a week. In 2006, he began his journalistic career with the

SAA Newsletter, providing colorful, insightful, and provocative discussions of the news from Boulder. From Mickey's columns you may have learned lively details about Boulder fires, floods, Jon-Benet, Ward Churchill, marijuana legalization, political rallies and debates, world-class athletes. He brought us headlines and tidbits from our Rocky Mountain campus.

As another retirement project, Mickey took the reins of the *CRC Handbook of Chemistry and Physics*. He became Associate Editor in 2009, working closely with fellow NIST alum Dr. David Lide, and took charge as Editor-in-Chief through the current 97th edition (2016). This ubiquitous resource is used and cited by many of us who require accurate compilations of the information that is at the foundation of our profession. As Mickey accepted increased responsibility for the Handbook, he instituted new standards of review and analysis of every entry. He worked with numerous subject matter experts to improve and expand the reference work, and advanced its entry into engineering applications through electronic editions.

In this way, Mickey's retirement years continued his traditional work ethic of seven-day-a-week presence in his office at NIST. In some sense, he gave up on retirement, returning to NIST in December of 2015 on a part time basis to chair the Boulder Editorial Review Board (BERB), which provides editorial and policy quality control for manuscripts prepared for publication by NIST Boulder authors. Mickey kept working on the Handbook and on technical manuscripts until a few days before his death, sometimes surrounded by papers on his hospital bed and, eventually, his home hospice bed.

Mickey's contributions to physics, to NIST, and to the international community of thermophysics garnered a number of accolades. Back in 1981, he received a *Russell B. Scott Memorial Award* for Outstanding Paper at the Cryogenic Engineering Conference. He was elected to Fellowship of the American Physical Society in 1999 and named a Fellow of ASME in 2015. Mickey was awarded a U.S. Department of Commerce *Silver Medal Award* in 2002, and was elected to the NIST Portrait Gallery of Distinguished Scientists, Engineers, and Administrators in 2005. Mickey was selected as recipient of the *Lifetime Achievement Award* of the European Conference on Thermophysical Properties at its meeting in Porto, Portugal in 2014. In 2015, he received the Symposium Award at the 19th *Symposium on Thermophysical Properties* (Boulder).

Outside of professional life, Mickey was an avid sports fan who loved to participate in golf, squash, hiking, biking and travel. He continued to cheer for his University of Virginia teams to the end; followed collegiate basketball carefully; and applauded the Denver Broncos football team through its 2016 Super Bowl season. Willie May joined Mickey at least annually for a sports event in the D.C. area and in Colorado, and for many years they traveled, with their sons, to watch the NCAA Basketball Final Four wherever it was being held. I was in the stands with Mickey at

the Broncos' last regular season game (a victory against the San Diego Chargers) in December, and we enjoyed a couple of our traditional pre-theater dinners with our wives earlier last winter.

Mickey counted a large number of NIST staff and alumni as his friends—golf with Rick Kayser; Final Four with Willie; lunchtime hikes for exercise with Becky Stevenson; shooting hoops with Michael Frenkel; an intense squash rivalry with Chris Muzny; ...

Mickey was diagnosed with stage 4 esophageal cancer in the spring of 2015. He remained upbeat and optimistic nearly to the end of his life, and continued his dedicated service to NIST and the thermophysics community throughout. The chemotherapy was often very hard on him, and he battled pneumonia a few times. He continued traveling to visit family and friends—and to continue work on the CRC Handbook. The final phase was fairly quick, and he continued chatting with friends and visitors, reminiscing about NIST and pleased as he reflected on his life and career.

Mickey is survived by his wife of 51 years, Toni Haynes, his son, Mike, a granddaughter, two sisters and several nieces and nephews. He was pre-deceased in 2013 by his daughter, Jennifer. He is also survived by several generations of younger scientists, for whom he was a superb mentor. Willie May, Tom Bruno, Chris Muzny, Anneke Sengers, and I were among those who paid tribute to Mickey at his memorial service on March 21, 2016.

As I complete this very personal obituary, I need to make a few more observations. Over the years, Mickey and I were often each other's sounding boards. We often edited each other's writing. I miss him both abstractly and concretely: he would have edited this tribute, correcting facts and suggesting changes in style and usage. I regret that missing touch to this memorial.

—Dan Friend

Editor's Note: On March 21, 2016 a memorial service was held in Boulder to celebrate Mickey's life. Director of NIST, Willie May was one of several speakers from NIST.

"I am truly honored that Toni and Mike have allowed me to say a few words about my dear friend and colleague during his Memorial Service.

I enjoyed Mickey's friendship for more than 20 years and feel especially privileged to have known and spent so much personal time with him and his wonderful family. Mickey was a great and well-respected scientist. In 2005, it was truly an honor for me to be able to present him for induction into NIST's "Gallery of Distinguished Alumni." He was a first ballot "Wall of Famer"!

Our friendship began during Chemical Science and Technology Laboratory management retreats convened by our boss Hratch Semerjian in the mid-1990s when we were both Division Chiefs. Mickey was Chief of the Physical

and Chemical Properties Division (parts of which were in both Boulder and Gaithersburg) and I was Chief of the Analytical Chemistry Division in Gaithersburg.

We were both "baby boomers" who grew up in the segregated south (he in Martinsville, VA and me in B'ham, AL). We occasionally shared stories about events and the influential people in our lives during those times. And of course we did not stop at that, we solved all the world's problems every time we got together!

We found that we were kindred spirits in so many ways. We shared a love for, and devotion to family, and we also loved, and were lifers at, NIST. We both loved competitive team sports. Mickey played basketball and I played baseball in high school and our freshman years in college. We both recognized during our respective freshman years that our professional futures would be that of a scientist --- not a jock !!!

We discovered that we both had been very competitive during our adolescence and wanted to win at anything where they kept score. Luckily we both mellowed a bit with age. When we met, we both were for the most part relegated to watching, not playing competitive sports; but boy, we really did truly enjoy getting together to watch several times a year. For the past 12-years we attended the "Final Four" together—usually with our sons—but a few times with our wives as well; something that we both really looked forward to. I would also occasionally bring along one of the characters that I had grown up with, just to show Mickey that folk like "Howlin Wolf", "Miss Lucy", "Dinky Lee", and "Tater Guyton" actually did exist!

