SAA NEWSLETTER

Standards Alumni Association
National Institute of Standards and Technology
Gaithersburg, MD 20899-0952

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Founding President: Churchill Eisenhart (1913-1994)

March 2016

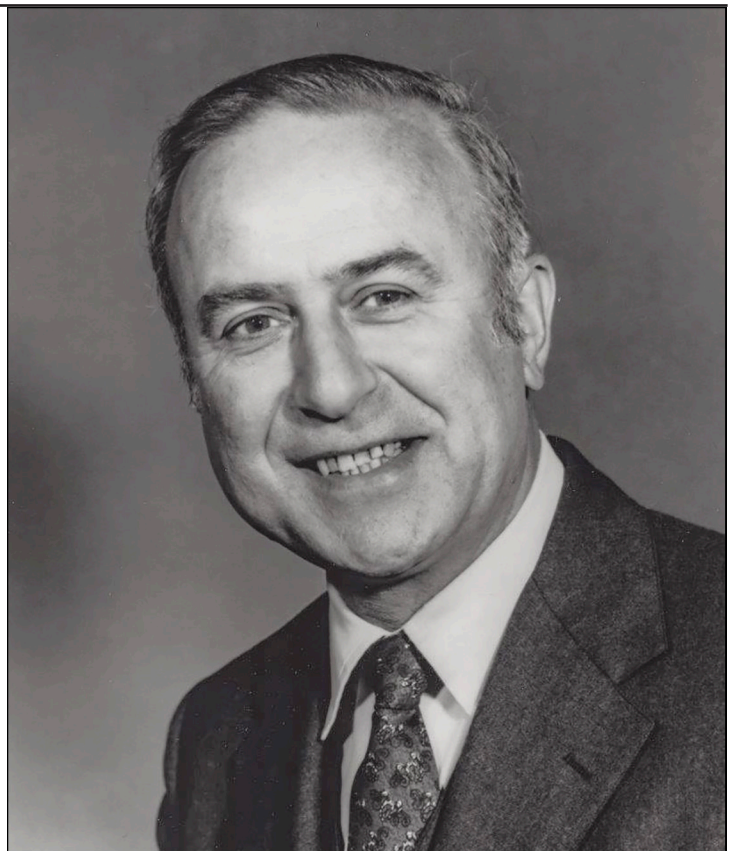
Ralph P. Hudson (1924-2016)

As we all (should) know, the SAA began life in 1985 as the "NBS Alumni Association." At that time, Ralph and Nancy Hudson were living in Paris, where Ralph was serving as Editor for the journal *Metrologia*. He occupied that position from 1980 to 1989, when he reached the mandatory retirement age of 65. What is not generally known is that Ralph is listed on the very first membership roster for the new association; Ralph was interested in participating in the NBS SAA even at a distance.

When Ralph and Nancy returned to Washington in 1989, he joined the National Science Foundation for a three-year stint, but nevertheless, he began an active role in the work of the "Standards Alumni Association." His first contribution was a talk on October 11, 1990 in which he recounted some of the details of his life and work in Paris. In 1994, Ralph finally retired from gainful employment for good, and he devoted more time to the SAA. He began to attend SAA functions such as Bob Kamper's autobiographical talk, an event that Ralph described for the SAA newsletter. He became a regular at SAA meetings, often reporting on them in the newsletters.

In 1995, SAA president Manny Horowitz asked Ralph to succeed John Bennett as Editor of the SAA newsletter. John and his family were moving away, and he felt that editing at a distance was not a good idea. Ralph agreed to become the Editor, and took on the job of chairing the Portrait Gallery committee as well (as mentioned below, Ralph had himself been inducted into the Gallery in 1988).

As newsletter Editor, Ralph intensified his reporting on SAA activities, even as the pace of newsworthy items seemed to increase. Talks by Sam Kramer, Bill Phillips, Jake Rabinow, and Gordon Day were reported, as were a growing number of obituaries. As age began to tell on Ralph's energies, Norm Belecki signed on as Associate Newsletter Editor in 2002. Eighteen months later, Norm replaced Ralph as Editor.



Ralph continued to attend SAA Board meetings, where his wit and wisdom continued to be most welcome, until in the year 2009 he acceded to the wishes of his children, Geoffrey and Wendy, to move to Madison, Wisconsin, where he could be closer to Geoffrey. Still, Ralph continued to read the newsletter and follow the progress of the SAA activities.

His Career

In 1951, Ralph was an Assistant Professor in the physics department at Purdue University. Half-way into his sec-

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ond year, he received a letter from Ferdinand Brickwedde, Chief of the Heat and Power Division at NBS. "Brick" was contemplating expanding his division into deep cryogenics, he had heard that Ralph was well qualified in that area, and he wondered whether Ralph would be interested in coming to Washington to talk about employment. Ralph was sufficiently interested that he took a train ride to DC, leading to an offer of a job with NBS. He accepted, packed up his family, and traveled to Washington, where he began his three-decade career at NBS.

When Ralph reported for duty as a member of the NBS Heat and Power Division's Cryogenic Physics Section, he joined a lively group. Besides Brickwedde, the power behind the expansion of cryogenics at NBS, there was Russell B. Scott, at that time chief of the Cryogenics Section, who was even then engaged with Brick in planning a monster liquid-hydrogen plant for installation in new facilities in Boulder, Colorado; John Pellam, an MIT grad whose specialty was second sound in liquid helium; and Emanuel Maxwell, another MIT alum, a pioneer in studies of the isotope effect in superconductivity. Brickwedde actively encouraged his colleagues to pursue their studies at the highest level.

Ralph found life in the Cryogenic Physics Section both exciting and agreeable. The working hours for Brick's scientists were whatever was consistent with their activities, and all Brick demanded in return was first-class science.

Ralph was instrumental in bringing his old acquaintance, Ernest Ambler, to NBS soon after Ralph himself arrived.

Brick had a specific plan for Ralph and Ernest, who was completing his D. Phil. work with Professor Kurti at Oxford. They would work with Dirk de Klerk, docent of physics at Leiden University, who would come to NBS on a one-year visit to supervise the installation of a magnetic cooling facility in the humble Low Temperature building, which stood between the much larger North and the West buildings on the NBS campus. Putting Brick's plan into reality occupied the team for more than a year, during which (September 4, 1951) Nancy Hudson gave birth to Geoffrey. Surprisingly, de Klerk and Hudson were able to publish an adiabatic demagnetization experiment in 1953 with the use of the new facility. A virtual flood of scientific papers came out the following year, and the very low temperature lab was off and running. Soon it became known throughout the scientific world for its progress in research below 1 K, including the creation of the thermometry needed to give meaning to experiments in that field.

No doubt the most famous experiment to come out of the NBS magnetic cooling apparatus followed a suggestion in 1956 by two theorists, T. D. Lee of Columbia Univer-

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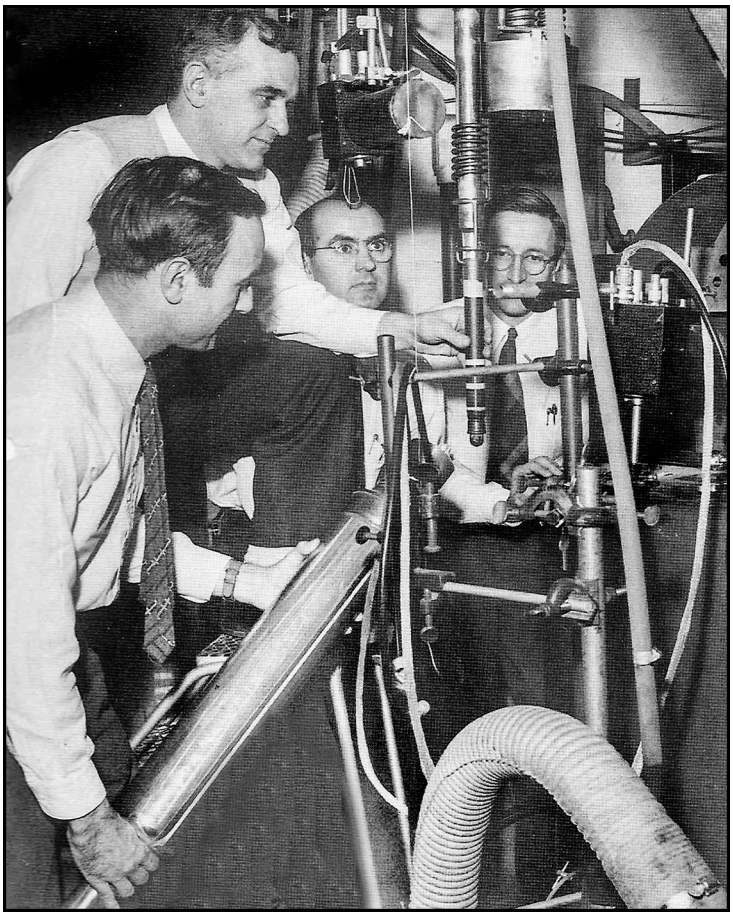
sity and C. N. Yang of the Institute for Advanced Study at Princeton University, that no scientific evidence existed regarding the conservation of parity in weak interactions. They suggested two experiments, one of which was "right up the alley" of the NBS team of Ambler and Hudson. It involved cooling ^{60}Co nuclei to temperatures low enough to orient the nuclear spins in one direction; measuring the rate of emission of the beta particles emitted from the decay of the radioactive ^{60}Co nuclei; reversing the orientation direction; and then re-measuring the emission rate. In fact, Ambler and Hudson had performed nuclear orientation experiments in the cryogenics lab, though not with the added complexity of detecting beta decay in the experimental cryostat.

Professor C. S. Wu of Columbia University, a colleague of T. D. Lee, was very knowledgeable in the field of beta decay, and she was excited about the possibility of testing the Lee-Yang idea. However, reaching the very low temperatures involved in the experimental test was a problem at her school's lab. Knowing of the capability of the NBS cryogenic group, she called Ambler and acquainted him with the Lee-Yang paper, which was then available only in preprint form. She asked whether NBS was willing to try the experiment. After checking out the situation with the help of Ray Hayward and Dale Hoppes, the NBS beta-decay experts in the Atomic and Radiation Physics Division, Ambler and Hudson agreed to give it "the old college try." After much hard work and late-night experimentation, the four-man group was successful, as history has duly recorded.



REMINDER-MEMBERSHIP RENEWAL

Have renewed your SAA membership for 2016?

If your SAA membership has not been renewed by April 01, 2016 we must remove your name from the SAA members list at the Main Security Gate and you will not be able to access NIST as an SAA member.

This is the last issue of the SAA Newsletter that will be mailed to you if we have not received your membership renewal by the time the June newsletter is ready.

Need a renewal form? Contact the SAA Office @ 301-975-2486 or Email: <alumni@nist.gov>.

Awards related to the parity experiment came thick and fast. Lee and Yang were awarded the 1957 Nobel prize in physics; Ralph, Ernie, Ray, and Dale shared the Department of Commerce *Gold Medal Award*; Ralph received the *Science Award* from the Washington Academy of Sciences, as well as a *John Simon Guggenheim Fellowship*, the *John Price Wetherill Medal* of the Franklin Institute, and the *Samuel Wesley Stratton Award* from NBS.

Together Ralph and Earnest Ambler would enjoy a decade of successful collaboration at NBS. Ambler, on his retirement as Director of NIST in June 1989, commented that Ralph had been best man at his wedding and that the "years working with Ralph were some of the happiest I have spent."

In 1956, Ferdinand G. Brickwedde left NBS to become Dean of the College of Chemistry and Physics at Penn State University, leaving a substantial legacy. He himself had provided Harold Urey with the long-sought isotope ^{2}H, "deuterium", which brought Urey the 1934 Nobel prize for chemistry. Brick had finished strong as the Heat and Power Division chief, having brought new blood and magnetic cooling to NBS cryogenics.

Brick was succeeded by Charles M. Herzfeld, who made substantial changes to update the structure of the newly renamed Heat Division, though he was only in that position for about five years, leaving to join the Defense Advanced Research Projects Agency where, as Charles modestly put it in his goodbye talk at NBS, "I will control a budget larger than the entire NBS budget."

In 1955 Ralph became chief of the Cryogenic Physics Section. In 1961 he became chief of the NBS Heat Division, a position that he held until 1978 when the division was eliminated as part of a sweeping reorganization of the agency.

In the opinion of many NBS staff members, Ralph was a superior administrator in his role as chief of the Heat Division. Without much fanfare, he continued to study, write, and serve the cryogenics community throughout his tenure, in addition to managing the progress of the other four

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Heat Division Sections (Low Temperature Physics, Heat Measurement, Equation of State, and Statistical Physics) as they adapted to changing demands and changing personnel. He hired carefully to replace retirees, deaths, and those who left for greener pastures, and the recognition earned by his staff showed that he chose well.

In 1978 Ralph was assigned the post of Deputy Director of the Center for Absolute Physical Quantities, under Karl Kessler, former chief of the Atomic Physics Division. During that time, Ralph was approached by the administration of the International Bureau of Weights and Measures (BIPM) with a request to serve as Editor-in-Chief of the journal *Metrologia*, the leading metrological magazine. In 1980, Ralph agreed to assume the post of Director of Publications for the BIPM; he and his wife, Nancy, headed for Paris.

Upon his return to Washington in 1989, Ralph spent three years at the National Science Foundation as program director for low-temperature physics. In 1998, he returned as a guest worker in the NIST Fundamental Constants Data Center, completing his NBS/NIST career.

His Life

Ralph was a well-traveled man by the time he joined NBS to work in cryogenic physics.

Born on October 14, 1924 in Wellingborough, UK, some 80 km north of London, he traveled to Oxford, a mere 60 km away, to study at the famous university's Merton College, having won an open scholarship there in 1942. An interesting sidelight on Ralph's studies at Merton is that an acquaintance, Ernest Ambler, was there, too, following a similar path leading toward the D.Phil. degree.

Ralph was awarded the B.A. degree by Merton College in 1944, after which he was made a Junior Scientific Officer of the U.K. Department of Scientific and Industrial Research. Ralph was assigned to Britain's Tube Alloy project. In 1945, he became a U.K. Ministry of Supply Scientific Officer, with two year's service "overseas" in Montreal and at the Chalk River Laboratories in Ontario, Canada. A Canadian lady, Nancy Brisby, became his friend there, and in 1947, she became his wife.

The newly married couple returned to Oxford, where Ralph and Ernest Ambler worked in the Clarendon Laboratory, where they came under the supervision of Professor Nicholas Kurti. Prof. Kurti had returned to Oxford only in 1945, after working several years on the Manhattan Project in Los Alamos, NM.

In 1949, Ralph was awarded M.A. and D.Phil. degrees, ending seven very busy years. His studies had seemed to be in constant competition with non-academic activities.

Armed with his new D.Phil., Ralph and Nancy set out for West Lafayette, Indiana, where Ralph joined Purdue University's Pieter Keesom's low temperature physics group as a visiting lecturer. As detailed above, in 1951 he accepted a position with NBS; packed up himself and Nancy, who was soon to deliver their first child, Geoffrey; and traveled to Washington, where he began his three-decade career at NBS. Their daughter, Wendy, was born there in 1954. He became a naturalized citizen in 1960.

Ralph was devoted to scientific study—he had three publications while at Oxford, and three more before leaving Purdue. He would continue his scientific studies at NBS, accumulating a total of 80 publications before leaving NBS in 1980. In addition to the awards and honors previously mentioned, Ralph was the recipient of NBS *Edward U. Condon Award* (1976) and an honorary doctorate from Purdue University (2001).

Ralph died January 29, 2016, at age 91. He was preceded in death by Nancy, his wife of 61 years. He is survived by his son, Geoff (Carol) of Madison; daughter, Wendy of Monmouth, Ore; and three grandsons, Keith and Nicholas of Madison and Matthew (Caroline) of Chicago, Ill.

Sources: NIST Archives; *SAA Newsletter*s; *A Unique Institution* by Elio Passaglia; *Responding to National Needs* by James Schooley; David Lide, and Geoffrey Hudson.

—James Schooley

Remembrance

While I had known Ralph for many years, I got to know him far better in serving as his apprentice in the eighteen months or so prior to my becoming his successor as editor of the *SAA Newsletter*. I think I learned more English grammar from him in that time than I had since taking my first two years of German in high school. And he taught me during the many hours we pored over submitted articles that patience in the attention to details is essential for any kind of edited material to be respectable to a critical reader.