Mickey was a great colleague, friend and, in so many ways, the big brother that I never had. In fact, we both have two sisters and no brothers.

My career has experienced some interesting and challenging transitions over the past 10–12 years and Mickey was always there for me with very sound counsel. Rest in peace my dear friend. You will truly be missed...not only by me, but also by your many friends and professional colleagues from around the world. You were one-of-a kind and will not be forgotten."

—Willie May

John W. Cahn* (1928–2016)

John Werner Cahn had a profound influence on the course of materials research during his illustrious career. One of the foremost authorities on thermodynamics, he applied the basic laws of thermodynamics to describe and predict a wide range of physical phenomena. Among his major contributions to materials science was the development of a fundamental theory that describes the behavior of mixtures of different materials and how they tend to separate at the microscale. The theory established an entire branch of materials research and is particularly important to the rational design of new alloys.

Hans Werner Cahn was born in Cologne, Germany, in 1928. His father was an anti-Nazi lawyer and his mother an x-ray technician. In 1933, Adolf Hitler became Chancellor of Germany, and the elder Cahn escaped arrest only because he had been forewarned by a fellow lawyer. The Cahns moved throughout Europe and eventually to Amsterdam. They emigrated to America in 1939, where Hans became John. The Cahns settled in New York City. John Cahn became an American citizen in 1945. He served in the United States Army and was stationed in Japan during its occupation by the Allies.

John received a B.S. in chemistry (1949) from the University of Michigan and a Ph.D. in physical chemistry (1953) from UC Berkeley. His doctoral thesis was titled “The Oxidation of Isotopically Labelled Hydrazine” and his thesis advisor was R. E. Powell. He also held an Sc.D. (hon) from Northwestern University (1990) and D. Hon. Causis from the Universit_ d’Evry, France (1996).

He taught at the University of Chicago (1952–1954) before joining the Metallurgy and Ceramics Department of the General Electric Company’s Research Laboratory in Schenectady, NY led by David Turnbull (1954–1964). Turnbull had done pioneering work on the kinetics of nucleation, and there was a focus in the group on understanding the thermodynamics and kinetics of phase transformations in solids. During this time Cahn completed a Guggenheim Fellowship at the University of Cambridge in England (1960–1961).

In 1957, Cahn worked with John E. Hilliard to develop the [Cahn–Hilliard equation](#)³⁶.

Alloys are not always uniform, homogeneous mixtures. In some alloys the different elements tend spontaneously to separate slightly at the microscopic scale in twisty, random clumps, a phenomenon called “phase separation.” Unlike crystallization, in which one component of a solution separates out to solidify at discrete starting points (think of making rock candy), this separation happens simultaneously throughout the mixture.

The phase separation and related changes in microstructure play a key role in determining the physical engineering properties of the bulk composite alloy—things like strength, toughness, ductility, magnetic strength and thermal conductance—but before the work of Cahn and Hilliard there was no good mathematical description of how this separation occurred. Developing a new alloy to meet specific material requirements was a painfully long and expensive process of trial and error. The [Cahn–Hilliard equation](#) supplied that basic framework. The equation describes, quantitatively, how the components of a binary mixture that becomes unstable when cooled will separate through a process called “[spinodal decomposition](#).”³⁷

Cahn proceeded to elaborate the theory, showing how basic thermodynamic principles could be used to design alloys that, under spinodal decomposition, would form desired microstructures. His work laid the foundation for the rational design and manufacture of new materials using the Cahn–Hilliard equation as well as for the related “phase-field” method, which uses similar thermodynamic considerations to model the behavior of complicated interfaces in materials.

Like many other fundamental theories, spinodal decomposition has proven relevant to a broad range of seemingly disparate fields. The Cahn–Hilliard equation, among other things, describes how galaxies began forming out of the primal material of the Big Bang in the early stages of the universe. In an interview in 2001, Cahn said that “having been the father of this equation, it really is very similar to being a father, because it has a life of its own...I long ago lost the ability to keep guiding it. It’s just going, and I’m very proud of it, but it’s on its own.”

In 1964, John became a professor in the Department of Metallurgy (now Materials Science) at MIT. There, in



³⁶ see <https://en.wikipedia.org/wiki/Cahn%E2%80%93Hilliard_equation>.

³⁷ In thermodynamics, a “spinodal” is a graph showing the critical conditions at which a mixture can easily separate into its components. For more, see <https://en.wikipedia.org/wiki/Spinodal_decomposition>.

1969, he began a long professional relationship with his graduate student, Francis Larché, whose work focused on the effect of mechanical stress on the thermodynamics of solids. The Larché–Cahn approach is the cornerstone of the treatment of the thermodynamics of stressed materials.

In 1972, Cahn and David W. Hoffman formulated vector-based techniques to describe the thermodynamics of interfaces, a formulation that is necessary to account for anisotropic materials. This is also known as the capillary vector formulation of interface energies. The mathematics of this treatment involves the concept of norms, although Cahn and Hoffman were unaware of it at the time.

In 1975, he worked with his graduate student Sam Allen on phase transitions in iron alloys, including order-disorder transitions. This work led to the [Allen–Cahn equation](#).

John began a long and distinguished career with NBS/NIST in 1977 as a scientist in the Center for Materials Science (1977). He became a Senior NIST Fellow, Materials Science and Engineering Laboratory in 1984.

In the early 1980s he teamed up with a visiting scientist, Dan Shechtman, to conduct a pair of experiments that proved crystals can be formed aperiodically, or in irregular patterns. The new type of crystals, called “quasi-crystals,” caused an explosion within the world of crystallography. In 1984, the news hit the *New York Times*, bringing international attention to Cahn’s work. A first-person blog written by Shechtman is reproduced below.

The complete list of honors and awards bestowed upon John Cahn is too numerous to mention here. In addition to his many professional memberships and offices, and the visiting appointments he held at leading universities and research facilities, a few of the honors and awards bestowed on John Cahn over his remarkable career include³⁸: [Kyoto Prize](#) (2011); [Bower Award and Prize for Achievement in Science](#) (2002); [National Medal of Science](#) (1998); Member [National Academy of Engineering](#) (1998); [Albert Sauveur Achievement Award](#), ASM International (1989); [Stratton Award](#), NBS (1986); [Von Hippel Award](#), Materials Research Society (1985); [DoC Gold Medal Award](#) (1984); Fellow, Japan Society for the Promotion of Science (1981); [Acta Metallurgica Gold Medal](#) (1977); Fellow, American Academy of Arts and Sciences (1974); Member, National Academy of Sciences (1973); and [S. B. Meyer Award](#), American Ceramic Society (1966).

In 2007, John moved to Seattle. In his “retirement,” he accepted a position at the University of Washington where he was working on a project that includes a glass that grows from a melt like a crystal—as if by a first-order transition.

In June 2011, when it was announced that Cahn had won the prestigious [Kyoto Prize](#)³⁹, then NIST Director Patrick Gallagher said: “We’re so pleased to see John receive this outstanding recognition. His work in understanding nature’s rules for atomic structure within metals and other

materials has had a profound effect on us all. It has enabled faster, more advanced materials design for many of the high-tech products we use every day.”

“John’s developments in the theory and models of materials have given scientists tools to understand and make new materials ranging from metals to plastics to ceramics and glass,” added NIST metallurgist Frank Gayle. “For instance, your smart phone or laptop might contain 100 different materials, and John’s work has probably influenced the understanding and development of half of those.”

Sixteen years ago, after the announcement that Cahn had won the *National Medal of Science*, a local newspaper⁴⁰ began an article about him with the following: “Dr. John Cahn keeps them on the highest pedestal in his office, sitting in a row above his chalkboard. He points to them, the black-and-white photographs of scientists who have been discussed in his lectures at universities throughout the world, and proclaims, ‘Those are my heroes.’ While Cahn, a senior fellow at (NIST), still has his own heroes, the 70-year-old Bethesda resident certainly has become a science hero in his own right.”

The article closed with: “What’s most astonishing is that, even after spending 46 years doing research in the material sciences, Cahn remains completely in love with what he does....And Cahn’s work is not over yet. At age 70, the medal winner has no plans to retire...When asked how long he’ll keep doing research, the *National Medal of Science* winner says, without hesitation, ‘Probably as long as I live’....and he did.

John Cahn, 88, who fled Nazi Germany as a boy and became a foremost thinker in materials science, died of leukemia on March 14, 2016 in Seattle. He is survived by his wife of 65 years, the former Anne Hessing, of Seattle; three children, Martin Cahn of Seattle, Andy Cahn of Kenmore, WA., and Lorie Cahn of Jackson, WY; a sister; and six grandchildren.

Sources: [The Washington Post](#), March 15, 2016; NIST Public Affairs Office; NIST Archives; [Wikipedia](#); [DoC Press Release](#), June 27, 2001; [Montgomery County Gazette](#), December 23, 1998, and *SAA Newsletter* archives.

My Memories of John Cahn

Danny Shechtman, 2011 Nobel Laureate in Chemistry, posted the following article on April 28 to the NIST Taking Measure: Just a Standard Blog website⁴¹

I first met John Cahn in the late 1960s when he visited our department of metallurgy at the Technion—Israel Institute of Technology. Already a famous thermodynamics-of-materials scholar, John was our most important vis-

⁴⁰ <http://www.gazette.net/gazette_archive/1998/199851/bethesda/news/a45034-1.html>

⁴¹ <<http://nist-takingmeasure.blogs.govdelivery.com/my-memories-of-john-cahn/>>

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³⁸ A more complete list of John Cahn’s awards and honors can be found at <<http://www.ctcms.nist.gov/~cahn/bio.html>>.

³⁹ see <https://en.wikipedia.org/wiki/Kyoto_Prize>.

iting scientist at the time. During that period I was studying for my master's and then Ph.D. degrees, and John and I were talking science. John was interested in my work and in particular in the microstructure of the titanium alloys I was studying.

In 1972 I started my postdoc studies at the Aerospace Research Laboratories at Wright-Patterson Air Force Base near Dayton, Ohio, and met John again. However, our life-changing meeting occurred later, in 1979, when John and his wife Anne came to stay at the Technion for a longer period. For a little while John even contemplated joining the Technion faculty.

My research during those days as a young Technion lecturer was centered on the structure and properties of rapidly solidified (RS) metallic alloys and I had developed a technique to make thin foils from fine RS powders for studies using a transmission electron microscope (TEM). This technique was crucial for TEM studies of RS powders, and produced remarkable results. I thought John would be interested in the solidification patterns I was observing, so one day I went upstairs to his office and invited him to the TEM room. John was elated at what he saw.

He told me that NBS scientists had been trying to obtain such images with very little success, and on the spot invited me to give a lecture on my findings at NBS. In the summer of 1980 I came to give this invited lecture and received an offer to come to NBS for my upcoming sabbatical from the Technion. In August 1981 I came with my family to work for two magnificent years at NBS. My official affiliation was with Johns Hopkins University, and DARPA was the sponsor of my studies.

John was my host, but most of my work was performed in collaboration with Bill Boettinger, with Frank Biancaniello making rapidly solidified alloys for me. John was interested in our work and we consulted with him frequently.

Several months after my arrival at NBS, on April 8, 1982, I made the discovery that affected our lives. I discovered the quasiperiodic materials.

John was interested in the new, at-the-time-unexplained five-fold symmetry-diffraction patterns of what was later known as the icosahedral phase, the first quasiperiodic material that I found in aluminum-manganese alloys. Although the reaction of other members of the NBS community varied from ridicule to interest, John was always encouraging. He said, "Danny, this material is telling us something, and I challenge you to explain it." In fact, John was the NIST researcher who was the most positive about my research during those days.