Moreover, our interactions, then and subsequently, heightened and broadened my appreciation for literature and the arts. I learned to rethink what I read and to look past its words for deeper meanings much more effectively from him. This is the kind of gift that cannot be repaid!

Before 2003, I had known Ralph mainly by reputation. When I was a graduate student in the George Washington University-NBS metrology program, he was the chief of the NBS Heat Division. One course I took was Thermodynamic Measurements, which was taught by several members of the division staff. All had unusually high levels of respect for him as a scientist and as a person. After I joined NBS in 1970, I was struck in the few interactions I had with him by his manner—he was a consummate gentlemen, a rare trait indeed! He was always willing to take time with people and I never heard him utter a bad word for anyone.

I shall miss him!

—Norm Belecki

Remembrance

When I came to NBS as a NAS-NRC Postdoctoral Fellow, I was working with Ralph whom I had met at the Clarendon Laboratory of Oxford University where he was spending a year on a Guggenheim Fellowship and I was spending a year on an NSF Postdoctoral Fellowship. At NBS, we were interested in studying the relaxation times of rare earth compounds at low

temperatures by methods of magnetic susceptibility for the pure salts and of electron paramagnetic resonance of the various dilute rare earth ions in the relevant lanthanum salts and ascertaining the processes by which they were relaxing. Later, I became interested in studying cooperative behavior at low temperatures of pure rare-earth compounds, the arsenates, phosphates and vanadates. Of particular interest was the sharp transitions to a Jahn-Teller distortion. Ralph then became interested in these and we collaborated in a study of one of these compounds.

—B. W. (Billy) Mangum

Remembrance

The contributions of Ralph Hudson to NBS/NIST and to the field of physics have been documented elsewhere in this newsletter. I would like to add a personal reflection.

I first met Ralph shortly after coming on duty at NBS in August of 1954. This turned out to be the start of a friendship that was to last 60 years. We were both in the Heat and Power Division, headed by Ferdinand Brickwedde; Ralph was Chief of the Cryogenic Physics Section and I joined the Thermodynamics Section to set up a laboratory for microwave spectroscopy of gases. After finding lab space and ordering equipment, some of which had to be custom built, I had time on my hands, and Ralph asked me to fill that time by helping with an experiment on nuclear alignment. The experiment involved exposing a sample in a cryostat to monochromatic microwave radiation, and he needed help with measuring the microwave frequency—a technique that I had experience with. I am not sure whether the experiment was successful, but I do remember spending many pleasant hours with Ralph and Ernie Ambler in the Low Temperature Building. Ralph's dry British wit was often displayed when something went wrong.

When Ralph became Chief of the Heat Division (now without Power), I had been reorganized into another part of NBS. By this time I had an English wife who, like Ralph, had an Oxford background. We developed a close social relationship with Ralph and his wife Nancy that continued for 20 years. A memorable highlight was the annual Oxford-Cambridge Boat Race Dinners. These were formal affairs attended, especially in the Kennedy years, by many high-ranking Government figures, including members of Congress, who had had a connection with Oxford or Cambridge. Both the wine and the wit flowed freely at these dinners, which Ralph greatly enjoyed.

When Ralph moved to the BIPM in 1980, it coincided with a period when I was heavily involved with CODATA and made trips to Paris every two or three months. I made it a point to see Ralph and Nancy on every trip. I either enjoyed Nancy's French cooking in their apartment or we went down the street to their neighborhood bistro where we were greeted enthusiastically by the chef and staff. In either case, it was a great meal.

Many of my memories of Ralph are associated with the bridge group that he organized. It started sometime in the 1970s and lasted until around 2005. Ralph worked out a complex rotating schedule in which we met at a different player's home on Wednesday nights. Ralph, of course, kept the score and specified what food and drink would be available. The participants varied over the years, but included NBS/NIST people like Harmon Plumb, Jack Colwell, Billy Mangum, Martin Reilly, and Hans Frederickse. With some reluctance, we finally closed the group when late-night driving became too hazardous for octogenarians with failing eyesight.

My final meeting with Ralph was in September 2013. I was in Madison for an event at the University of Wisconsin Physics Department, and I arranged to have breakfast with Ralph at his assisted living facility. His son Geoff and wife Carol joined us. Ralph was in good spirits and appeared very content in this attractive home. He talked about the various activities he took part in. His long-term memory was still sharp, and he wanted to know about former friends and colleagues at NIST. It was a nostalgic but happy time for all.

—David Lide

Remembrance

I came to NBS in 1960 as a postdoc. I admit to being somewhat intimidated by Ralph's businesslike demeanor. I was to inherit the parity apparatus for my first project, and I recall discussing my first experimental results with Ralph. "Should I publish right away?" I asked. "Well", said Ralph, "that depends on whether you have something useful to say."

I also remember that Ralph, based partly on his experience at Purdue and partly on listening to my Hoosierisms, expressed the view that people from Indiana should be regarded as speaking English only as a second language. Ralph probably was kidding, but I never forgot the hint to watch my tongue.

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As the years went by I realized the important truth that Ralph ran a fine division, encouraging the staff to excel in their research and providing them with all the resources that he could muster.

—Jim Schooley

1. PRESIDENT'S MESSAGE

Do you ever wonder how those meteorology folks figure out one number for the temperature of the planet Earth? Well, I do. There are fires and volcanoes, mile-deep ice caps, droughts and floods. And I spent my career measuring temperature. I asked the people at Wood's Hole once, and they said something like, "We have a lot of thermometers." Well, I know about thermometers, and I know about radiation thermometers that you can put in airplanes and space ships, but still, I wonder. My curiosity increases when I contemplate the name of that science—meteorology. In our business, we do metrology, a name derived from what we do—measure stuff. I looked up "meteorology" in my Webster's Unabridged Dictionary—you know the one, it's 5 inches tall when you lay it on its side—to see where they got that word. OK, it's from the Greek *meteoron*, meaning meteor, and *legein*, meaning to speak. Well, if you are listening to meteors…

Anyway, when I am pulling on my long johns and my warmest jacket so I can keep from freezing while I shovel another inch or two of snow, I realize that I have a somewhat parochial view of the global temperature. Maybe it goes with being old.

But back to business. I've also been thinking about the SAA's spring luncheon coming up on the 28th of April. During that affair, I will quit being your president, and I remember some famous goodbye presidential addresses. I may use LB Johnson's line, "I shall not run for this office again. If nominated, I shall not run. If elected, I shall not serve." That's a good, solid, unambiguous statement. There is also Ike's farewell admonition, "Beware the military-industrial complex", which is as appropriate now as it was then.

But back to business again. We at SAA do not need to be concerned about the weather, about me trying to be president again, or about all the misery around us. Things are going swell for the SAA:

- Bj Lide, wearing the Portrait Gallery Chairperson's hat that she inherited from the ageless wonder, Dick Wright, is on track for another successful ceremony in the Fall.
- Wearing her Education Committee hat, Bj is looking forward to the multitude of summer kids coming to NIST to get smarter than they already are.
- Dave Lide and Bill Gadzuk have more NBS/NIST heroes to conduct oral histories of than they have time or money to give to the program.
- Roger Martin has so much news to report in the SAA newsletter that he is never sure whether it will take 32, 36, or 40 pages to get it all in.
- Bill Gadzuk, Herb Bennett, and Henri Mitler have tough choices when they select Quarterly SAA speakers, because there are so many old and new NIST heroes.
- Norm Belecki continues to baffle me as I try to follow his Information Technology Committee progress in the SAA office.
- John Tesk continues to bring in new SAA members to more than replace those of us really old geezers who drop by the wayside. (John will gratefully accept help, if you are interested.)
- Jim Hormuth claims that he absolutely does not print money, yet every month he pays the bills somehow.
- Karma Beal, Janet Miller, and new recruit Paul Majewski continue to run the SAA office so smoothly that they must be doing something that's illegal.
- Those of us who talk history during the New Employee Orientation seminars speak to new people brought in by the Onboarding group almost every other week.

.....I think maybe I'll use LBJ's line.

—Jim Schooley

2. APRIL 28–ANNUAL MEETING-LUNCHEON

The Speaker: Dr. Willie E. May
Director of NIST
Date: Thursday, April 28, 2015
(*PLEASE NOTE CHANGE IN DATE)*
Time: 11:30 AM
Place: The Golden Bull Grand Café, 7 Dalamar Street, Gaithersburg, MD

Please plan to attend the SAA Annual Meeting and Luncheon on April 28. There will be an installation of the new Officers and Board of Directors for the coming year, SAA awards, and a brief State of the Association address.

The luncheon speaker this year will be Dr. Willie E. May. Dr. May was confirmed as the fifteenth Director of NIST on May 4, 2015. He also serves as Under Secretary of Commerce for Standards and Technology, a position created in the America COMPETES Reauthorization Act of 2010. He had served as Acting NIST Director and Acting Under Secretary of Commerce for Standards and Technology since June 2014. Prior to that assignment, he was Associate Director for Laboratory Programs, where he was responsible for oversight and direction of NIST's seven laboratory programs and served as the principal deputy to the NIST Director.

We invite all members and guests to attend the annual meeting and to celebrate, one week early, the first anniver-

sary of Dr. May's appointment as Director. In his presentation, Dr. May will talk about the current programs and activities at NIST and answer member's questions.

If the luncheon registration form inserted in this newsletter is missing, please contact the SAA Office.

Save The Date – July Meeting

Dr. Laurie E. Locascio, director of the Material Measurement Laboratory, will be the guest speaker at the Thursday, July 21, 2016 quarterly SAA member meeting which will be held in Gaithersburg. Look for more information in the June newsletter.

3. JANUARY 14 MEETING REPORT

Kristen Frederick-Frost, NIST Museum Curator, gave a delightful presentation to a large group of members and guests at the January 24, 2016 quarterly meeting. The topic of the talk was "What's new with the NIST Museum and History Program?"

We found out over the course of Kristen's presentation that the answer to the question is "Lots!" She enthusiastically spoke about how special NBS/NIST history is because the science and history is actually still here all around us where actual research can be done on it..

The Museum, founded in 1960, was originally intended to be open to the public but that is no longer the case since the public no longer has open access to the Gaithersburg campus. The NIST Virtual Library[1] includes the NIST Virtual Museum[2] which provides digital/electronic access to the Museum artifacts and exhibits for those unable to visit them in person.

The presentation included many artifacts from the Museum collection. One of the most unusual was a roll of toilet paper that was used on the first NBS computer when the researchers ran out of paper

After a very interesting and entertaining presentation Kristen offered the group the opportunity to tour the Museum and to ask questions. A large number of attendees took her up on this offer and, after a short walk down the hall, the conversation about the museum continued well into the lunch hour.

Members and guests attending the January 14, 2016 meeting included:

Regina Avila	Paul Majewski
Karma Beal	Susan Makar
Donald Becker	Keith Martin
Norm Belecki	Roger Martin
Stacy Bruss	Ileana Martinez
Kate Bucher	Carla Messina
Gina Bush-Lazarski	Janet Miller
Greg Cala	Don Novotny
Jack Cowell	Hans Oser
Robert Cook	William Ott
Mary Derech	Katie Rapp
Bill Gadzuk	Joe Reader
Linda Greatorex	Dick Rhorer
Jeffrey Horlick	Jim Schooley
Michael Horman	Vicky Spitalniak
Bill Kirchoff	Csilla Szabo-Foster
Ralph Krause	Sommerfield Tillett
Dave Lide	Robert Toense
Dick Lindstrom	Amy Trost
Rosemary MacDonald	Kimberly Tryka

1 http://www.nist.gov/nvl/
2 http://museum.nist.gov/

4. NEW 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>

Living Color at Low Power[3]

Combining state-of-the-art nanometer-scale gratings with a thin-film polymer, Center for Nanoscale Science and Technology researchers have developed a new technology for energy efficient full-color video displays, switches and routers for optical signals, as well as smart windows and coatings.

Electrochromic polymers make up a special class of materials that can switch from clear to colored and back again when their electrical charge changes. However, wide adoption has been hindered because it may take up to several seconds for this transformation to occur, depending on the thickness of the film. Reducing the film's thickness to increase speed robs the colors of their contrast, resulting in a semitransparent black tint rather than opaque black. In addition, an electrochromic display using an additive color scheme would need up to six colored transparent, electrically conducting layers to work—adding substantially to the cost of manufacturing.

The CNST researchers overcame this impasse by layering a thin film of electrochromic polymer over an aluminum nanograting. The light first encounters the nanograting which, depending on the spacing of the slits, filters out all but one color of light. The electrochromic coating serves to modulate that light by allowing all or some (or none) of it to pass. A display based on this scheme would have an array of nanogratings acting that as single-color pixels that

3 T. Xu, E. Walter, A. Agrawal, C. Bohn, J. Velmurugan, W. Zhu, H. Lezec and A. Talin. High-contrast and fast electrochromic switching enabled by plasmonics. *Nature Communications*, Jan. 27, 2016. <http://dx.doi.org/10.1038/NCOMMS10479>

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can then be combined to create any color. In addition, the individual pixels will have adjustable levels of brightness or contrast.

Co-lead author **Amit Agrawal**, said that this works, "because the electrochromic film that coats the sidewalls of the nanograting is so thin, it's very easy for electrons to make their way through and change its opacity.The slits are much narrower (about 60 nanometers) than the wavelengths of light they are transmitting (from about 400 to 700 nanometers). This forces the incoming light to cling to the interface between the metal and the electrochromic layer on its way down the slits. Because the grating is so much deeper (about 250 nanometers) than it is wide, and the walls of the slits are coated with electrochromic polymer all the way down, it can reduce the light's intensity to the same degree as if the light were passing through a much thicker layer of electrochromic film, enabling a great amount of control."

According to **Henri Lezec** (NIST Fellow) the existing setup uses a liquid electrolyte to facilitate the proper flow of electrons. For manufacturability and reliability, it would be replaced with a more physically stable and compact solid-state electrolyte. Alec Talin (formerly CNST, now Sandia National Laboratories) said that the next step in extending this principle will be toward reflective, sunlight-readable displays that do not require an energy-consuming backlight.

Source: NIST News Release, February 3, 2016.

Tuning Microscale Optical Resonators[4]

Microscale optical resonators are like tiny bells that ring not with sound, but with light. Just like a bell's tone, the frequency with which an optical resonator "rings" is determined by its size and shape. The devices are so tiny that the light actually extends outside their outer surfaces where they form "near-fields." Where these vibrating near-fields are strongest, the resonator is hypersensitive to changes in the environment such as additional atoms or molecules nearby, much like touching a ringing bell changes its tone. Mapping these vibration patterns of light in real devices help make them even more sensitive.

High-resolution imaging of a microresonator requires a probe that is able to reach the surface without disturbing the near fields. At present, the vibrational profiles of these resonators are measured using a sharp, needle-like probe which strongly disturb the near-field before it is able to get close enough to the surface to do high-resolution imaging. Enter a focused lithium-ion-beam technique developed by the Center for Nanoscale Science and Technology that enables the fine-tuning of the trapped light's frequency by subtly altering the shape of the resonator.

We map out the oscillation pattern by focusing the ion beam on different locations on the resonator's surface and noting the change in the vibration," says CNST physicist **Vladimir Aksyuk**. "If the vibration at that spot is strong, the vibration is strongly affected. If the vibration there is weak, then the perturbation has no effect."

The focused ion beam injects ions into the silicon resonator affecting the structure's resonant properties, influencing the pattern of the light trapped within. The sharply focused ion beam provides the ability to edit the tone of a resonator and enables the tuning of resonators to have the same vibrational qualities. Aksyuk believes that the lithium ions the group used are particularly well suited for this kind of work because of their low mass. He remarked that "it is presently impossible to manufacture identical resonators or measure them with great precision...I'm hoping that this technique will be of great use to the micro- and nanophotonics community."

Paper co-author Jie Zou (former NIST guest researcher) is interested in what the resonators can reveal about lithium ion beams. "We used the lithium focus ion beam to map the subtle light fields in the microresonators," Zou said. "But we can also use the microresonators to investigate how the lithium ions interact with the resonator's silicon lattice with unprecedented sensitivity—work that may offer important insights for the lithium-ion battery and semiconductor industries."

Source: NIST News Release, December 22, 2015.

A Denser Quantum Crystal

Physicists from the Quantum Physics Division have made a denser "quantum crystal" of ultracold molecules that contains nearly five times more molecules than previous crystals. The crystal is actually a gas of particles trapped in 3-D formation by laser beams. The trap, called an optical lattice, has wells—local regions of low energy—like an egg carton made of light. A single molecule is maneuvered into each well, successfully filling about 25 percent of the crystal. The structure has an advantage over a real crystal, as it is made of scientifically interesting molecules that normally would not crystallize.