My sabbatical at NBS was about to end in 1983, and John, with Robert Mehrabian, the head of the lab, offered me a good permanent position at NBS. This was a tempting offer, but I decided to go back to the Technion.

The mystery of the icosahedral phase was still unsolved, but upon my return to the Technion, I met with Ilan Blech, who was the first scientist to help solve the mystery. Ilan developed a model that showed how the new structure

could form, and together we wrote a scientific article that announced the newly discovered atomic order in crystals.

The article, sent for publication to the *Journal of Applied Physics*, was rejected by the journal's editors, who claimed that it would not interest the community of physicists. I then sent the article to *Metallurgical Transactions* and it was accepted, but scheduled to be published only months later, in the middle of 1985. In the summer of 1984, I came back to NBS for the summer and showed the rejected article to John, asking him why, in his opinion, the article was rejected.

John proposed to write another article based on my discovery without the Ilan Blech model. He brought on board Denis Gratias from France, and the three of us wrote a short article describing the discovery of quasiperiodic materials. The article, sent to *Physical Review Letters*, was accepted and published in November 1984.

From the day of the publication, John, Denis and I were in the eye of the quasicrystal storm. Scientists from around the world developed the discovery into a fast-growing science. The *Physical Review Letters* article was the first in a series John and I published together, and our collaboration on quasicrystal materials lasted for years. I continued to visit NBS every summer at John's invitation, and together we stood against criticism from several eminent scientists headed by Linus Pauling, one of the greatest chemists of the 20th century.

My friendship with John and Anne lasted for many years, beyond our scientific collaboration, and our two families celebrated many occasions together, including a traditional yearly dinner at the restaurant L'Auberge Chez François in Great Falls, VA.

My life and career intertwined with those of John, and the serendipity created by our long-lasting relationship changed our lives and created opportunities and excitements that otherwise would not have happened.

—Dan Shechtman

Editor's Notes:

(1) On May 30, 2013 John Cahn met with the NBS/NIST Oral History Committee for a wide-ranging discussion about Cahn's background, education, and perspective on his career and the colleagues he worked with. The transcript of the interview is available in Gaithersburg in the Library reading room. If you are unable to visit the Gaithersburg campus, a digital copy of the transcript is available on request. Send a request to <library@nist.gov>.

(2) An eleven minute interview with John Cahn, originally recorded in 2001, in which he talks about his life, and the impact of his theories is available at <<https://www.youtube.com/watch?v=dhn1QIZHYsU>>.

(3) John W. Cahn was invited to give the *Dow Distinguished Lecture* on May 2, 2013. His lecture, "Plausible Fallacies and Inconvenient Truths" can be viewed at <<https://www.youtube.com/watch?v=hMqifrqstDe>>.

9. NEWS OF ALUMNI

Patrick Gallagher, University of Pittsburgh Chancellor and former NIST director, has been appointed to the Commission on Enhancing National Cybersecurity, part of President Obama's \$19M Cybersecurity National Action Plan. The Commission is comprised of 12 leading thinkers from business, technology, and academia selected by the White House and the bipartisan Congressional leadership. It is charged with recommending bold, actionable steps that the government, private sector, and the nation as a whole can take over the next decade to strengthen cybersecurity in today's digital world. Their recommendations will be reported to the President by the beginning of December.

Source: White House press release, April 13, 2016.

Arati Prabhakar, DARPA director and former NIST director, participated on May 18 in *Transformers*, a live journalism event about "advances pushing the boundaries of knowledge and the people who are making radical change seem inevitable." The event was hosted by *The Washington Post*. Prabhakar was one of the "transformative thinkers" (science and technology pioneers, business leaders, and policymakers) invited to discuss breakthroughs in artificial intelligence, commercial space travel, education, and health care, and to exchange ideas, strategies, and lessons learned. Also participating was **Vinton Cerf**, former VCAT member, Google executive, and Internet pioneer.⁴²

Source: *The Washington Post*.

—Janet Miller

10. ASSOCIATION NEWS

2016 SAA Awards

The following SAA Awards were presented at the annual spring luncheon held on April 28, 2016:

Distinguished Service Award

Karma Beal, for her outstanding management of SAA Office Operations over the last four years. In this capacity she has assured smooth communication flow among SAA officials and has provided important support to the Membership Committee and other bodies. In addition, she has successfully taken on the duties of arranging SAA social events.

Mickey Haynes, for assuming direction of the "Boulder Babble" column in the *SAA Newsletter* from Bob Kamper in 2006. His work is easily the most commented-upon item in the newsletter. The Local News portion has been unique and "delicious" over the years, and Mickey wrote it for his

entire tenure. He did this while continuing a very active professional career.

Roger Martin, has done a remarkable job with the newsletter. He has brought his own style and ideas to it, and it remains fresh because of that. He serves as managing editor, necrologist, and compositor/publisher—any one of these can, especially for a big issue, consume the entire six weeks before it goes to the print shop. The effort he puts into garnering information for the obituaries alone is staggering!

John Tesk is recognized for SAA's Distinguished Service Award based on his exceptional and dedicated decade-long service as Chair of the Membership Committee where he advanced SAA's membership recruiting process and organized and streamlined SAA's membership reporting system; and for his conscientious record keeping and gentle follow-up to many late membership renewals.

Certificate of Appreciation

Norm Belecki for running the IT works and leading the IT Committee.

Morgan Frycklund, for including SAA membership applications and benefits in the retirement packages given to those retiring from or leaving NIST employment.

Jeffery Horlick for putting a tremendous amount of effort into SAA activities: acting as interface between the SAA and Kevin Kimball, taking care of all of the badge applications, interacting with the legal office, helping keep our relationships with the NIST IT people on an even keel, giving sage advice and good ideas to many, if not all, of the standing and *ad hoc* committees, acting as Schooley's right-hand man, collecting archival information such as phone books, jumping in wherever there seems to be a gap of some sort, etc.

—Sheldon Wiederhorn
Awards Committee, Chair

NIST Portrait Gallery

The SAA Portrait Gallery Committee is pleased to announce the 2016 honorees to be inducted into the NIST Gallery of Distinguished Scientists, Engineers, and Administrators. A jury was convened on March 30, 2016, to recommend those selected from this year's nominees to Dr. Willie E. May, NIST Director. On March 31, 2016, Dr. May approved the recommendation to add the following eight names (*asterisk after the name indicates SAA Member*):

Bert Coursey, PML (1972–2011), for pioneering technical advances in measurement of ionizing radiation in the environmental and medical sciences, and for leadership in the establishment of a national standards infrastructure for homeland security.

Raymond Driscoll, PML (1936–1971; 1971–1990 post retirement), for significantly advancing metrology through absolute determinations of the ampere and the proton gyromagnetic ratio in H₂O, contributing crucially to the implementation of the SI, the determination of fundamental

(continued on next page)

⁴² More information and video from the event is available at <https://www.washingtonpost.com/pb/blogs/post-live/>.

constants, and bringing atomic magnetic resonance techniques into electrical metrology at NBS.

Robert Goldberg*, MML (1969–2008; 2008–current Scientist Emeritus), for pioneering research in microcalorimetry in conjunction with extensive studies on the thermodynamics of enzyme catalyzed reactions of great significance to biotechnology and for assembling the world's largest thermodynamic database of important enzyme catalyzed reactions.

Robert Greenberg, MML (1976–2008), for exceptional contributions to the field of radioanalytical chemical metrology, instrumental and radiochemical activation analysis, and gamma-ray spectrometry, leading to unprecedented accuracy and precision for elemental determinations.

Leslie Guildner, EL (1959–1982), for research in thermometry that provided the basis for the redefinition of the International Practical Temperature Scale in the critical range from the triple point of water to 457 °C.

George Kelly*, EL (1970–2007; 2007–current Guest Researcher), for leadership of environmental systems research for the performance of building systems and appliances, and standards for open systems for integration of building environmental, fire safety and structural safety controls.

Graham Morrison, MML (1979–1993), for outstanding leadership in establishment of a NIST-wide program for determining thermophysical properties of alternative refrigerants which resulted in improved energy efficiency and reduced depletion of the stratospheric ozone, meeting the goals of the Montreal Protocol ahead of schedule.

Joseph Reader*, PML (1963–2014; 2015–current Scientist Emeritus), for exceptional contributions to development of the atomic reference data program at NIST covering production, evaluation, collection, and dissemination of the best atomic data in the world.

Members of the SAA 2016 Portrait Gallery Jury were:

| | |
|----------------------|--------------------|
| Norman Belecki | Mike Rowe |
| Gordon Day | James Schooley |
| Eugene Domalski | Stephen Seltzer |
| Cita Furlani | Hratch Semerjian |
| Harry Hertz (nv) | Jack Snell |
| Bettijoyce Lide (nv) | Sheldon Wiederhorn |
| David Lide | Richard Wright |
| Billy Mangum | |

(nv): non-voting

Please mark your calendars to attend the Portrait Gallery Reception and Ceremony on Friday, October 28, 2016, at NIST.

—Bj Lide

Education Committee News

Mark Your Calendar to Attend ...

The SURF (Summer Undergraduate Research Fellowship) Symposium, August 2–4, 2016, in the NIST Red and

Green Auditoriums and various lecture rooms. The format is a plenary session with a keynote presentation from one SURF student from each NIST organizational unit, followed by parallel sessions (organized by laboratory and subject area) in which each SURF student presents a summary and results of his/her summer research.

The SHIP (Summer High School Internship Program) Poster Session, August 2, 2016, at lunchtime in the NIST Hall of Flags. Each SHIP student will be available to answer questions and discuss his/her summer research.

2015 SAA Audit Report (Summary)

| | |
|-----------------------------|-------------|
| Balance 12/31/2014 | \$33,000.77 |
| Total Receipts - 2015 | \$11,585.68 |
| (Contributions...\$ 620.00) | |
| (Member Dues...8,069.00) | |
| (Luncheons.....2,812.00) | |
| (Interest.....84.68) | |
| Total Expenses - 2015 | \$12,169.80 |
| (Newsletter.....\$6,385.55) | |
| (Office an IT.....2,831.82) | |
| (Portrait Comm.....450.00) | |
| (Luncheons.....2,402.43) | |
| Balance 12/31/2015 | \$32,816.65 |

11. COMMUNICATIONS

From: Norm Belecki

Subj: In memory of Dr Bryan Kibble, 1938–2016

I lament to report the untimely passing of Byran Kibble, a research metrologist of international prominence at the UK's National Physical Laboratory (NPL).⁴³

Bryan suffered cardiac arrest and died April 28, 2016. He worked at the NPL (1967–1998) as an experimental physicist. He was instrumental in reshaping the International System of Units (SI), and is best known for his conception of the watt balance, one of the measurement approaches proposed for the redefinition of the kilogram. Kibble will be dearly missed by the international measurement community, with former colleagues citing his quiet and patient guidance, and praising his problem-solving skills.

Bryan Kibble was born in 1938 in Berkshire. He studied Physics at Wadham College, University of Oxford, where he was awarded a Ph.D. (1964) for research in atomic spectroscopy. He continued his research as a Postdoctoral Fellow at the University of Windsor in Ontario, Canada (1965–1967) and joined NPL as a Senior Research Fellow in 1967. He retired from NPL in 1998, but continued to be active in the field. He worked on the Mark II watt balance and high-frequency standards and bridges at NPL, and be-

⁴³ For the NPL obituary on Brian Kibble, see <<http://www.npl.co.uk/news/in-memory-of-dr-bryan-kibble-1938-2016>>.

came a guest worker at both the Physikalisch-Technische Bundesanstalt (Germany) and BIPM, where he played a key part in eliminating a number of unresolved problems with the measurement of the ac quantum Hall effect.

Kibble continued to be active on various international committees. In 2009, he won the IEEE *Joseph F Keithley Award* in Instrumentation and Measurement and was invited to write a regular column for *IEEE Instrumentation and Measurement Magazine*. In 2010, he published a book with Jurgen Schurr and Shakil Awan.