As described in a recent issue of *Science*,[5] this quantum crystal is useful for studying correlations among the molecules' "spins," or rotations—a quantum behavior related to magnetism. The denser quantum crystal will enable the modeling and study of complex effects such as how spin correlations or entanglement of separated particles spread through a large system. "The density in the crystal is now high enough to introduce long-range order, so the molecules behave as an interconnected system instead of just a collection of isolated particles," JILA/NIST Fellow **Jun Ye** says. "The molecules are close enough to each other for their spins to migrate and relocate to other molecules,

4 K. Twedt, J. Zou, M. Davanco, K. Srinivasan, J. McClelland, V. Aksyuk. Imaging Nanophotonic Modes of Microresonators using a Focused Ion Beam. *Nature Photonics*. Published Dec. 21, 2015. <http://dx.doi.org/10.1038/nphoton.2015.248>

5 S.A. Moses, J.P. Covey, M.T. Miecnikowski, B.Yan, B. Gadway, J. Ye and D.S. Jin. Creation of a low-entropy quantum gas of polar molecules in an optical lattice. *Science*. Nov. 6.

allowing us to investigate quantum connections of many particles that may lead to new materials."

Each molecule consists of one potassium atom bonded to one rubidium atom. The molecules are polar, with a positive electric charge on rubidium and a negative charge on potassium. This enables the molecules to be controlled with electric fields and interact strongly, even when far apart. "Because our molecules are polar, neighboring molecules in the lattice will interact with each other," JILA/NIST Fellow **Deborah Jin** says. "When each molecule has multiple neighbors to talk to, these interactions become much more important and affect the entire crystal."

Building the quantum crystal was something of a *tour de force* in atomic manipulation. While researchers can create a crystal from one atomic gas relatively easily, combining two different atomic gases was difficult. The formation of the two different atoms into a molecule required a small cloud of rubidium atoms, a class of particles that tend to act in unison, and a large cloud of more independent potassium atoms.

The optical lattice was loaded by overlapping the two clouds to match their densities and energy levels in the intersection so that one of each type of atom tended to accumulate in each well. Magnetic fields and lasers were then used to fuse the atom pairs into molecules with the lowest possible vibrational and rotational energy. Remaining stray atoms were flushed out of the trap. JILA scientists first created ultracold molecules in 2008 and several years ago formed the first molecular crystal, in which the molecules swapped spins. To reduce chemical reactions and extend molecule lifetimes, researchers made the trap wells deeper. Now they've achieved their next goal of filling enough wells to unify the crystal as a system.

Source: NIST News Release, November 5, 2015.

Measuring Nanoscale Features with Scattered Light

Using a novel microscope that combines standard through-the-lens viewing with a technique called scatterfield imaging, researchers from the Engineering Physics Division have measured patterned features on a silicon wafer that were 30 times smaller than the wavelength of light (450 nm) used to examine them. They report that measurements of the etched lines—as thin as 16 nm wide—on the SEMATECH-fabricated wafer were accurate to one nm. They were able to identify variations in feature dimensions amounting to differences of a few atoms.[6]

Measurements were confirmed with an atomic force microscope, which achieves sub-nanometer resolution, but is considered too slow for online quality-control measurements. Combined with earlier results, it is believed that the innovative optical approach could provide chip makers and others aiming to harness advances in nanotechnology with a means for nondestructive measurement of nanometer-scale structures with sub-nanometer sensitivity, while still having high throughput.

Light-based, or optical, microscopes can't clearly "see" features smaller than the wavelength of light in the detail necessary for accurate measurements. However, light scatters when it strikes subwavelength features and patterned arrangements of such features. "Historically, we would ignore this scattered light because it did not yield sufficient resolution," explained **Richard Silver**, who initiated NIST's scatterfield imaging effort. "Now we know it contains helpful information that provides signatures telling us something about where the light came from."

With scatterfield imaging, Silver and colleagues methodically illuminate a sample with polarized light from different angles. From this collection of scattered light they extract characteristics of the bounced lightwaves that reveal the geometry of features on the specimen. Light-scattering data are gathered in slices which image the volume of scattered light above and into the sample. These slices are analyzed and reconstructed to create a three-dimensional representation. The process is akin to a CT scan, except that the slices are collections of interfering waves, not cross-sectional pictures.

Scatterfield imaging has critical prerequisites that must be met before it can yield useful data for high-accuracy measurements of exceedingly small features. Key steps entail detailed evaluation of the path light takes as it beams through lenses, apertures and other system elements before reaching the sample. The path traversed by light scattering from the specimen undergoes the same level of scrutiny. The method benefits from knowledge of the supposed structure of the specimen that greatly aids in fitting the scattered data to discern a detailed pattern.

Standard equations are used to simulate light scattering from an ideal, defect-free pattern and, in fact, any variation thereof. Using wave analysis software they developed, the team has assembled an indexed library of light-scattering reference models. So once a specimen is scanned, the team relies on computers to compare their real-world data to models and to find close matches.

Source: NIST News Release, December 2, 2015.

Assessing Biosimilarity of Protein Drugs

A first-ever inter-laboratory study of four versions of a therapeutic protein drug—all manufactured from living cells—reports that an established analytical tool akin to magnetic resonance imaging reliably assessed the atomic structures of the biologically similar products, yielding the equivalent of a fingerprint for each. The findings demonstrate that the method—known as two-dimensional nuclear magnetic resonance spectroscopy, or 2D-NMR—"can be a robust and powerful complementary technique for companies and regulators" when assessing these bio-

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6 J. Qin, R.M. Silver, B.M. Barnes, H. Zhou, R.G. Dixson, and M.A.Henn,"Deep-subwavelength Nanometric Image Reconstruction using Fourier Domain Optical Normalization." *Light: Science & Applications.* Nov. 5, 2015; e16038. Download the pdf file at <http://221.8.12.233/cms/accessory/files/AAP-lsa201638.pdf>

similars, said **Robert Brinson** (Biomolecular Measurements Division, MML). This type of assessment is part of a set of comparisons required to determine whether a follow-on biological product is highly similar chemically and clinically to an existing product.[7]

"Other analytical methods provide useful information, but 2D-NMR is one of the few approaches that can yield complete assignment of three-dimensional structure across the entire molecule in solution at atomic-level resolution," Brinson explains. "Our study indicates that 2D-NMR data can yield a precise and unique 'fingerprint' of structural information in a biological product."

Results were reported for measurements of four independently manufactured versions of filgrastim, a biological drug used to help ward off infection and anemia in cancer patients. At four laboratories, researchers used 2D-NMR to map the atomic structures of the original—or reference—filgrastim product licensed in the U.S. and three unapproved biosimilar versions. A biosimilar is a biological product shown to be "highly similar to an FDA-approved biological product, and has no clinically meaningful differences in terms of safety and effectiveness." Only minor differences in clinically inactive components are allowable in biosimilar products. Biosimilar versions of approved biological drugs at the end of their patent life are expected to cost less but be as safe and effective for licensed clinical uses.

Unlike chemically synthesized drugs—aspirin, for example—biological drugs usually are composed of large, complex protein molecules and are produced by living systems. This makes producing exact duplicates impossible, even from batch to batch in the same biomanufacturing process. For specified health conditions and symptoms, the nearly exact copies that result must be shown to achieve the same clinical effects as the already-licensed biological product.

Samples of the four filgrastim products were measured on six NMR instruments made by two manufacturers and distributed across laboratories at NIST, the FDA's Center for Drug Evaluation and Research, the Medical Products Agency of Sweden, and Health Canada's Center for Biologics Evaluation. Each sample of filgrastim—a chain of 175 protein building-blocks known as amino acids—was independently measured in each participating laboratory. Rendered as a complex pattern of peaks corresponding to signals from hydrogen and nitrogen in the sample, the data were gathered on each instrument and then analyzed together. Statistical analyses determined how tightly the signals were clustered when data from all six instruments were superimposed.

Across all samples on all six instruments, measurements hardly varied. The experimentally determined precision limit of 8 parts per billion for the interlaboratory comparison, the researchers write, is "well below" the threshold beyond which structural differences due to mutations, changes in three-dimensional shape, or other causes might be obscured. The atomic structures of all four filgrastim versions were determined to be the same within the tight precision limits of the NMR data.

Separately, NIST researchers repeated measurements on all four samples one year after the interlaboratory comparison to assess their stability. Using the same 2D-NMR method, they did not find significant structural changes in any of the four biologics. Brinson stresses the importance of proper instrument calibration and control of laboratory conditions to ensure that results are reliable. Early in the interlaboratory study, the team identified deviations in data gathered with two instruments. Variations in temperatures were subsequently determined as the cause of the differences, and recalibrated measurements largely eliminated the deviations.

Source: NIST News Release, February 5, 2016.

Measuring Space Telescope Components

NIST researchers have measured composite titanium and stainless steel parts, for the upcoming James Webb Space Telescope, the long-awaited successor to the Hubble Space Telescope. The parts, which support the skeleton for the telescope's massive mirror, will be used in the final round of NASA's vibration tests on the mirror assembly before the scheduled launch in October 2018.

The Webb telescope, which will travel in an Earth orbit beyond the Moon, contains a mirror much larger than the Hubble's. It will be able to observe the formation of some of the first stars and galaxies more than 13.5 billion years ago. The telescope is NASA's largest ever piece of precision metrology equipment. With its size, and the sophistication of its parts, extreme care must be taken to ensure the mirror and instruments remain properly assembled and aligned as they travel into space and face significant temperature changes throughout their journey.

"When you have something like this and bring it into orbit, you can't go up to space and reposition it" if something goes out of position or alignment, said **John Stoup**, (Engineering Physics Division, PML). Stoup and his colleagues performed measurements of four alignment mounts that support and help to position a major Webb telescope structure known as the Primary Mirror Backplane Support Structure (PMBSS). The structure will hold the 6.5-meter diameter mirror as well as approximately 2,400 kg (5,300 lb) of the telescope's instruments and optical components.

NIST's M48 Coordinate Measurement Machine (CMM) measured the four mounts, which are 200 mm on a side and 150 mm high. The M48 CMM uses laser interferometry to measure the location of a ruby tip that is placed in contact with the components being measured. The room

7 H. Ghasriani, D.J. Hodgson, R.G. Brinson, I. McEwen, L.F. Bushe, S. Kozlowski, J.P. Marino, Y. Aubin and D.A. Keire, Precision and Robustness of 2D-NMR for Structure Assessment of Filgrastim Biosimilars, *Nature Biotechnology*, February 5, 2016. DOI: 10.1038/nbt.3474. <http://www.nature.com/nbt/journal/v34/n2/full/nbt.3474.html>

in which the measurements were done has a stable thermal environment that can be controlled to a few thousandths of a degree. The mounts were accurately measured to within 5 mm, the tolerance that NASA needed for these parts. "The precision of the backplane assembly has to be impeccable for the high-quality work they want to do with the telescope," Stoup said.

NASA needed these measurements done very quickly for upcoming tests, with a one-week turnaround. "They know we're down the road," said Stoup. "The same day they called about the parts, they drove them down here." He and his colleagues started work on the measurements that afternoon.

With the measurements, NASA has the information needed to position and orient the parts and the components within them during their upcoming critical vibration tests—an important step in determining that the telescope will operate properly in space. The ultimate goal is to identify and minimize the actual stresses the mirrors will experience during launch and orbit.

Source: NIST News Release February 1, 2016.

Early Detection of Lyme Disease[8]

Lyme disease afflicts about 300,000 Americans annually and is very difficult to detect in the early stages of onset. The current standard blood test for Lyme disease exposes the infection only after antibodies have accumulated to detectable levels, which can take up to 4 to 6 weeks. If patients exhibit a telltale bull's-eye rash, diagnosis and treatment can begin earlier. But, according to the CDC, the rash does not occur in 20 to 30 percent of Lyme disease patients.

Researchers from NIST, the Institute for Bioscience and Biotechnology Research, and Johns Hopkins School of Medicine have reported the first successful trial of a method that appears capable of detecting the stealthy Lyme bacteria in the early stages of the infection.

Larik Turko (Biomolecular Measurement Division) explained that the research team started with the hypothesis that Lyme bacteria sheds vesicle-like particles—or fragments—derived from the cell wall of the bacteria circulating in the serum of individuals. It was believed that these particles would contain membrane proteins that could be detected to provide a unique indicator of infection.

The challenge was to detect these bacterial membrane proteins among the far more plentiful (10^7x) proteins normally present in serum—the watery, cell-free component of blood. The researchers speculated that running serum samples through a high-speed centrifuge would selectively concentrate the larger, heavier fragments containing the bacterial membrane proteins into pellets differentiated from the much more abundant human serum proteins.

Rather than waiting for an infected person's immune system to produce noticeable amounts of antibodies, the team chose to home in on the bacteria itself—specifically, proteins the bug sheds when attacked by the body's defenses. "From many candidates, we chose one that is both easily distinguished from human serum proteins and an unambiguous indicator of the bacteria," Turko says. "This protein, which resides on the outer surface of membranes, became the target of our search in serum samples."

The team tested serum samples from three patients with undetected Lyme disease at the time of their initial doctor visit. By customizing standard analytical techniques for determining the types and amounts of chemicals in a sample, the team detected extremely small amounts ($4x10^{-15}$ mole) of the target protein in all three samples. In one case it detected the bacteria three weeks before infection was confirmed with the usual standard blood tests. For the other two, infection was detected simultaneously by the two methods.

Source: NIST News Release, February 11, 2016.

Management and Administrative News

Budget Update

FY 2016

After several continuing resolutions extending through the middle of December, the Congress passed omnibus legislation providing full-year appropriations for the federal government. The Consolidated Appropriations Act, 2016 (H.R. 2029) became P.L. 114-113 when it was signed by President Obama on December 18.

NIST received appropriations totaling $964M, an increase of $100.1M (11.6%) over the FY 2015 enacted levels. Highlights of the NIST FY 2016 appropriations are:

Scientific, Technical Research & Services (STRS) – $690M ($14.5M or 2.15% increase over FY 2015) that funds NIST's Laboratory Programs. The associated Joint Explanatory Statement (114-39)[9] specifies initiative levels for disaster resilience, the Materials Genome initiative, quantum-based sensors, and enhancing cryptographic capabilities that exceed the total increase provided. NIST has responded by proposing an alternative spending plan and is awaiting Congressional approval before allocating the funds.

Industrial Technology Services (ITS) – $155M, including $130M (the same as FY 2015) for the Hollings

8 C.S.F. Cheung, K.W. Anderson, K.Y. Villatoro Benitez, M.J. Soloski, J.N. Aucott, K.W. Phinney, and I.V. Turko, "Quantification of Borrelia burgdorferi Membrane Proteins in Human Serum: A New Concept for Detection of Bacterial Infection." *Analytical Chemistry* (2015) 87, 11383-11388. <http://pubs.acs.org/doi/abs/10.1021/acs.analchem.5b02803>

9 Both Senate Report (114-66) and House Report (114-130) to accompany the respective FY 2016 appropriations bills included other NIST requirements affirmed by the Joint Explanatory Statement.

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Manufacturing Extension Partnership (MEP) program and $25M for the National Network for Manufacturing Innovation (NNMI). Congress directed that activities related to the Advanced Manufacturing Technology Consortia (AMTech) program be merged into the NNMI. Of the NNMI total, $20M is to create up to two new industry-driven manufacturing innovation institutes, and $5M is for the program office that provides shared services and support to all NNMI institutes (currently seven, whose operations are funded by the Departments of Defense, Energy, and Commerce).

Construction of Research Facilities (CRF) – $119M ($68.7M or 136.6% increase over FY 2015), of which $60M is to begin the design and renovation of Building 245 (Radiation Physics) in Gaithersburg.

Sources: *NIST Connections*, December 2015/January 2016, Congressional website, and NIST Budget Office.