A letter of condolences sent to NPL by NIST Director Willie May included the following: "It is with great sadness that we learned of the passing of Dr. Bryan Kibble, a man we knew as a distinguished scientist and scholar who contributed greatly to the field of precision electrical measurements, not only through his own world-leading, innovative research, but through his active participation in the work of the CCEM⁴⁴ of the CIPM⁴⁵.... Bryan was well known to us at NIST; he not only spent time with us as a guest researcher, he collaborated with a number of NIST staff on various projects. One of the most important of these was the establishment through the CCEM of the conventional values of the Josephson and von Klitzing constants adopted by the CIPM in 1990 to ensure the world-wide consistency of all electrical measurements. Deeply respected at NIST for his many contributions to measurement science, Bryan was a warm and collegial mentor of electrical researchers around the globe, and a commanding presence in international electrical metrology... His intellect, creative drive, and deep understanding of all things electrical will be sorely missed."

The History Column (see page 38) contains a brief historical overview of the watt balance and Kibble's impact on metrology.

From: Alan Hoffman <ajh@us.ibm.com>

Subject: Churchill Eisenhart

Although Eisenhart and I were not buddies, I think of him often, because: (1) the alumni association is a really great idea, and I like to show the quarterly bulletin to (the many) skeptics who think everything in the civil service is incompetent or evil, or both; and (2) he recruited an unbelievably talented group of statisticians for his group; at least, that was so in my time.

I had dinner a few years ago at a meeting of the American Academy of Arts and Sciences and I remember Joan Rosenblatt and Marvin Zelen and spouses. I apologize for not remembering the others. I saw a lot of Dick Savage in the years I taught at Yale. Also, a large part of my research career grew out of a paper I wrote completing work begun by Bill Connor. Is Connor still around? I do not remember thanking him.

I am also curious to know if any alumni of Jack Todd's group, other than Phil Davis, is still among us.

From: Bill Gadzuk <william.gadzuk@nist.gov>

Subj: AVS Special Session on John Yates

A special session—"Celebrating a Life in Surface Science: A Symposium in Honor of John T. Yates, Jr."—will be held during the AVS 63rd International Symposium & Exhibition in Nashville, TN, November 6–11, 2016.

The invited speakers for this special event will be:

- Jinguang Chen, Columbia University/Brookhaven National Laboratory
- Ib Chorkendorff, Danish Technical University, Denmark,
- Hajo Freund, Fritz Haber Institute of the Max Planck Society, Germany
- J. William Gadzuk, NIST
- Michael Grunze, University of Heidelberg
- David Hercules, Vanderbilt University
- Sir David King, Cambridge University, UK
- Peter Maksymovych, Oak Ridge National Lab
- Patricia A. Thiel, Iowa State University
- Michael Trenary, University of Illinois at Chicago
- Ellen Williams, ARPA

John Yates, my friend and colleague, was a joy to share life with. His perpetual enthusiasm, imagination, and sincere interest in whatever happened to be the topic of the moment—whether a complex issue in surface science, the fate of an astronomically distant galaxy, the program for Lorin Maazel's next Pittsburgh Symphony concert, the well-being of his scientific "children" and real family, or speculation on what's likely to be tonight's specialties on the menu of our favorite Il Pizzico Restaurant—was infectious.

John's retirement in 2006 from his chair at the University of Pittsburgh [which he went to from NBS/NIST in 1982] brought him to an emeritus-like guest faculty desk at the University of Virginia. Soon, his "desk" became a full-fledged surface science lab with an active group of students and post docs supported by research grants that totaled among the highest within UVA chemistry, all of which was built up from scratch after John "retired." He was the only person I know who confessed that he really liked writing research proposals. He lived and executed his retirement with more excitement, energy, and enthusiasm than a young, tenure-seeking assistant professor—he was the energizer bunny personified.

John and I had the privilege of being co-participants in two NIST Oral History interviews in 2014–15, once as a "target" and then as an interviewer (of each other). This was a great way for us to summarize our nearly half a century of being a part of each other's life, a privilege that I feel very fortunate and honored to have had.

⁴⁴ Consultative Committee for Electricity and Magnetism

⁴⁵ International Committee for Weights and Measures

From: Geoff Hudson <geoffhudson94@charter.net>
Subject: Ralph Hudson

I wish to express my gratitude to you and your colleagues at the SAA for the gracious, thoughtful article about my father that headlined the March issue of the *SAA Newsletter*. Even though I have known the contributors of the Remembrances for many, many years, I found their insights to be particularly interesting as, in some instances, they were quite new to me. Speaking of which, I had never before seen the very nice photograph of Dad that appeared on the first page of the newsletter—nicely done! I have learned more about Dad during his last six-plus years living here in Madison than I ever knew before and yet the article contained some additional stories and facts for which I am forever grateful to have learned. I can extend no higher praise to you and your colleagues for your efforts than to offer that I know Dad would have been most pleased to have shuffled off this mortal coil with such a fine flourish.

12. HISTORY

The Watt Balance

The idea of improving the old Ampere-balance experiments to use the generative power of its coil(s) in motion was Bryan Kibble's and he performed the first measurements relating mass to g , e and h using it, as well. He was well known at NBS/NIST and has spent time here as a researcher and collaborator.

Dr Bryan Peter Kibble, who worked at the National Physical Laboratory (1967–1998) as an experimental physicist, was instrumental in reshaping the International System of Units (SI), and is best known for his conception of the watt balance, one of the measurement approaches proposed for the redefinition of the kilogram.

Early in his NPL career, Dr Kibble successfully measured the high field gyromagnetic ratio of the proton. This measurement, in conjunction with a similar low field measurement, indicated that there was a problem with the existing realization of the ampere, the SI base unit of electrical current. He also worked with Dr Geoffrey Rayner on coaxial AC bridges and the calculable capacitor from which the SI definition of the unit of resistance, the ohm, could be established. In 1984, Kibble and Rayner compiled and published their research in the book, *Coaxial AC Bridges*.