FY 2017 Budget – Discretionary Appropriations

On February 9, 2015, President Obama submitted his FY 2017 budget request to Congress. The budget proposes $1,014.5M for NIST's three appropriations, an increase of $50.5M (5.2%) over FY 2016 enacted appropriation levels. Highlights of the request by appropriation are:

Scientific and Technical Research and Services (STRS) – $730.5M ($40.5M or 5.9% increase over FY 2016) to fund NIST's Laboratory Programs and the following $27.4M in new initiatives:

- Measurement Science for Future Computing Technologies and Applications (+$13.6M)
- Advanced Sensing for Manufacturing (+$2M)
- Biomanufacturing/Engineered Biology: Developing Engineering Principles for Efficient Biomanufacturing (+$2M)
- Advanced Communications – Addressing the Spectrum Crunch (+$2M)
- Ensuring a World Class Neutron Research Facility (+$4.8M)
- Lab-to-Market/Technology Transfer: Expand Technology Transfer Activities to Leverage Existing Authorities to Promote Data Sharing Efforts (+$2M)
- Departmental Working Capital Fund Increase (+$1M)[10]

The STRS request also includes $13.1M for pay-related and other cost-of-living changes.

Industrial Technology Services (ITS) – $189M, including $142M ($12M or 9.2% increase over FY 2016) for the Hollings Manufacturing Extension Partnership (MEP) program and $47M ($22M or 88% increase over FY 2016) for the National Network for Manufacturing Innovation (NNMI).

Construction of Research Facilities (CRF) – $95M (decrease of $24M or -20.2% from FY 2016) – including $40M to continue the Radiation Physics renovation and $55M (decrease of $4M or -6.8% from FY 2016) for the bureau's Safety, Capacity, Maintenance, and Major Repairs (SCMMR) account.

FY 2017 Budget – Mandatory Funding

In addition to the discretionary appropriation requests described above, the FY 2017 President's Budget reflects $1,990M in new mandatory funds for NIST. Mandatory funding is outside the appropriation process and not subject to the discretionary levels set by the Bipartisan Budget Act of 2015 (P.L. 114-74). The President has proposed $4B in new mandatory funding throughout the federal R&D enterprise, thus reflecting the high priority of R&D in a time of limited discretionary funding.

Authorizing legislation will be proposed to provide the following for NIST:

- **National Network for Manufacturing Innovation** (NNMI) – $1,890M to complete the proposed remaining 27 manufacturing innovation institutes, thus creating a network of 45 institutes over the next ten years that will position the U.S. as a global leader in advanced manufacturing technology. Each institute is expected to become self-sustaining within five to seven years after launch.
- **Construction of Research Facilities** (CRF) – $100M to renovate and modernize NIST facilities in order to maintain and enhance current R&D capabilities.

In addition to these proposals, NIST has existing authority[11] to execute mandatory resources provided through the **Public Safety Communications Research Fund** (PSCRF) from spectrum auction proceeds to help develop cutting-edge wireless technologies for public safety users. In FY 2015, NIST received $92.7M in reimbursable funding. An additional $40M is available for FY 2016, with transfers expected as proceeds from the spectrum auctions become available.[12]

NIST's budget justification document and the DoC Budget in Brief are available at <http://www.osec.doc.gov/bmi/budget/>.

The President's Budget is available at <https://www.whitehouse.gov/omb/budget>.

Other sources: NIST news release, February 10, 2016, and the NIST Budget Office.

10 This increase will cover the additional NIST portion of shared service investments within the Departmental WCF, including DoC-wide systems, network security initiatives, and replacement of degrading IT infrastructure.

11 As part of the National Wireless Initiative included in the Middle Class Tax Relief and Job Creation Act of 2012.

12 Since the PSCRF/Wireless Innovation (WIN) Fund resources are considered reimbursable to NIST, they are not presented in the newsletter's "NIST Appropriations Status" table.

NIST Appropriation Status

(Dollars in thousands)

		FY 2015 Enacted	FY 2016 Request	FY 2016 Enacted	FY 2017 Request
Discretionary Accounts					
STRS	NIST Laboratory Programs	$675,500	$754,661	$690,000	$730,533
ITS	Hollings Mfg. Extension Partnership	130,000	141,000	130,000	141,991
	Advanced Mfg.Technology Consortia	8,100	15,000	0	
	National Network for Mfg. Innovation[1]		150,000	25,000	47,000
		138,100	306,000	155,000	188,991
CRF	New Construction	0	0	60,000	40,000
	Safety, Capacity, Maint., and Major Repairs	50,300	59,000	59,000	54,995
		50,300	59,000	119,000	94,995
NIST Discretionary Total		**863,900**	**1,119,661**	**964,000**	**1,014,519**
Mandatory Accounts					
NNMI	National Network for Manufacturing Innovation				1,890,000
CRF	Construction and Major Renovations				100,000

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

Additional 2016 IMS Winner Announced

One more new project will be funded in FY 2016 by the Innovations in Measurement Science (IMS) program. IMS (formerly known as the Competence Program) has been a mechanism to identify and fund high-risk, innovative research projects since 1979.

In addition to the three winners announced in October, $1.5M has been awarded to "*Nanoscale molecular orientation maps in liquid- and gas-containing environments with synchrotron X-rays*" which was proposed by **Dean DeLongchamp** (MML) with collaborators from MML and CNST staff **Dan Fischer**, **Andy Herzing**, and **Alex Liddle**.

Source: All-staff e-mail, Richard Cavanagh, Dec 14, 2015.

2015 NRC Assessments

Since 1959, the National Research Council has assessed the technical merit, relevance, and quality of NIST's laboratory programs in the context of its mission. Assessments made in 2015 – three divisions of the Information Technology Laboratory, the Center for Neutron Research, and telecommunications research and engineering at the Communications Technology Laboratory – are now available on the NIST website. The reports[13] are posted with permission from the National Academy of Sciences, courtesy of the National Academies Press.

13 See <http://www.nist.gov/director/nrc/index.cfm> for the three reports, as well as other assessment reports published since 2007.

NIST in Media's Top Science Stories of 2015

At the end of each year, many science publications print lists of what they consider to be the year's top stories. NIST is featured in several of them:

In research achievements, NIST's confirmation of quantum entanglement made several media lists of top stories of the year, along with similar experiments by two other groups. In its "Top 25 Science Stories of 2015," *Science News* noted in its #9 pick, "Quantum spookiness is real," that the NIST research yielded particularly strong data. *RealClearScience* included quantum entanglement as #4 and linked to the *Science News* story in "The (Ultimate) Top Ten Science Stories of 2015." In addition, *Gizmodo* highlighted NIST's high precision in its spooky action experiment in "These are Our Picks for the Top Science Stories of 2015." The NIST research is also featured in the American Physical Society's "Highlights of the Year," which notes the achievements "lay the groundwork for secure quantum cryptography schemes." Several additional media lists of top stories include the spooky action experiments without mentioning NIST by name. For example, *CNET's* #3 story of the year is "Quantum entanglement loopholes closed." (CNET previously covered the NIST experiments.) *CBC Radio Canada's* "Top science stories of 2015" includes "Spooky Action at a Distance" (the story uses a NIST image but does not mention NIST specifically otherwise).

Among other research topics highlighted by the media, *Digital Journal's* "What you should know about the top

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science stories of 2015" included work by NIST and collaborators on using nanoparticles and heat to attack cancer tumors. *Cosmos* magazine, in its "Top Ten Tech Stories of 2015," lists JILA's strontium atomic clock as its #6 story and links to its associated article, "The Most Accurate Clock Ever Made."

NIST's change at the helm was a top headline in *Chemical and Engineering News'* "Chemistry Year in Review." "NIST Veteran Became U.S. Government's Top Chemist" notes that "Willie E. May became the U.S. government's top chemist on May 4 when the Senate confirmed him as the 15th director of the NIST.... He leads NIST at a time when it is the go-to federal agency for research and standards in important areas such as forensic science, cybersecurity, and manufacturing."

Sources: NIST news release, January 6, 2016, and *NIST Connections,* February 2016.

NIST Security Update

Following the sensational events last July[14], NIST invited three external security experts with specific experience in protecting a research facility to conduct reviews of the NIST security posture at both campuses. After site visits in November, David S. Komendat (Boeing Senior VP and Chief Security Officer), William C. Cullen (NIH Associate Director for Security and Emergency Response), and Nicholas M. Schnare, (DoC Assistant Director for Security and Emergency Management) provided their independent assessments. Six high-level themes were identified:

- Authorities – There is no clear articulation of NIST senior management authority and responsibility to assure the security of NIST facilities, personnel, property, and assets.
- Culture – The NIST corporate culture is not amenable to strengthening security measures in any way that would further reduce the collegial atmosphere conducive to science.
- Risk – There is no designated official who is responsible for accepting risk on behalf of NIST in the security area, and NIST does not have a robust program of identifying and mitigating security risks.
- Organization – NIST's current organizational structure limits the effectiveness of the security program. The security organization is bifurcated and located too low in the organization for security leaders to carry out the mission effectively.
- Resources – Security resources at NIST (staffing, services, equipment, and systems) are undersized for the breath of responsibility of the program.
- Strategic Planning – There is no long term security management strategy/sustainment plan in place for NIST.

The experts' recommendations are now under consideration, in collaboration with the DoC Office of Security

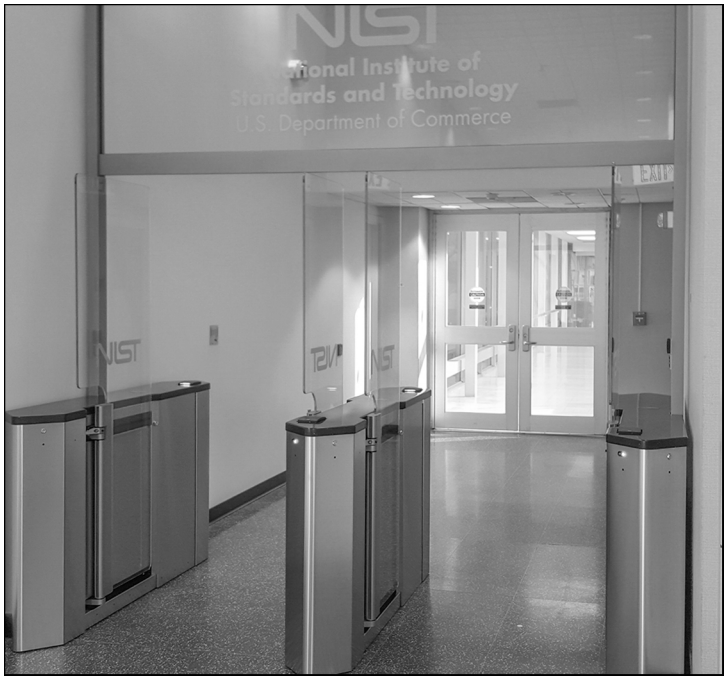
Even before the events, NIST had been making plans to enhance security at its facilities. Physical security improvements include providing expanded coverage of the site with CCTV cameras, installation of cypher locks for individual labs, improvements to both the visitor registration and associate systems, and improving visitor control at key access points in the Building 101 (see related story below). IT improvements include critical IT network security equipment upgrades, expanding staff and equipment resources for privileged access management at the system-to-system level, and additional information in NIST email display names to indicate whether the sender is a federal employee, NIST contractor, or NIST Associate (either domestic or international).

Additionally, NIST and the DoC Office of Security have been working with the DoC Office of the Inspector General to review the NIST Foreign Guest Researcher program.

Sources: Director's NIST Update to VCAT, February 3, 2016, and *The Washington Post* article, "Ex-officer sentenced to 3 ½ years in Washington's unusual version of 'Breaking Bad'," January 7, 2016.

Administration Building Turnstiles

NIST has recently installed ID card-activated security turnstiles in the first-floor, southwest corner corridor of Building 101 (Admin) to control unauthorized access to the laboratory buildings along the spine south of there. Each year, more than 32,000 visitors (including 4,000 foreign nationals) come to the Gaithersburg campus. Only those who have received pre-authorization to visit access-controlled spaces should be allowed to do so, but "piggybacking" – multiple people going through on one person's badge swipe – regularly occurs. And, when the handicap-access button is also pushed, an access door can



14 Former NIST Police officer Christopher Bartley pleaded guilty to trying to manufacture methamphetamine on the NIST campus July 18, 2015. He will begin serving his 41-month sentence in March. See the September 2015 *SAA Newsletter* lead story, "Explosion in Bldg. 236!"

remain open for 25 seconds, which is long enough for 20 or more people to pass through. Once through that locked door, there are no access controls all the way down through nine laboratory buildings, from Building 223 (Materials) to the AML complex.

The new control point has two bi-directional turnstile lanes, or portals. All employees and associates must swipe their NIST ID card in order to pass through the turnstiles in either direction. If someone is escorting one or more visitors who are authorized to visit a NIST lab, they also must swipe their card once for each visitor. When activated, a glass door will open long enough for one person to pass, and an optical sensor closes the door as soon as the individual steps through. Throughput claims by the turnstile manufacturer, Aeroturn LLC, are 30-60 passages per minute.

Source: *NIST Connections*, December 2015/January 2016.

Public Access to NIST Research Data

A major component of NIST's plan[15] to manage public access to content and data resulting from the research it funds is a partnership with NIH to use its PubMed Central® (PMC) system as the repository of full-text, peer-reviewed scholarly publications. In December it was announced that the *Journal of Research of the National Institute of Standards and Technology* (JRes) has become a full participant in PMC, meaning that all future articles will be automatically sent to system. In addition to JRes volumes 118 (2013) and 119 (2014), which are currently available in PMC, and volume 120 (2015), which should be up soon, the Information Services Office is working with PMC to make back catalog content available. JRes in PMC can be found at: <http://www.ncbi.nlm.nih.gov/pmc/journals/2767/>.

NIST is also exploring a relationship with CHORUS (the Clearinghouse for the Open Research of the United States), and the two launched a one-year pilot project in December. CHORUS was formed as a not-for-profit membership organization in 2013 to help federal agencies comply with OSTP and OMB directives requiring open access to federally-funded research data and peer-reviewed publications. A portal to publishers' websites, CHORUS provides citation information and links to an estimated 9,000 journals that its members publish. NSF, the Department of Energy, the U.S. Geological Survey, and the Smithsonian Institution have already partnered with CHORUS. The NIST "dashboard" on CHORUS can be found at <http://dashboard.chorusaccess.org/nist - /summary>.

NIST Publication Series documents are publically available through GPO's Federal Digital System (FDSys).[16]

Sources: NIST news release, December 3, 2015, and Information Services Office *Inside NIST* internal website posting, December 3, 2015.

15 See NISTIR 8084, *The NIST Plan for Providing Public Access to Results of Federally Funded Research*, September 2015, at <http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8084.pdf>.
16 See <https://www.gpo.gov/fdsys/

Head Health Challenge III

Then acting NIST director Willie May and MML director Laurie Locascio led a small NIST delegation to last year's Super Bowl in Phoenix to help announce that NIST, the NFL, GE, and sports-clothing manufacturer Under Armour were jointly launching Head Health Challenge III (HHC III), an open innovation competition to develop materials that can better absorb or dissipate energy. The goal is to improve the performance of protective equipment for athletes, military personnel, and first responders.

By March 2015, some 125 abstracts for specific new protective materials were received in response to the Challenge, and 75 were invited to submit full proposals with material samples. NIST played a central role in winnowing them down to the 21 most promising—MML engineers designed ways to test the new materials, conducted that testing, and analyzed the reams of resulting data, which made it clear which materials performed best. A panel of leading experts in the field of materials science selected the five winners, and each received $250,000 to use in improving their materials. Announced in December 2015, the five finalists are:

- Alba Technic LLC (Winthrop, Maine) has developed a patented, shock-absorbent honeycomb material with an outer layer that diverts the energy from a fall or hit. The material is normally soft and compliant, but upon impact, the outer layer changes into a hard shell to spread the energy and protect the user from injury.

- Charles Owen, Inc. (Lincolnton, Georgia) made cellular structures that use a stacked, origami-like design to optimize energy absorption. The essential building block is a double corrugated sheet of the material, whose ability to fold efficiently was originally developed for applications in areas such as solar array packing in the space industry.

- Corsair Innovations (Plymouth, Massachusetts) has developed a textile that uses tiny, spring-like fibers to repel rotational and linear impacts, thereby reducing potential damage. Unlike foam materials, this textile is washable, breathable, wicks sweat, and can be easily engineered to meet impact performance requirements.

- Dynamic Research, Inc. (Torrance, California) and 6D Helmets LLC (Brea, California) are collaborating to evolve 6D's single-impact suspension technology for use in repeated impact conditions. The technology consists of a multi-layer, suspended internal liner system that allows the outer layer to move independently of the inner layer in order to reduce the effect of both angular and linear impact forces.

- University of Michigan (Ann Arbor, Michigan) researchers designed a lightweight, multi-layered composite that includes a viscoelastic material. This material can be uniquely utilized to help limit the force of multiple and repeated impact events.

(continued on next page)

The HHC III partners will work with the finalists to optimize their materials, and later this year the developer of the best-performing material will be awarded a grand prize of $500,000.

The challenge is part of the Head Health Initiative[17], a multiyear, $60M collaboration between GE and the NFL launched in March 2013 to invest in research and technology development to better understand, identify, and protect against brain injury. Challenge I focused on discovering imaging and methods for diagnosis and prognosis of mild traumatic brain injuries. Challenge II focused on new technologies to monitor, identify, and protect against mild traumatic brain injury.

The Head Health Challenge III collaboration helps implement a pledge made by NIST and DoC at the White House Healthy Kids and Safe Sports Concussion Summit in May 2014 to invest resources and to accelerate the development of materials that can protect against concussions.

Sources: *NIST Connections*, February 2015 and December 2015/January 2016; NIST news releases, January 29, 2015, and December 15, 2015; and Director's NIST Update to VCAT, February 3, 2016.

Black History Month Colloquium

The NIST Colloquium on February 19 featured Dr. William A. Lester, Jr., Professor of the Graduate School in the College of Chemistry at the University of California, Berkeley. "Experiences of a Theoretical Chemist: Southside Chicago to Berkeley, California, with Stops In-Between," chronicled the key parts of his career that set his life trajectory. He had his professional start at NBS in the early 1960s as a physical chemist doing research in quantum chemistry. Notable aspects of the science he has pursued include the scattering theory of atoms and molecules and the electronic structure of such systems. He also directed the nation's first unified effort in computational chemistry–the National Resource for Computation in Chemistry.

Sources: NIST Public Affairs Office and UC-Berkeley.

iTAC Improvements

The Office of Information Management System's IT Assistance Center (iTAC) reopened its doors on December 11 following a three-month renovation of its space in Building 225 (Technology). Taking customer feedback into consideration, Room B106 has been dedicated to in-person support only, and telephone and online support requests are now being handled directly across the hall in Room B105. Walk-in customers can meet one-on-one with an iTAC consultant, test drive a number of mobile devices that are available, use a kiosk to reset their password, complete their online IT security training, and other in person services.

Source: *The UpTimes* (OISM newsletter), Winter 2016.

17 For more information on the Initiative, see < https://ninesights.ninesigma.com/web/head-health/head-health>.

Just a Standard Blog[18]

NIST officially joined the blogosphere on January 14, 2016, with the initial post to *Taking Measure*[19], by Director Willie May. The blog will feature posts by NIST researchers, staff, and 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.

An interesting posting made close to National Periodic Table Day (February 7) by Charles Clark[20] explores NIST's connections to the table of the elements.

There are three additional 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>.

The NIST Fleet and Climate Change

As part of its response to Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*,[21] NIST is installing telematics capability in all NIST fleet vehicles to provide operating information. The telematics chip will enable tracking of such factors as frequency of use, location, speed, and idling time—information that will enable NIST to identify low-use vehicles (for potential return to GSA) and vehicle usage that contributes to a high level of greenhouse gas emissions.

The Executive Order is an aggressive campaign intended to establish the federal motor vehicle fleet as a leading service in reducing greenhouse gas emissions. NIST will be moving its fleet toward zero-emission vehicles in the passenger vehicle class and in the medium-size vehicles class (pick-up trucks and other service vehicles) where possible.

Source: Office of Facilities and Property Management *Inside NIST* internal website posting, November 20, 2015.

NIST Hiring Is Up

During FY 2015, the Office of Human Resource Management (OHRM) completed 542 competitive hiring actions, an increase of ~75% over FY 2014, which was a more typical year. Despite the unusually heavy workload, OHRM reported an average time to hire of 62.5 days, which beat the DoC and NIST targets of 65 days. In addition,

18 A blog (short for "weblog") is a discussion website that includes "posts" and usually allows others to comments.
19 See < 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 <https://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change>.

hiring managers reported an overall satisfaction score of 8 (out of 10) on OPM's Hiring Manager Satisfaction Survey, exceeding both DoC and government-wide scores in FY 2015. The OHRM Staffing team is continuing to work to get closer to the theoretical limit in federal hiring speed: 12-20 days per hiring action.

Source: NIST Management Resources *It's Your Business* newsletter, November 2015.

SEBA Community Garden Update

After two years of planning and groundwork (literally), the SEBA Community Garden plans to open on April 15. Since we last covered the garden concept (in the June 2014 SAA newsletter), the organizers have received the appropriate approvals, obtained funding from grants and donations, prepared the soil, and installed a tool shed and an eight-foot deer fence around a 929m^2 (10,000 ft^2) site near one of the campus ponds. There will also be a water tank with hose hook-ups to supply water pumped from the pond.

There are about 60 ten-foot square plots available to SEBA members at $30 per year or $100 for five years. The gardeners must observe organic practices, work in their assigned plot(s) at least once a week, help with community garden chores, and follow other conditions of use established by the SEBA Organic Community Gardens organization. SEBA will provide the gardeners with tools, water, advice, and community. There are plans to have a Montgomery County Master Gardener at the site occasionally.

Sources*: NIST Connections*, February 2016, and <http://www.sebagarden.org/>.

Deer Management

Since 1993, most of the female deer living on the Gaithersburg campus have been given an annual immunocontraception vaccine, administered via darts by the Humane Society of the United States (HSUS)[22]. This has reduced the resident deer population from about 250 in 2004 to approximately 170 in 2015, but that number is still larger than what the campus acreage can properly sustain, and overpopulation is dangerous for both people and the deer.

Something new was tried during evening hours in February – the HSUS coordinated and paid for permanent, surgical sterilization of several dozen female deer at NIST. The work was approved by the Maryland Department of Natural Resources. A similar sterilization program has been conducted at NIH in Bethesda since 2014.

In addition, a future population-control option may be a longer-term contraceptive vaccine, now being developed, that will stop fertility for three to five years.

Source: *NIST Connections*, February 2016.

22 Contraception vaccine has not been used for the last year and a half while NIST awaits approval from EPA, the new regulator of the use of the vaccine. The previous regulator, the FDA, had approved its application for deer population control at NIST.

Visiting Committee on Advanced Technology (VCAT)

Two New Members Join VCAT

Director Willie E. May has appointed Allen Adler and Waguih Ishak to three-year terms on the VCAT.

Adler is vice president of Enterprise Technology Strategy for The Boeing Company. He leads the company's strategic planning for technology, setting research priorities and fostering enterprise-wide collaboration and replication of key technologies across the company's multiple global businesses. Before joining Boeing, he served at DARPA as director of the Tactical Technology Office, which had responsibility for the initial phases of the Future Combat Systems and Unmanned Combat Air Vehicle programs. Adler earned a B.S. from the California Institute of Technology in 1973 and a Ph.D. from Princeton in 1978, both in physics.

Ishak joined Corning in 2007 to establish the Corning West Technology Center (CWTC), where he is vice president and director of the center's Science and Technology Division. CWTC is a Corning Innovation Hub in Silicon Valley responsible for business development, collaborations, and startups on the West Coast. Prior to joining Corning, he held executive positions at Avago Technologies, Agilent Labs, and Hewlett-Packard Labs. Ishak obtained his Ph.D. in electrical engineering from Canada's McMaster University in 1978. He serves on the technical advisory boards of the University of California San Diego, Santa Clara University, and the National Research Council Canada, and he is a Life Fellow of IEEE.

Source: NIST news release, February 2, 2016.

February VCAT Meeting

The VCAT met in Gaithersburg on February 3-4. The agenda included sessions[23] on:

Overview and Safety

- NIST Update and Agenda Review (Willie May)
- Safety Update (Richard Kayser)
- *NIST Workforce: Employee Survey results, actions and HR practices and policies*
- Context Setting (Willie May)
- Improving Employee Engagement at the local level
- Joannie Chin, Acting Deputy Director EL
- Carroll Thomas, Director MEP
- Laurie Locascio, Director MML
- HR Recruitment and Engagement Activities (Susanne Porch, Director OHRM)
- Ensuring a world-class scientific and technical NIST workforce: Thoughts from two NIST Fellows (Michael Moldover and Jun Ye)

Commerce Digital Economy Agenda (Alan Davidson,DoC)

VCAT Business

- Deliberations and Presentation on Observations, Findings, and Recommendations of 2015 Annual Report
- VCAT Elections and Administrative Business

23 The VCAT agenda and visuals for most presentations are available at <http://www.nist.gov/director/vcat/agenda_020316.cfm>.

(continued on next page)

The next VCAT meeting will be June 7-8, 2016, in Gaithersburg. Meeting sessions are open to the public.

Election Results

At its meeting in February, the VCAT elected Rita Colwell (University of Maryland/The Johns Hopkins Bloomberg School of Public Health) to serve as its chairman and William Holt (Intel Corporation) to serve as vice chair. Their bios are available at <http://www.nist.gov/director/vcat/membership.cfm>.

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

Recent Congressional Testimony

There has been no NIST testimony given at hearings since last fall.

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

Staffing Changes

After a nationwide search and more than 85 applicants, **Kent Rochford** is the new Associate Director for Laboratory Programs, effective January 10. In selecting his ADLP successor, Director Willie May told the staff that he was looking for someone with a number of qualities, including a true understanding of NIST and its mission, an open mind, a commitment to the continued improvement of NIST's support functions, and the capacity to serve as acting director, if called upon to do so.

Since March 2014, Rochford has served as the founding director of the Communications Technology Laboratory (CTL). During his 20 years at NIST/Boulder, he has progressed from his 1992 postdoc appointment to become chief of the Optoelectronics Division and acting director of EEEL, chief of PML's Quantum Electronics and Photonics Division, and NIST Boulder Laboratories director. Prior to returning to NIST to lead the CTL start-up, Rochford served for almost two years as a technical director at Sharp Laboratories of America.

Rich Cavanagh has been acting ADLP for over a year, while also serving in his ongoing role of directing the NIST Office of Special Programs.

In early February, Office of Acquisition and Agreements Management (OAAM) director Cecelia Royster announced the selection of two managers within her organization:

Todd Hill is the new deputy director of OAAM, where he will have management oversight over the Policy and Compliance Team and administrative operations within OAAM. Hill came to NIST in 2005 as a member of the equipment team and most recently served as Team Lead in the Acquisition Management Division. In 2015, he received a *Bronze Medal Award* from DoC for outstanding service to the Department's Business Application Solutions team. He entered government service in 1998 through the Navy's Outstanding Scholar Internship program and served seven years at Naval Sea Systems Command negotiating contracts for weapons systems and nuclear ship construction. He holds a B.S. in accounting from Frostburg State University.

Paul Bugenske is the new Chief of the Acquisition Management Division. A 34-year veteran of the Air Force, he has extensive experience in leadership and management and in-depth acquisition knowledge and technical skills. He most recently served as Director of Contracting for the U.S. Special Operations Command, where he led 26 global procurement offices and 450 acquisition professionals, executing over $3B annually. In addition, Bugenske has served as the Mission Support Commander at Goodfellow AFB, Director of Contracting for the Air Force Nuclear Weapons Center, and Director of Contracting at Kirtland AFB. As a Headquarters Contracting Staff Officer, he served as principal business advisor to the Assistant Secretary of the Air Force (Acquisition) on major weapon system acquisition. He holds Master's degrees in strategic studies (Air University) and human resources management (Lesley University) and a B.S. in industrial management from Kansas Newman University.

Sources: *NIST Connections*, December 2015/January 2016, All-Staff email-Willie May, November 30, 2015, Cecelia Royster emails to OU Directors, February 1, 2016, and February 8, 2016.

—Janet Miller

Extramural Program News

Baldrige Performance Excellence Program (BPEP)

Impact Data Available

BPEP has released data that document the scope of services provided to U.S. organizations in every sector and nearly every state through the national network of Baldrige-based nonprofit programs that form the Alliance for Performance Excellence.[24]

Available on the Baldrige website,[25] the data are searchable by state and highlight the scope and key impacts of each Alliance program, such as the number of organizations from the area that applied for the national Baldrige Award in recent years, the economic value for the state of its Baldrige Award-applicant organizations, the number of

24 The Alliance is a key partner of BPEP in promoting the long-term success of U.S. businesses and organizations in other sectors through improvements based on the Baldrige Excellence Framework (including the Criteria for Performance Excellence). Alliance member programs offer performance assessments, training, and other services to organizations in their states, regions, or particular sector based on the Baldrige framework and related resources produced by BPEP. For more information, see <http://www.baldrigepe.org/alliance/>.

25 <http://patapsco.nist.gov/Baldrige_Impacts/index.cfm>

Baldrige examiners from the state, the financial value of those examiners' volunteer service in helping organizations improve through Baldrige assessments, and the names and sectors of organizations from the state that have been honored as national Baldrige Award recipients. Also featured are profiles of national and state-level Baldrige award-winning organizations now serving as role models for others.

The Baldrige Program annually updates and posts on impact data[26] of its assessment and training services at the national level. Through 2015, the Baldrige Program has trained nearly 9,750 examiners in using the Baldrige framework and evaluation processes. In 2015, 349 Baldrige examiners volunteered roughly $5.3M in services. There have been Baldrige examiners and award recipient organizations from nearly every state and the District of Columbia.

Source: NIST news release, February 11, 2016.

Quest for Excellence® Conference[27]

The 28th annual *Quest for Excellence®* conference will be held April 3-6 at the Baltimore Marriott Waterfront Hotel. The ceremony to recognize and celebrate the four recipients of the 2015 *Malcolm Baldrige National Quality Award* will take place on Sunday evening, April 3. The conference will be highlighted by keynote addresses by Daniel Pink and John R. Heer, Jr.

Pink is the author of five books about the changing world of work, including *A Whole New Mind* and *Drive*. Currently he hosts "Crowd Control," a series on the National Geographic Channel that takes problems and creates solutions using unique design, technology, and behavioral science principles.

Heer is the former president and CEO of North Mississippi Health Services. With more than 30 years of service in hospital management leadership positions, he has been CEO of three Baldrige Award recipient organizations: North Mississippi Medical Center, North Mississippi Health System, and Baptist Hospital, Inc. Heer will be honored at the conference with the 2016 *Harry S. Hertz Leadership Award* which recognizes individuals who demonstrate exemplary leadership behaviors consistent with Baldrige core values.

Source: NIST news release, January 26, 2016.

Hollings Manufacturing Extension Partnership Program (MEP)

J. Chancy Lyford became the new MEP Executive Officer on November 30. With the U.S. Small Business Administration since 1998, he most recently was the Deputy Associate Administrator for the Office of Small Business Development Centers, serving as deputy to Carroll Thomas (now MEP Director) when she was the Associate Administrator there. A native of Arkansas, he briefly worked at the Clinton White House and served ten years as press secretary for former Senator Dale Bumpers (D-AR), then the chairman of the Senate Small Business Committee. Lyford holds a combined B.A. in English literature from Hendrix College and St. Peter's College, Oxford University.

Source: Carroll Thomas email, November 23, 2015.

—Janet Miller

Standards and Technology News

Grants to Support Standards Education

A new round of financial support for developing undergraduate and graduate level curricula that integrate standards and standardization information and content into learning resources, courses and seminars has been announced. Accredited institutions of higher education, both nonprofit and commercial organizations; and state, local and Indian tribal governments located in the United States and its territories are eligible.[28]

In 2015, NIST awarded seven grants totaling over $490K. Additional information on NIST work in standards education is available on the Global Standards Information website.[29]

Source: NIST News Release, Feb 17, 2016.