In the early 1970s, the imperfections of the current balance weighed on Kibble's mind. The current balance was an elaborate and difficult experiment used to measure current as described by the definition of the SI Ampere. Results were coupled with those of absolute measurements of the ohm to calibrate chemical voltage standards (Weston cells) used for practical measurements, there being no artifact standard of current. The problems of using the current balance inspired him to conceive a new and improved instrument, the moving coil watt balance. He described his idea to Bob Cutkosky, a highly respected experimental sci-

entist visiting from NBS. Cutkosky's response encouraged Kibble to proceed with the idea and also planted the seeds for similar developments at NBS, which were pursued by his friends Ed Williams and Tom Olsen. Together with the calculable capacitor realization of the ohm, it could replace the current balance and improve the accuracy of electrical standards used internationally.

In 1978, the Mark I watt balance was built at NPL with Dr Ian Robinson and Ray Smith. The instrument was used to realize the ampere with greater accuracy than was possible with the current balance, and the results played a major role in setting the 1990 conventional values of the Josephson and von Klitzing constants, used today for electrical measurements throughout the world. In recognition of his work, Kibble was awarded the International Union of Pure and Applied Physics SUNAMCO *Senior Scientist Medal* in 1992.

The kilogram, the SI base unit of mass, is the last of the seven SI base units to be defined by a physical object. It is expected be redefined in terms of a natural constant, the Planck constant, the quantum of action in quantum physics.⁴⁶ Wide-spread implementation of this definition will be possible because of Kibble's watt-balance.

In 1990, a second watt balance was built by Kibble, Ian Robinson and Janet Belliss at NPL. It was designed to operate in a vacuum and was intended to measure the Planck constant with sufficient accuracy to support the redefinition of the kilogram. The watt balance eliminates the properties of the coil and magnet from the measurement thereby allowing electrical power and mechanical power to be equated. Using the ac Josephson and quantum Hall effects, electrical power can be measured in terms of the Planck constant and time, allowing the watt balance to relate mass to the Planck constant and SI units of length and time.

By changing the definition of the unit of mass within the SI to fix the value of the Planck constant, the last artifact standard in the SI—the platinum-iridium cylinder kept at the International Bureau of Weights and Measures (BIPM) in Paris—can be replaced and, by the additional fixing of the value of the elementary charge, the electrical units can return to the SI.

In 2014, Kibble and Robinson published new principles for building simple watt-balance designs, making the instrument more accessible. Canada's National Research Council used the NPL Mark II watt balance to measure the Planck constant with sufficient accuracy for the redefinition.

A fitting tribute to Bryan Kibble's visionary work is that, from 2018 forward, watt balances should be used throughout the world to realize the kilogram definition.

—Norm Belecki

⁴⁶ See Schooley, J.A., "3. Report on the July 19 Meeting", *SAA Newsletter*, Vol. 28, pp. 4–5; and "News from NIST: Fundamental Constants: The Latest . . . and the Last?", *SAA Newsletter*, Vol. 31, No. 4, p. 6.

Pies and People

How do you select the best pie at the county fair? This is the question that faces judges year after year. Presented with dozens of choices—apple, cherry, pecan, blueberry, rhubarb, and more—they do their best, just as the bakers have done in preparing their offerings. In a curious analogy, I was assigned a similar task by the folks at the NIST Connections newsletter: Whom do I admire most among the myriad souls that have populated NBS/NIST during its century-plus years of existence?

There is a certain logic to the request. Some years ago, I wrote the book *Responding to National Needs: The National Bureau of Standards Becomes the National Institute of Standards and Technology* about the hundreds of people who have brought international renown to our agency. In the process, I did develop favorites, and herewith I present three of them.

For me, Samuel Stratton leads the list. Stratton was a farm boy, born on July 18, 1861 near Litchfield, Illinois. Like most farm boys, he spent lots of time operating and repairing machinery, and he was good at it. A bright lad, he enrolled in the Illinois Industrial University—later to become the University of Illinois. In 1884, he received a B.S. degree in mechanical engineering.



The school administration recognized his ability; soon he became its Professor of Physics and Electrical Engineering. Then the University of Chicago beckoned; Samuel was made a full Professor of Physics there in 1898. So far, just another success story.

Then fate intervened in Sam's life. Frank Vanderlip, one of Sam's classmates at IIU, had become a New York banker, then private secretary to Lyman Gage, Secretary of the Treasury. In 1899, Gage felt strongly that America needed a national organization to provide leadership in improving the country's measurement standards, which were mediocre at best. Gage asked Vanderlip to suggest someone who could write a prospectus for such an entity. How about my old classmate Sam Stratton? thought Vanderlip.

In record time, Stratton had prepared an outline, Gage had presented it to the Congress, and with the backing of nearly all of the technical leaders in America, the Gage/Stratton proposal was adopted. On March 3, 1901, Congress established the National Bureau of Standards pretty much as Stratton had designed it. Sam was immediately appointed to head the new agency by President William McKinley.

Not all of the Congressmen were enthusiastic about creating another government agency, and the meager support given to the new director showed it. Stratton began his work as NBS director with Congressional authority to hire

one physicist, one chemist, two junior scientists, two lab assistants, one each of a secretary, a clerk, a messenger, an engineer, a mechanic, a watchman, and a laborer. Let's see, that's 14 humans including Stratton as of 1901.

No sweat, for Stratton. He hired carefully, choosing well-known scientific men who shared his vision for the new agency and who were willing in many cases to take a pay cut to become part of something important. It was later said that he assembled the lowest-paid corps of first-rate scientists ever accomplished by a government. By 1922, when he retired to take the position of President of MIT, Stratton left behind a staff of about 850, housed in ten divisions. Besides their achievements in creating and disseminating increasing numbers of standards for science and industry, they had undertaken some 50 military projects to help out in World War I.

Sam Stratton was quite an admirable NBS employee, wouldn't you say?