Small Business Innovation Research Program Grants

The Small Business Innovation Research (SBIR) program[30] has announced Phase I of its FY 2016 Federal Funding Opportunity (FFO). SBIR is a competitive program that encourages domestic small businesses to engage in federally funded R&D opportunities that have the potential for commercialization. Phase I is used to determine the technical feasibility of the research. Awards of up to $100K are given.[31]

The FFO describes 19 specific technologies for development:

Advanced Sensing for Manufacturing

- Absolute Interferometry with Nanometer Precision
- Design of Fiber-coupled Waveguide Difference Frequency Generation Devices
- High-Accuracy Angle Generator for Precision Measurements
- High-Density Cryogenic Probe Station
- High Temperature In Situ Pressure Sensor
- Iron Corrosion Detection Technology Using THz Waves: A Field-operable Unit Based on NIST Spectroscopic Technology

26 <http://www.nist.gov/baldrige/publications/impacts.cfm>

27 More information on the conference is available at < http://www.nist.gov/baldrige/qe/>.

28 For details see <http://www.grants.gov/> under Grant Opportunity 2016-NIST-SSCD-01.

29 <http://gsi.nist.gov/global/index.cfm>

30 See SBIR program website at <http://www.nist.gov/tpo/sbir/>.

31 The complete FFO is available at <http://www.grants.gov/> under grant opportunity 2016-NIST-SBIR-01.

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- Object Identification and Localization via Non-Contact Sensing for Enhancing Robotic Systems in Manufacturing Operations
- Pre-Concentration Technology for Analysis of Halocarbon Gases at Trace Levels
- Quantitative Magnetometry of Single Nanoparticles with High

Throughput Biomanufacturing
- Measurement Tools to Advance the Development and Manufacturing of Biologic Medicines

Cryptography and Privacy
- Personal Data Stores to Put Users in Charge of Their Own Information

Cyber Physical Systems
- A Category-Theoretic Tool for Modeling Cyber-Physical Systems
- Manufacturing Process Reference Data for Sustainability
- Novel Methods for Determining Commercial Building Envelope Airtightness
- Single-Chip eLoran Receiver
- Smart Visualization of Smart Manufacturing

Lab to Market
- NIST Technology Transfer

Materials Genome
- Infrastructure Requirements and Architecture to Enable Scalable Scientific Data and Metadata Acquisition and Curation

Quantum-based Sensors and Measurements
- Highly Efficient Optical Frequency Converters for Quantum Interfaces

Source: NIST News Release, Feb 3, 2016.

SI Superheroes Return—Another Weighty Adventure

In the latest animated adventure of the NIST League of SI Superheroes, the nefarious Major Uncertainty has kidnapped Monsieur Kilogram, putting the world's measurements of mass in jeopardy. As the world spirals into "Mass Hysteria," the remaining SI Superheroes, champions of the metric system, leap into action to save the day, and hopefully Monsieur Kilogram as well.[32]

"Mass Hysteria" touches upon a topic—how to redefine the basic unit of mass, the kilogram—that represents a cutting-edge undertaking for researchers working to modernize the International System of Units (SI).

From the very big, to the very small, accurately measuring mass is important. Many of the products sold by a grocery store and other places are sold by mass or the related quantity of weight. For example, the mass of each ingredient in medications from aspirin tablets to cancer drugs is carefully measured to ensure that they are both safe and effective. The mass of a patient is often used to determine the dosage of a medications. And both the fuel and the amount of thrust produced by the huge engines that power airplanes and rockets depend on mass.

Small errors of even a few milligrams per kilogram can be costly when measuring huge quantities of something like a tanker ship full of grain or oil. With medicines, slightly too little of a chemical could make it ineffective and slightly too much could be toxic.

The kilogram is the last standard unit of measure still based on an actual physical object, in this case a golf-ball-sized cylinder of platinum and iridium. As a result, the kilogram is vulnerable to damage, as well as to being lost or even stolen. While the international prototype kilogram itself cannot change because it is the kilogram by definition, copies of the international prototype that many countries use as their standard of mass have been gaining or losing mass relative to it.

The SI Superheroes' latest episode briefly explores one of the efforts to redefine the kilogram in terms of natural forces called the watt balance, a complex machine that uses electric and magnetic forces to balance a one-kilogram mass against the Earth's gravity. Precise measurements related to these forces can then be used to provide a consistent definition of the amount of mass in the kilogram. After years of work, scientists at NIST and elsewhere are closing in on the goal of having the watt balance replace the international prototype kilogram. It is widely anticipated that the kilogram will be redefined in 2018. Once this process is complete, the kilogram will have been freed from its dependence on a physical object, and anyone with the right technical expertise and equipment will be able to determine the mass of a kilogram independently.

Source: NIST News Release, Feb 2, 2016.

Standard Reference Peanut Butter

While NIST chemist **Carolyn Burdette** spent a cold morning last February testing samples of peanut butter (yes, that's part of her job), a visitor was snapping a photo of a jar of the stuff, which was on display. The image quickly shot around social media and stories soon appeared on sites including BoingBoing, the Food Network and Smithsonian magazine. "I felt a mix of pride and amusement as this story quickly played out over the Internet," says Burdette. "We know what we do is valuable for industry and ultimately the consumer, but we don't expect to see it talked about on Reddit!"

NIST seems an unlikely source for peanut butter, but it actually sells a variety of "foods," including spinach, low-calorie cranberry juice cocktail and something called "meat homogenate." Commercially packaged foods come with a list of nutritional values mandated by the Nutrition Labeling and Education Act of 1990, which is enforced by the FDA. As a result, food and beverage-related standard reference materials (SRMs) are required to help manufacturers determine the nutritional value numbers. When a company buys an SRM from NIST, they are buying all of the measurements and scientific expertise that went into determining its chemical or physical properties, as well as NIST's level of certainty regarding those measurements

32 To see more about the latest SI Superhero adventure go to <http://www.nist.gov/public_affairs/kids/kidsmain.htm>.

Retirements – October through December 2015

Name	Organization	Date
Kelvin W. Combs	136 Fabrication Technology Office, MR	12/12/15
Deborah A. Dubeau	181 Information Technology Security & Networking Div., OISM	10/02/15
David E. Hayes	193 Gaithersburg Facility Maintenance Division, OFPM	10/30/15
Galen H. Koepke	672 RF Technology Division, CTL	11/14/15
Daniel Madrzykowski	733 Fire Research Division	12/31/15
Roy A. McLane	733 Fire Research Division	12/31/15
Nancy A. McNabb	731 Materials and Structural Systems Division, EL	12/26/15
Linda L. Milburn	643 Materials Measurement Science Division, MML	12/31/15
Dennis C. Myers	151 Gaithersburg Safety, Health and Environment Div., OSHE	12/31/15
Dianne M. O'Leary	771 Applied and Computational Mathematics Division, ITL	11/20/15
John W. Roberts	774 Information Access Division, ITL	12/30/15
Till P. Rosenband	688 Time and Frequency Division, PML	10/17/15
Linda A. Souders	642 Materials Science and Engineering Division, MML	12/31/15
Jose C. Victorio	193 Gaithersburg Facility Maintenance Division, OFPM	12/31/15
Bradford J. Wing	774 Information Access Division, ITL	11/27/15

which is why NIST works constantly to improve measurement science.

Food manufacturers use the SRMs to calibrate their test methods and equipment. If their tests of the SRMs do not give them the answers that NIST has determined they should be, they know they have a problem. Once their results agree with the SRM, they can then accurately label their products with nutritional information for the consumer. NIST sells some 1,300 SRMs that help a variety of industries make sure they are meeting regulations or industry standards that help ensure the safety and consistency of their products.

Source: Taking Measure–Just a Standard Blog,[33] Jan 25, 2016.

—Belinda Collins

National Cybersecurity Center of Excellence

On February 8, 2016, NIST celebrated the opening of a new facility in Rockville, MD, renovated to house the National Cybersecurity Center of Excellence (NCCoE).[34] Celebrating the growth of this public-private collaboration, Commerce Secretary Penny Pritzker, Senator Barbara Mikulski, Senator Ben Cardin, Rep. John Delaney, Rep. John Sarbanes, Maryland Lt. Governor Boyd Rutherford, Montgomery County Executive Ike Leggett, and Under Secretary of Commerce for Standards and Technology and NIST Director Willie May participated in the ribbon cutting.

"It is absolutely critical to address cyber threats with as much urgency as we do public health crises, natural disasters, and war-time threats," said Secretary Pritzker. "We need every company and every sector to bring their cybersecurity issues to the center and work with us to find and implement innovative solutions." As Director May commented in his blog[35] posting that day "it takes the whole organization working in concert to give a company, government agency, or non-profit a fighting chance to fend off today's array of cyber threats."

NIST partnered with the state of Maryland and Montgomery County to found the NCCoE in 2012.[36] This partnership was instrumental in establishing the center as a nationally recognized cybersecurity resource that has the potential to increase the number of local cybersecurity companies, local workforce development, and provide local companies with exposure to NIST's expertise.

Representatives from 11 companies joined federal and local officials in a partner signing ceremony in 2013. The NCCoE was temporarily housed on the Shady Grove campus of the University of Maryland, working in a 885 m^2 space, which included four labs.

In 2014, NIST awarded a contract to the MITRE Corporation to operate DoC's first Federally Funded Research and Development Center (FFRDC), the National Cybersecurity FFRDC[37] in support of the NCCoE. This was the first FFRDC solely dedicated to enhancing cybersecurity.

Now, after more than two years working in cramped temporary quarters, NCCoE's new facility provides five times the laboratory space previously available for collaborative advanced information technology projects. The building, a former biotech business incubator site, boasts

33 http://nist-takingmeasure.blogs.govdelivery.com/introducing-nists-new-blog-taking-measure/

34 <http://nccoe.nist.gov/>.

35 <http://www.nist.gov/director/strengthening-public-private-cooperation-cybersecuritys-toughest-issues.cfm>

36 see *SAA Newsletter*, 28-2, June 2012, p 11.)

37 <http://www.nist.gov/itl/nccoe-092414.cfm>

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National Cybersecurity Center of Excellence (NCCoE) Dedication Ceremony

FRONT ROW (left to right): Ike Leggett, Mont County Executive; Md. Lt Gov. Boyd Rutherford; Sen. Ben Cardin; Sen. Barbara Mikulski; DoC Secretary Penny. Pritzker; Rep. John Delaney; Rep. John Sarbanes

BACK ROW (left to right): Alfred Grasso, Pres. & CEO, MITRE; Gil Quiniones, Pres. & CEO New York Power Authority; Michael Brown, Pres. & CEO, Symantec; Robert Caret, Univ. System of Md Chancellor; Willie May, Director, NIST; Amit Yoran, Pres.. RSA; Dean Garfield, Pres. & CEO , Information Technology Industry Council. *photo credit: Joseph Andrucyk / State of Maryland Office of the Governor*

5,575 m^2 and has been fully renovated from the rafters to the HVAC, plumbing and electrical services. The more than $12M renovation was equally funded by NIST, the state of Maryland and Montgomery County and has enough space to accommodate an additional 50 workers. NIST has a 10-year license to use the facility for the NCCoE's mission.

The Information Technology Laboratory, expanding on its long history of leadership in cybersecurity standards and practices, is home to the NCCoE. Chief Cybersecurity Advisor, **Donna Dodson**, is the Director of NCCoE and oversees the cybersecurity program to conduct research and outreach necessary to provide standards, guidelines, tools, metrics and practices to protect the information and communication infrastructure.

The NCCoE collaborates with industry, including critical infrastructure sectors, to identify specific technical cybersecurity problems that affect entire industry sectors or reach across sectors. It shares those findings for the benefit of the broader community. The center has spurred collaboration with, and among, large and small companies from multiple sectors—including health care, energy, financial services, retail, restaurants and hospitality.

The NCCoE identifies applicable standards and best practices and collaborates with the creators of commercial off-the-shelf products to use them in developing example solutions. Specialists at other government agencies and academia also participate in, and sometimes sponsor, these projects. The NCCoE publishes *NIST Cybersecurity Practice Guides* to show businesses how to put these example solutions into practice for themselves in ways that align with relevant standards and best practices.

Following the building dedication ceremony, senior elected and government officials, and CEOs from several large technology corporations led panel discussions on increasing consumer confidence in cybersecurity and the importance of collaboration. The NCCoE also highlighted renewed collaborative commitments from its partners, including Intel and Hewlett Packard Enterprise each designating an employee to serve as NIST Guest Researchers. Other partners committed to continuing their support of specific NCCoE projects with technical expertise and resources.

Gil Quiniones, CEO of New York Power Authority (NYPA), announced at the event that the organization will be the first utility to adopt the new NIST guide, *Identity and Access Management for Electric Utilities*. This guide maps security characteristics to guidance and best practices from NIST and other organizations.

The event concluded with NCCoE staff and partners demonstrating several of the center's current projects that address challenges faced by organizations across U.S. business sectors, including identity management, mobile device security, online identity authentication, data integrity, situational awareness and IT asset management.

—Cita Furlani

5. NIST STAFF HONORS AND AWARDS

The 43rd Annual NIST Awards Ceremony was held December 9, 2015. For the first time, the ceremony was held simultaneously in Gaithersburg and Boulder with video teleconferencing also to the Hollings Marine Laboratory. The DoC *Gold Medal Awards* and *Silver Medal Awards* were reported in the December newsletter.

Bronze Medal Award for Superior Federal Service

The *Bronze Medal Award* is the highest departmental honorary recognition available for NIST presentation. The award, approved by the Director, recognizes work that has resulted in more effective and efficient management systems as well as the demonstration of unusual initiative or creative ability in the development and improvement of methods and procedures. It also is given for significant contributions affecting major programs, scientific accomplishment within NIST and superior performance of assigned tasks for at least five consecutive years. The award was initiated in 1966.

Kamran Sayrafian (Applied and Computational Mathematics)[38] for leadership in establishing an internationally recognized research program in Body-Area Networking that enables implanted medical sensors to transmit information for medical analysis.

Dorothy Smothers (Compensation, Recognition and Effectiveness) for exemplary customer service in administering the Office of Workers' Compensation Program.

Christopher A. McKinney (Boulder Maintenance and Support Services) for superior building-management customer service in Building 81 (Precision Measurement Laboratory, Boulder).

Dylan Klomparens (Center for Nanoscale Science and Technology) for developing a highly intuitive, efficient tool reservation and tracking system for the CNST NanoFab.

Vladimir Aksyuk (Center for Nanoscale Science and Technology) for contributions to the fields of nanomechanics and nanoplasmonics (the study of optical phenomena in the nanoscale vicinity of metal surfaces).

Jan Obrzut (Materials Science and Engineering) for pioneering microwave methods that enable the determination of fundamental properties of carbon nanomaterials and high-throughput quality assurance measurements.

Lili Wang (Biosystems and Biomaterials) for improving the reliability of flow cytometry, the most widely used single-cell measurement, for use in disease diagnosis and cell therapy manufacturing.

Robert Lipman (Systems Integration) for technical contributions to the development of the STEP File Analyzer software tool for digital exchange of product data for manufacturing.

38 The awardee's Division is listed after their name.

Rick Davis and Mauro Zammarano (Fire Research) for research correlating flexible polyurethane foam characteristics with smoldering ignition mass loss and the development of standard smoldering foam.

James Clay Booth (RF Technology) for development of measurement methods to determine electrical properties of thin-film materials over a broad range of frequencies, and application of to the study and optimization of tunable materials that enable frequency-agile chipsets.

Joseph Rice and Keith Lykke (Sensor Science) for design, development and calibration of the NIST Advanced Radiometer (NISTAR), a space-based, Earth-viewing sensor for emitted infrared and reflected solar radiation from the full sunlit Earth used to quantify small changes in the Earth's radiation balance.

Allen R. Goldstein (Quantum Measurement) for establishing a performance baseline for Phasor Measurement Units that are used in power girds which led to the creation of robust performance standards and an international commercial test network for PMUs.

Jonathan G. Fiscus, **David Joy**, **Gregory A. Sanders**, **Martial Michel**, **Paul Over**; **Darrin Dimmick**, **Angela G. Ellis**, and **John Garofolo** (all, Information Access) for significant technical contributions providing the measurement science infrastructure advancing the state of the art in automated video/multimedia analysis.

Xiao Tang, **Oliver Slattery**, **Paulina Kuo**, and **Barry Hershman** (all, Applied and Computational Mathematics) for development of quantum frequency conversion systems that convert single photons in the telecommunications frequency bands to the visible region with near 100% internal efficiency.

Joe Boone, **Robert Brock**, **Robert Densock**, **William Haag Jr.**, **David Kim**, **William Lindsey**, **Gale Richter**, **Robert Sorensen**, and **Guo Zhang** (all, Information Technology Security and Networking) for exceptional accomplishments in architecting, planning, and implementing the NIST Research Equipment Network service.

Boulder Grounds Crew for providing exemplary snow removal services to Boulder site during a snow season which set snowfall records during the month of February.

Jerry Bowser, **Elise Pilat**, **James Bittner**, and **Joseph Di Pasquale** (Center for Nanoscale Science and Technology); and **Mark Khalil**, **Andy Halich**, and **Sam Ayala** (Gaithersburg Facility Maintenance) for implementing significant improvements in the new-equipment installation process. that has saved NIST time and money across the campus from AMD to Shops, and improved NIST-vendor relations.

James Moyer, **Douglas Ogg**, and **Michael Rinehart** (NIST Center for Neutron Research) for the mechanical design, installation, and alignment of a complex neutron detection and analyzer system that is an integral, state-of-the-art component of the Multi-Axis Crystal Spectrometer.

Christopher Zangmeister, **James Radney**, and **Joseph Hodges** (Chemical Sciences); and **Keith Gillis**

(continued on next page)

(Sensor Science) for pioneering developments in particle synthesis and innovative metrological techniques for characterization of aerosol optical properties of relevance to climate change.

W. Bertrand (Randy) Doriese, **Daniel Swetz** and **Joel Ullom** (Quantum Electromagnetics) and **Daniel Fischer** (Materials Science and Engineering) for providing novel best-in-class X-ray spectrometer systems to some of the world's most prestigious research facilities, enabling them to run their cost-intensive beam lines more efficiently and to perform new kinds of experiments.

Elizabeth Colbert, **Diane Henderson**, **Bill Kinser**, **Sunni Massey**, **Kaleema Muhammad**, **Dave Stieren**, and **Tab Wilkins Jr.** (Hollings Manufacturing Extension Partnership Program); and **Mike Teske**, **Jannet Cancino**, **Jedd Vertman** (Grants Management) for creative and innovative problem solving in developing a comprehensive set of standard policies, procedures and protocols to launch the first-ever multi-year, system-wide recompetition of the 50-state national system of MEP Centers.

Kenneth Cole and Jamie Almeida (Biosystems and Biomaterials) for developing assays that allow the unambiguous verification of the identity of cell lines that are widely used in biomedical research, cancer research, and biomanufacturing.

H. Wayne Adams, Tish Brush, **Lisa Eldrige**, **Wendy Morrison**, **Katherine Pagoaga**, **Sean Sell**, **Debra Strawbridge**, **Sandy Yu** and **Aiping Zhang** (Office of Information Systems Management) for developing and implementing a program to make PIV credentials the common means of authentication for access to NIST IT resources.

NIST "Named" Awards

These awards, named after distinguished former NBS/NIST staff members, have been established to recognize exceptional service in various categories.

Allen V. Astin Measurement Science Award, first presented in 1984, is granted for outstanding achievement in the advancement of measurement science or in the delivery of measurement services.

David Howe, **Craig Nelson**, and **Archita Hati** (all, Time and Frequency) for developing a world-leading program of research and measurement services in phase noise – the exquisitely precise measurement of timing jitter and spectral purity in electromagnetic signals.

Edward Uhler Condon Award recognizes distinguished achievements in written exposition in science and technology. The award was initiated in 1974.

David B. Newell (Quantum Measurement) for his *Physics Today* cover article "A More Fundamental International System of Units," which articulates in clear entertaining language the historic arc of our metric system and the monumental "facelift" it will soon receive.

Eugene Casson Crittenden Award, first presented in 1967, recognizes superior achievement by permanent employees who perform supporting services that have a significant impact in support of the mission of NIST.

Andrew Barnhart (Information Technology Security and Networking) for exemplary support as the program process coordinator of the NIST cybersecurity Assessment & Authorization Program.

Carmene Brown (Operations & Strategic Programs) for unflagging commitment to ensuring that NIST staff members get paid correctly and on time.

Robert Gregory Driver (Quantum Measurement) for establishing the world's best piston-gauge pressure standards and measurements.

Art Ellison, **Glen Glaeser**, **Daniel Greb**, **Luis Luyo**, and **John Wamsley** (all, Energy and Environment) for exemplary efforts that enabled the demonstration of net-zero energy use by the Net-Zero Energy Residential Test Facility while maintaining the facility's pristine condition.

Andrew G. Halich (Gaithersburg Facility Maintenance) for dedication to exceptional customer service in prioritizing and executing work for the research and mission needs of NIST Gaithersburg.

Christopher J. Neary (Gaithersburg Safety, Health, and Environment) for outstanding contributions to the safety and health of the NIST staff and surrounding environment through the management of the NIST Gaithersburg Hazardous Waste Program.

Christopher A. Voigt (Gaithersburg Facility Maintenance) for consistently maintaining the highest level of skill and craftsmanship in his trade.

Judson C. French Award, first presented in 2000, is granted for significant improvement in products delivered directly to industry, including new or improved NIST calibration services, Standard Reference Materials, and Standard Reference Databases.

Jacob E. Ricker and **Jay H. Hendricks** (Applied Physics); and **John S. Quintavalle** (Innovation and Solutions) for creating the Vacuum Calibration Standard Facility, which reduces calibration cost and turnaround time by a factor of four.

Alexander Kramida, **Joseph Reader**, and **Yuri Ralchenko** (all, Quantum Measurement) for exceptional creativity and dedication in forging and continually improving the world's most comprehensive virtual resource of atomic standard reference data.

Therese A. Butler; Marc L. Salit; Michael R. Winchester; Gregory C. Turk (posthumous) (Chemical Sciences) for the development, production and support of a suite of 68 single-element solution SRMs (the SRM 3100 series) to provide measurement traceability for key elements of the periodic table.

Jacob Rabinow Applied Research Award, first presented in 1975, is granted for outstanding achievements in the

practical application of the results of scientific engineering research.

Richard S. Gates (Materials Measurement Science) for pioneering work in nanotribology (which studies friction phenomena at the nanometer scale) and tribochemistry (which studies chemical and physiochemical changes to matter due to the influence of mechanical energy).

Edward Bennett Rosa Award, established in 1964, is granted for outstanding achievement in, or contributions to, the development of meaningful and significant engineering, scientific, or documentary standards either within NIST or in cooperation with other government agencies or private groups.

C. Cameron Miller, **Yoshi Ohno**, and **Yuqin Zong** (Sensor Science) for international leadership in developing the measurement foundation that is enabling the rapid advancement and commercialization of high-quality solid-state lighting products.

William P. Slichter Award, first presented in 1992, is granted for outstanding achievements by NIST staff in building or strengthening ties between NIST and industry.

Melissa M. Phillips, **Laura J. Wood**, **Catherine A. Rimmer** (all, Chemical Sciences); and **Katherine E. Sharpless** (Special Prgrams Office) for leadership and support in creating voluntary consensus standard methods for over 25 nutrient groups in infant formulas and adult nutritional products in collaboration with AOAC International and the Infant Nutrition Council of America.

Samuel Wesley Stratton Award, first presented in 1962, is granted for outstanding scientific or engineering achievements in support of NIST objectives.

Emanuel Knill (Applied and Computational Mathematics) for pioneering work in the field of quantum information science and engineering.

George A. Uriano Award, first presented in 1996, is granted for outstanding achievements by NIST staff in building or strengthening NIST extramural programs, with emphasis on fostering U.S. competitiveness and business excellence.

Kenneth P. Voytek (acting director, Hollings MEP Manufacturing Policy and Research group) for outstanding and singular contribution to improve the effectiveness of the MEP system by developing a sophisticated mathematical model for normalizing funding among the states.

Barbara Uglik (Baldrige Performance Excellence Program) for extraordinary commitment to the needs of the Baldrige community through the updating and implementing of BOSS, an automated evaluation tool annually used by over 400 volunteer Baldrige Examiners.

LouAnn Scott for demonstrating exceptional technical knowledge in the design, implementation, and management of the *Quest for Excellence Conference* app.

*Colleagues' Choice Award, e*stablished in 2006, the NIST Colleagues' Choice Award is granted to non-supervisory employees who are recognized and nominated by their colleagues for having made significant contributions that broadly advance the NIST mission and strategic goals or broadly contribute to the overall health and effectiveness of NIST.

Steven Grantham (Sensor Science) for technical contributions to an especially broad range of projects that have included optical and mechanical design and electronic and computer interfacing.

Glenn Holland (Center for Nanoscale Science and Technology) for exceptional support of NIST measurement science activities.

Dennis Nester (NIST Center for Neutron Research) for 15 years of exemplary service as the primary engineering technician responsible for the operation and maintenance of the NCNR cold neutron sources and the complex cryogenic refrigerator and equipment needed to keep them operating.

Honeyeh Zube (Technology Partnerships Office) for her significant impact all across NIST in developing complex agreements and assisting with intellectual property issues between NIST and companies.

Director's Award for Excellence in Administration, first presented in 2008, is granted to recognize administrative professionals in the ZA career path at NIST who have made significant contributions that broadly advance the NIST mission and strategic goals through excellence in administrative services and functions.

Tina Marie Faecke (Materials and Structural Systems) for her superlative administrative leadership since 2006 for two prominent NIST statutory programs: the four-agency, National Earthquake Hazards Reduction Program and the National Construction Safety Team .

Amy O. Eckstine (Compensation, Recognition and Effectiveness) for significant contributions in advancing NIST's mission via her administrative expertise. Her commitment to HR clients is unparalleled.

Director's Recognition for Excellence in Mission Support recognizes staff within the Management Resources Directorate whose commitment and excellence in service delivery stands out among customers and significantly contributes to NIST mission delivery.

Christopher Hamilton (Office of Facilities and Property Management, Boulder) for providing exceptional service for the highly sophisticated and technically challenging network of electrical utilities in the Precision Measurement Laboratory (Building 81).

Equal Employment Opportunity/Diversity Award, first presented in 1977, is granted for exceptionally significant accomplishments and contributions to Equal Employment Opportunity/ Diversity goals.

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Zeeshan Ahmed (Sensor Science) for outstanding mentorship of economically disadvantaged students who have expressed interest in pursuing careers in science.

Safety Award, first presented in 1979, is granted for unusually significant contributions to NIST Occupational Safety and Health Program activities.

Laurie Locascio (Director, Material Measurement Laboratory) for leadership in eliminating hazardous materials in the Material Measurement Laboratory.

Elizabeth Mackey (Material Measurement Laboratory); **Lawrence Denicola** and **Laslo Varadi** (Engineering Laboratory); **Su Jen Kau**, **Hicham Laoudi** and **Xinwei Wen** (Applications Systems) for developing and implementing an iPad-based mobile application for use in auditing safety criteria in NIST spaces.

Dean of Staff award honors the current employee with the longest tenure at NIST. The honoree receives a framed copy of an antique print of pioneering scientist Michael Faraday. A rare carbon print of this photo, now in NIST's historical artifact collection, hung in the office of the first three NIST directors for four decades.

Elizabeth Fong (Software and Systems, ITL) has worked at NIST for 48 years. A computer scientist for her entire tenure, she helped to create the Structured Query Language (SQL) standard by which databases and applications of various types communicate. She currently works on the Software Assurance Metrics and Tool Evaluation (SAMATE) project, which aims to ensure that software is functionally correct and free from malicious code.

6. BOULDER BABBLE

Editor's Note:

Over the years, we have received many comments from members about how much they relish reading Boulder Babble each quarter. ***Mickey Haynes*** *normally wrote the unique and very popular "Local Scene" as well as other parts of the column. "Boulder Babble" has appeared in each issue of the SAA Newsletter since its inception by Bob Kamper in September 1994. Mickey took over for Bob in September 2006. Mickey was joined by Ray Radebaugh in September 2009 and they have prepared this quarterly column ever since.*

On Thursday, February 25,we received the sad news that Mickey had died that morning.

While I only met Mickey face-to-face a couple times over the past few years, I found him to be a great person to work with. I had come to rely on him very heavily each quarter for an extremely well-written Boulder Babble that arrived very close to layout-ready every time. Mickey will be very hard to replace.

—Roger Martin

Portable Kit to Recover Traces of Chemical Evidence

The recovery of trace chemical vapors is important for investigation of hidden explosives, environmental pollutants, food safety, and forensic evidence including secret graves and arson fire debris. The concentration of such chemical vapors in the headspace air above the source can be extremely low, especially for chemicals with low vapor pressures. The analysis of such low chemical concentrations requires the use of some method to collect and concentrate the chemical before it is analyzed by such methods as gas chromatography, Fourier Transform infrared spectrophotometry, nuclear magnetic resonance spectrometry, etc. A laboratory method known as PLOT-cryo for the collection and concentration of such vapors was previously developed at NIST by **Tom Bruno** and colleagues in the Advanced Chemicals and Materials Division. It had a sensitivity of one part per billion.

Now the team has developed a portable version of the technique.[39],[40] If successfully commercialized by industry, the brief-case sized kit could provide detectives, field inspectors, and others a convenient method of carrying out the NIST's "headspace analysis" technique in the field. The technique identifies solid or liquid compounds based on the makeup of vapors released in the nearby air. The NIST method is called porous layer open tubular cryogenic adsorption, or PLOT-cryo for short. With this technique the vapor sample is blown or sucked through a small capillary tube lined with a porous adsorbent. The tube is cooled to about -40°C with the cold air from a vortex cooler. At such a low temperature the adsorption of the vapor is greatly enhanced, but very little air is adsorbed. After some period of time the capillary tube is heated to about 150°C by the hot air from the vortex cooler to desorb the vapor and send it into a portable gas chromatograph or other analysis instrument. Alternatively the concentrated vapor sample could be collected in a vial to be analyzed later in the laboratory. The portable device requires no electrical power, but it does require compressed air for the vortex cooler. Compressed air is often readily available in the field. In laboratory tests with the portable device Bruno recovered and reliably identified substances such as the chemical compound coumarin, the explosive TNT, and diesel fuel. Collection times were as fast as 3 seconds. The kit detected diesel fuel—a concern with respect to illegal dumping and leaking tanks—with a sensitivity better than one part per million. Further research is expected to increase the sensitivity.

39 T.J. Bruno, "Field portable low temperature porous open tubular cryoadsorption headspace sampling and analysis part I: Instrumentation," *J. Chromatography* A 1429 (2016) 65-71.

40 M. Harries, S. Bukovsky-Reyes, and T.J. Bruno, "Field portable low temperature porous open tubular cryoadsorption headspace sampling and analysis part II: Applications," *J. Chromatography* A 1429 (2016) 72-76.

Quantum Mechanical 'Squeezed' Motion in a Large Object

The motion of objects the size of atoms are accurately described by the laws of quantum mechanics. Their discrete energy levels are widely spaced and readily discernible. The energy level spacing in larger objects is usually so small that they cannot be detected, and they become blurred by thermal motion at room temperature into a continuous band of energies. In that case, classical mechanics describes their motion. Researchers in the Applied Physics Division, led by **John Teufel**, are pushing the limits where quantum mechanical behavior can be observed in relatively large objects. The object being investigated in this case is a macroscopic mechanical oscillator in the form of an aluminum membrane or tiny metal drum head about 30 μm in diameter. That size is about the detectability limit of the human eye, but it is about 100,000 times larger than an atom. The membrane motion is activated and sensed by coupling the membrane to two separate microwave circuits. The membrane forms one plate of a capacitor. The drum head is made stiff enough that it resonates at a frequency of about 100 MHz. That high frequency makes the energy level spacing large enough to detect as long as thermal motion is greatly reduced by attaching the membrane and microwave circuits to a dilution refrigerator operating at 30 mK (0.030 K above absolute zero). Last year the same team cooled the membrane further with the microwaves to observe the quantum mechanical ground state of the mechanical oscillations.

The team is pushing the limits of physics to see how large a system can be made to behave quantum mechanically. In the present experiments the team demonstrated that the state of the membrane's motion could be 'squeezed,' which is a uniquely quantum phenomenon and never before demonstrated in an engineered mechanical system.[41] The Heisenberg uncertainty principle dictates that for any quantum entity, the simultaneous values of two complementary variables (such as position and momentum) are limited in the precision to which they can be measured. Squeezing shifts all of the uncertainty to a single variable, such that the other variable can be measured with arbitrary precision. By tuning the two microwave circuits just right, they achieved something that looks like the membrane was cooled to the ground state, but it has an extra level of interference that makes it cool to a squeezed state instead. Preparing the squeezed state, however, is only half the problem. One must also measure without destroying the delicate quantum state of the system. This special kind of measurement was implemented by illuminating the system with microwaves at time intervals that correspond to the period of the mechanical motion (much like adjusting a strobe light until it shows a swinging object at exactly the same place every flash). The results of this research could be useful in quantum networks and quantum information processing.

Fast DNA Sequencing with a Graphene Nanopore

Knowledge of DNA sequences has become indispensable for basic biological research, and in numerous applied fields such as medical diagnostics, biotechnology, forensic biology, virology, and biological systematics. DNA sequencing is the process of determining the order of the four bases—adenine, guanine, cystosine, and thymine—in a strand of DNA. Conventional sequencing, developed in the 1970s, involves separating, copying, labeling, and reassembling pieces of DNA to read the genetic information. The method was very laborious and time consuming. Newer sequencing methods have been developed that are much faster and have been instrumental in the sequencing of complete DNA sequences, or genomes of numerous types of species of life, including the human genome. One such method—pioneered 20 years ago at NIST—involves pulling the DNA through a hole in a protein, which causes charged particles to pass through the hole. The method has the disadvantage of unwanted electrical noise and inadequate selectivity.