I give second place to Allen Astin, who endured a very public incident that temporarily cost him his job as Director of NBS, but who showed the true meaning of integrity in the process. Astin, born to meager circumstances on June 12, 1904, in Salt Lake City, Utah, came to NBS in 1930 after a 2-year term as a postdoctoral fellow at the Johns Hopkins University. His NBS research in the areas of electronics and weather instrumentation established him as a senior scientist; his research on proximity fuses during WWII added to his reputation. In 1951, Astin was named Associate Director of NBS under Edward Condon. When Condon resigned in September 1951, after years of Congressional torment over his advocacy of collaboration with the Russians on the future of atomic weapons, Astin was named Director of NBS.



When Ed Condon left NBS, a problem was brewing that would expose NBS to Congressional scrutiny as intense as it was at the founding of the agency, and potentially more damaging. An aggressive California businessman, one Jess Ritchie, saw no reason that NBS could not test his product, a battery additive he called AD-X2. Mr. Ritchie claimed that the additive would extend battery life. Indeed, he had a collection of testimonials from satisfied customers. The trouble, as George Vinal, chief of the electrochemistry section, explained in the course of much correspondence with Mr. Ritchie, was that NBS had established a policy early in its existence not to test commercial, brand-name products. The policy had served NBS well, avoiding any chance of favoring one company over another.

Mr. Ritchie was persistent and creative in his effort to bend NBS to his will. Eventually, some two dozen Congressmen and the National Better Business Bureau joined

(continued on next page)

his team. In accepting the directorship of NBS, Allen Astin inherited the growing problem.

Astin was a calm, reserved man, much the opposite of the mercurial Condon, though extremely capable as a manager. For example, it fell to him to re-deploy NBS programs from the hectic WWII activities to more peaceful pursuits, and he accomplished that mission with care and efficiency. Astin was willing to suspend the NBS no-test-for-commercial-products policy when the Department of Commerce leadership and the US Senate demanded that NBS test Mr. Ritchie's AD-X2. Astin directed the electrochemistry section staff to design a testing program for AD-X2. This was no small feat, inasmuch as batteries were notoriously finicky and erratic; the protocol required many batteries, divided into an AD-X2 group and a control (no AD-X2) group for comparison. Astin himself monitored the test results on a daily basis. The test showed no evidence that AD-X2 extended battery life. Of course, Ritchie and his team were not about to quit.

The Secretary of Commerce, Sinclair Weeks, and his deputy, Craig Schaeffer, decided that the NBS should have taken account of President Eisenhower's pre-election promise to "get big government off the backs of small business". New to their offices, they saw a need to get off on the right foot with the President and reform the agency, especially its testing program. They called Astin "downtown" and told him to resign his position while they empaneled a blue-ribbon committee to revise the testing protocols. Wearily, Astin resigned, realizing that his bosses had no confidence in his leadership.

Then came a national uproar as US scientific and technical communities—government, academic, and industrial—realized that the Department of Commerce intended to change NBS from an objective source of accuracy in measurement into a pawn of business. Even the general public became aware of the fracas, as the big newspapers, their columnists, and their cartoonists ridiculed the DoC stance.

Through it all, Astin retained his gentle demeanor. When he was called to testify before a Congressional committee, he calmly explained the goals and practices of NBS, and why NBS so valued its reputation for accuracy and objectivity. Many speakers testified in support of these goals. Weeks and Schaeffer reversed their decision and re-instated Astin. Schaeffer resigned his post. Weeks, finally understanding the agency's importance to America as an objective expert in measurement standards, became one of its enthusiastic supporters. Astin and NBS had achieved a very public endorsement of the agency's integrity.

When I came to NBS in 1960, Allen Astin still occupied the Director's chair; he retired on his own terms in 1969, when he turned 65 years of age, greatly admired and in possession of numerous awards.

For what it's worth, he also has my sincere admiration.

My third favorite among the staff is Bill Phillips, who reached the pinnacle of scientific success, but did not forget his roots.

One day in the late '70s, Barry Taylor and I were talking about ways to manage our technical sections. Times were getting tough, with upper management responding to reduced Congressional funding for research. I still recall Barry saying that his plan was to recruit scientific talent and "sell" upper management on specific individuals. He said that he



had his eye on a grad student at MIT. He spoke in glowing terms about the great promise of one Bill Phillips. What a good idea, I thought; why didn't I think of that technique?

Time passed, and I heard nothing of the details, but Bill Phillips did come to NBS in 1978. My wife and I got to know Bill, his wife, and their two daughters because they were neighbors in Darnestown. They enjoyed occasionally visiting our place to see our current crop of horses and other farm animals. Of course I ran into Bill in the halls of NBS; we shared an interest in cryogenics. When Bill became NIST's first Nobel Laureate in 1997, I, along with the rest of the scientific world, learned at least the bare bones of his experiments. The idea that his laser cooling technique dropped the effective temperature of a trapped gas to mere nanokelvins above absolute zero amazed me—I had spent a lot of time and effort reaching a few tenths of a kelvin, so I listened spellbound to his occasional talks to NIST staff.

But even more interesting to me was the aftermath of his Nobel award. Without knowing any of the facts, as a fellow scientist I was sure that offers to move his team to laboratories unfettered by the strictures of the US Office of Personal Management were plentiful. Surely NIST management would do its best to retain Bill, but...

Yet time passed, and Bill was still actively working with colleagues all over the scientific landscape, but he was also still participating in the technical life of the NIST campus. He still is. And the fact that Bill stayed "home" after winning worldwide fame, I really admire that a lot.

Which "pie" do you like best?"

—Jim Schooley, SAA Historian

Source: *NIST Connections*, May 2016 included a shorter version of this essay. This longer version was posted to the NIST internal website.

SAA Membership* (05/03/2016)

| | |
|----------------------|-----|
| Annual Members | 277 |
| Spouse-Annual | 50 |
| Lifetime Members | 109 |
| Spouse-Lifetime | 7 |
| Honorary Members | 12 |
| Spouse-Honorary | 2 |
| Total SAA Membership | 457 |

* Membership in the SAA is open to all former and current employees of NBS/NIST. Encourage your colleagues to join.

ASSOCIATION OFFICERS 2016–2017

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| | |
|-----------------|---|
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