A newer NIST method, proposed and simulated by **Alex Smolyanitsky** and colleagues of the Applied Chemicals and Materials Division, uses a chemically activated hole in graphene.[42] In operation a graphene ribbon, about 4.5 nm wide by 15.5 nm long is stretched between two electrodes and placed in a water bath. Several copies of one particular base are attached to the nanopore (2.5 nm diameter). A base size is about 0.3 nm. For the case where cytosine is attached, and an unzipped DNA strand is pulled through the nanopore, a hydrogen bond is formed between the cytosine and any guanine that passes through. As the DNA continues moving, the graphene is distorted and then slips back to the original position as the bond is broken. The strain affects the graphene's electrical properties and gives rise to a change in electrical current on the order of milliamperes, which is easily measured. To detect all four bases, four graphene ribbons, each with a different base inserted in the pore, could be stacked vertically to create an integrated DNA sensor. The theory and simulations showed that the method is 90 % accurate with no false positives. The uncertainty involves only missed bases rather than wrong ones. The researchers suggest that four independent measurements of the same DNA strand would yield a 99.99% accuracy, as required for sequencing the human genome. The method shows promise for a realistic, fast DNA sequencing device without the need for advanced data processing, microscopes, or highly restrictive operating conditions.

—Ray Radebaugh

41 F. Lecocq, J.B. Clark, R.W. Simmonds, J. Aumentado, and J.D. Teufel, "Quantum Nondemolition Measurement of a Nonclassical State of a Massive Object," *Phys. Rev.* X **5**, 041037 (2015).

42 E. Paulechka, T.A. Wassenaar, K. Kroenlein, A. Kazakov, and A. Smolyanitsky, "Nucleobase-functionalized graphene nanoribbons for accurate high-speed DNA sequencing," *Nanoscale* **8** (2016) 1861-1867.

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7. OBITUARIES[43]

Charles Douglas (Doug) Bostian, 71, of Taneytown, MD died January 8, 2016 after a two-year fight with cancer.

Doug joined the NBS Instrument Shops Division in 1968. Over his 32 years of service to NBS/NIST he worked in the Radiation Source & Instrumentation Division (1978-1990) and the Reactor Radiation Division. He retired from the NIST Center for Neutron Research in December 1999.

Born June 19, 1944, Doug was the son of the late Charles T. and Lois Hobbs Bostian. He was an active life member of the Union Bridge Volunteer Fire Company for the past 52 years. He served as president, vice president, trustee, on the executive board, the executive committee and chaired many committees including the Building Committee. He was the president of the Carroll County Volunteer Firemen's Association (2002-2003) and was inducted into their Hall of Fame in 2001.

He is survived by Linda E. Bostian, his wife of 30 years; two daughters Jennie (Andrew) Jack and Lottie (James) Wiebolt; four grandchildren; and two step grandchildren.

Source: The *Frederick News-Post,* January 10, 2016.

Norman Louis Brown, 92, died November 7, 2015. Born in 1923 in Atlantic City, NJ, he attended M.I.T. for two years before volunteering for the Army in 1943. He was stationed at Los Alamos, NM, where his job was to purify plutonium for the Nagasaki bomb. After the war, he returned to M.I.T. and earned a Ph.D from Brown University.

After graduation, he worked for General Electric and then joined the NBS Heat and Power Division - Free Radicals Research Section in 1957. He moved to the Electricity Division in 1960.

Although Brown was proud of his work at Los Alamos and his contribution to ending the war, when he realized and understood the devastating death and destruction caused by the bombs he became a peace activist.

He married Janet Welsh Brown in 1957. In 1963, after the birth of their first child, he left NBS and shifted his career path. In all of his subsequent jobs he applied his scientific training to the solution of human problems, at first addressing hunger, and later in the development and application of small scale and renewable energy technologies in developing countries. He continued to protest wars and injustice throughout his life.

He is survived by Janet, his wife of 58 years, and three children and their families: Leah, Mira. and Ian.

Source: *The Washington Post*, November 21, 2015.

H. Radford Byerly, Jr., of Boulder, died January 27, 2016, after a long fight with Parkinson's disease. He was 79. Born May 22, 1936, to Garvis Nell Cook and Radford Byerly, Rad grew up in Houston and the piney woods of East Texas. He earned B.A. and M.A. degrees in physics at Williams College and a Ph.D. in physics at Rice University.

1967-1969, he was a postdoc at the Joint Institute for Laboratory Astrophysics (JILA), conducting experimental physics related to processes in the upper atmosphere. He left JILA to work as a policy advisor to NBS Director Lewis Branscomb. During the early 1970s he also served as Deputy Chief of the Fire Technology Division and Deputy Chief for Air Measurement in the Office of Air and Water Measurement. His assignment as a 1973-74 ComSci Fellow was with the staff of the House Science and Astronautics Committee[44], where he was involved with legislation such as the Fire Prevention Act of 1974 and the Metric Conversion Act.

Rad left NBS in 1975 to work on several subcommittees of the House Committee on Science and Technology[1], eventually becoming staff director of the Subcommittee on Space Science and Applications, where issues included NASA authorizations, space policy, the investigation of the Challenger Shuttle accident, and the development of the Space Station. He helped establish and served as director of the Center for Space and Geosciences Policy at the University of Colorado (1987-1991); established an ongoing space policy research program at the university; and also developed and taught a course in space policy. In 1991 he was recruited by Representative George E. Brown (D-CA) to be chief of staff of the House Committee on Science, Space, and Technology[1], which had oversight of all civilian R&D, including NIST. Returning to Colorado in 1993, he served briefly as vice president for public policy and director of the Walter Orr Roberts Institute at the University Corporation for Atmospheric Research. He was elected a Fellow of AAAS in 2001.

43 an asterisk (*) after a name indicates SAA Member.

44 All references are to essentially the same House committee, also known for a time as the House Science Committee.

Rad wrote extensively and served on numerous science advisory and review committees, including the NRC Board on Assessment of NIST Programs for the FY 1999 and FY 2000 reviews of the Laboratories. He was not all work—he loved to ski and was an avid backpacker.

He is survived by his wife, Carol, his ex-wife, Kay, his sister, three children, and five grandchildren.

Sources: *Boulder Daily Camera*, January 28, 2016, NIST Archives, and online resume

Robert (Bob) Johnson Carpenter,* a highly respected national and international leader and pioneering innovator in the development of radio and computer technology, instrumentation and measurement methods died on January 8, 2016 at Holy Cross Hospital in Germantown, MD, following a brief illness. He was 85.

Born on July 31, 1930 in Washington, DC, Bob was the son of the late Byron H. and Margaret (nee Johnson) Carpenter. He was a long time resident of Glen Hills, Rockville, MD. Bob received his B.S. in Electrical Engineering from the University of Maryland in 1951. Following his service in the U.S. Air Force at the Cambridge, MA Research Center, Bob worked at the Johns Hopkins Applied Physics Laboratory in Baltimore, MD from 1953 to 1955.

He joined NBS/Boulder, Radio Propagation Physics Division in 1955. In 1959 he moved back to Washington, DC to join the NBS Electricity Division. In 1975 he joined the Institute for Computer Science and Technology, Systems Component Division where he developed NBSNET, the original, groundbreaking, local computer network for NBS that became operational in 1979. Over his career at NBS/NIST he held positions of group manager and section chief with the Measurement Engineering Division and the Information Technology Laboratory.

Bob retired from the Advanced Systems Division in 1992 but continued to work at NIST, first as a contractor and then as a Guest Worker, in the Scalable Parallel Systems and Applications Division. In total, Bob's service to NBS/NIST extended to nearly 50 years.

He was the author of technical papers and book chapters on radio propagation research and laboratory instrumentation; he held three patents for electric circuits; and received many awards in recognition of his achievements, including: *Silver Medal Award* (1979) for conceiving, designing and implementing an innovative local area computer network (NBSNET), a major step toward the more productive use of personnel, computers, and computer terminals by national and international organizations; *Research & Development Magazine R&D 100 Award* (1988), along with John W. Roberts and Alan Mink, for the development of tools to measure the performance of multiprocessors; *Gold Medal Award* (1988) for outstanding leadership and personal contributions in developing measurement hardware and software for high performance computers; and *Allan V. Astin Measurement Science Award* (1990), along with Alan Mink, George Nacht, and John W. Roberts, for laying the foundation and developing circuitry for performance measurement of multiprocessor computers and digital networks, and the development of a wide range of instrumentation.

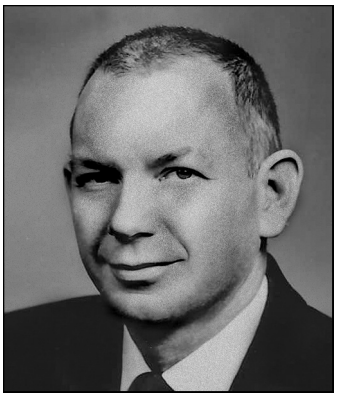
In 1999 Bob was selected to the NIST/NBS Portrait Gallery for his achievements in instrumentation and measurement techniques for computers and networks.

From his days in junior high school, Bob's interests and hobbies were focused on radio and computer technologies. Between 1960 and 1964 he designed and built hardware for WHFS 102.3, the first FM stereo broadcasting station in the DC area. Throughout his career and retirement, he volunteered his time to help the Amateur Radio Satellite Corporation (AMSAT). A colleague recalls visiting Bob at his home in the 1960s, and seeing an entire room of the house devoted to Bob's "personal computer", which at the time was a large, complex arrangement of many devices. Bob moved to Asbury Methodist Village in Gaithersburg, MD in 2008. His continued passion for advancing the development and use of computing technology led him to become the principal supporter and caretaker of the computer facility in his Village community.

In addition to his parents, Bob was preceded in death by his brother, Byron L. Carpenter, and sister-in-law, Phyllis L.M. Carpenter. He is survived by many nieces and nephews, great-nieces and nephews, and great great-nieces and nephews.

Sources: *The Washington Post*, January 18, 2016; NIST archives; recollections of current and retired NIST staff.

—Shirley Radack and Michael Hogan



William E. Case was born December 26, 1920 near Mitchell, Nebraska. After serving in the Army as a Radar Officer he attended the University of Colorado, Boulder and graduated with honors in Electrical Engineering (1957). He began working for NBS part-time in 1955. Upon graduation he joined NBS full time in the Microwave Division—working mostly in the development and use of microwave power standards.

In 1968, Bill joined the Quantum Electronics Division where he worked with E.D. "Dale" West as a principal as-

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sistant (along with Alvin Rasmussen and Leonard Schmidt) in the development of the C-series isoperibol calorimeter as a standard for laser power and energy. Bill's work in microwave power standards and measurements fit well with the development and use of laser standards for power standards and energy measurements.

C-series calorimeters were mostly designed for low power cw laser measurements. The K-series were used for higher power continuous wave lasers up to about a kilowatt (mostly carbon dioxide lasers). The Q-series were similar type calorimeters for high power pulse lasers. These calorimeters included a special volume absorbing glass within the cavity which absorbed the pulse within the volume, rather than the surface and thus precluded surface damage. Since these volume absorbers were sensitive to wavelength, different ones were needed for each type of laser. The Q-series were designed for Neodymium lasers.

Bill worked closely with West in using these calorimeters as the basis for developing a complete measurement system and implementing many of the techniques learned from Donald Jennings, Alvin Rasmussen and others who developed the earlier liquid cell calorimeters.

When West retired in 1974, Bill continued to work and develop these measurement systems and became the principal person performing the day-to-day measurements, maintenance, and further development of these systems. He carried out many international comparisons for laser power and energy measurements and for many years did the methodical and careful work of a dedicated metrologist.

Following his retirement in 1986, Bill continued to work initially full time, and then part time, as an adviser and consultant until 2006. His career at NBS/NIST, including his post-retirement service extended over fifty years.

Bill died on November 27, 2015 at age 94. He was preceded in death by his wife of 68 years, Lillian. He is survived by his sons James and John; five grandchildren; and one great granddaughter.

Although he led a full, happy, productive and accomplished life, the loss to his friends is still very difficult and he will be sorely missed. He was always enthusiastic, positive, and cheerful.

Sources: *The Daily Camera,* November 29, 2015 and NIST Archives.

—Aaron Sanders

Ronald M Fisher, 88, died December 14, 2015 in Boulder, CO. Fisher worked at NBS/Boulder as an electronics technician in the Ionospheric Telecommunications Division from 1965 to 1971. His work involved ionospheric research, medium-wave propagation, and a program involving the detection of high altitude nuclear detonations.

After leaving NBS in 1971, Fisher worked for over 20 years as a senior design/development technical specialist in magnetic, electro-optics and cryogenics engineering for Ball Aerospace and Technologies Corporation on numerous projects including low- and high-voltage power supplies for the Corrective Optics Space Telescope Axial Replacement for the Hubble Telescope.

The son of Harry and Alberta Vogel Fisher, he was born on October 15, 1927 in Cincinnati. Ronald married his wife of 58 years, Rose Ann, on April 16, 1955. She preceded him in death on August 25, 2013. He is survived by his son, Brian; four daughters: Jennifer (Reed) Thompson, Claudette (Ridgely) Fisher-Johnson, Hilary (Mark) Langston, and Priscilla (Patrick) Madden; his only sister Muriel Babcock; and nine grandchildren.

Source: *The Daily Camera*, December 20, 2015.

Nolan Vincent Frederick, 85, died of bladder cancer in Boulder, CO on February 20 2016.

Nolan was born on September 8, 1930 in Tooele, UT. He attended Provo High School, and played trumpet in the school orchestra, where he met his future wife Gwen Ence, who played clarinet. He would bring out that trumpet again on a couple of occasions much later in life, once to lead a fanfare for Dick Roberts on the occasion of his first visit to Boulder as the new Director of NBS, and once in an orchestral concert in a remote valley high in the Rocky Mountains, reachable only by a long and strenuous hike. Wes Hoyt remembers another activity of Nolan's youth that foreshadowed his later career as an engineer: he developed a fascination with the Cord automobile, which had sleek, modern styling and a straight-eight engine that made it very fast. It was so expensive that Nolan couldn't possibly afford to buy one in working order, so he combed the junk yards of Utah to find one that was salvageable, took it home and restored it.

In 1950 Nolan joined the Air Force as an electronics instructor. While he was stationed at Keesler Air Force Base in Mississippi he married Gwen, and then he received an honorable discharge in 1954. He and Gwen then moved to Boulder where Nolan started his 31-year career at NBS. He was a part-time student at the University of Colorado, and earned his M.S. degree in electrical engineering in 1970.

Nolan's NBS career began in the radio standards program, as an instrumentation engineer. He developed measurement techniques and calibration standards for the

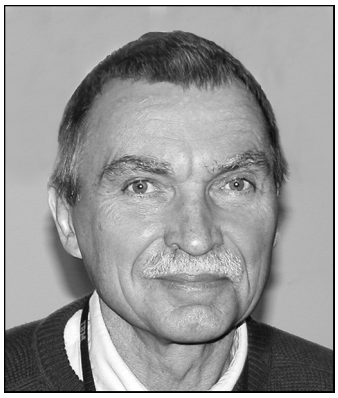
saturation magnetization of ferrites (1960) and for RF current (1968). Then in 1969 the Cryoelectronics Section was formed to explore the application of the Josephson effect and other phenomena at very low temperature to measuring instruments and standards. This was a new and wide-open field that really appealed to him—and he was one of the founding members. He worked mainly on the new possibilities for RF instrumentation and also took some interest in a possible new realization of the absolute ampere. Nolan retired in 1986, but returned to work on various projects in the chemical engineering program. He also founded a small company called Rocky Mountain Electron Video.

Nolan and Gwen were devout and very active members of the Mormon Church, holding several offices. They also took a very active part in the construction of a new church, which was funded by the local Stake and built partly by volunteer labor. It is a simple, elegant building, and Nolan's funeral was held there.

Nolan loved the great outdoors, with his usual energy and enthusiasm. He and Gwen went hiking and cross-country skiing. He became a skillful white water boatman, and took his friends and colleagues out for wild rides on the turbulent rivers of Colorado.

Gwen, Nolan's wife of 64 years, died in January 2015. Nolan is survived by his daughter Bobbi Ericksen, six grandchildren, and many great grandchildren.

Sources: Bobbi Ericksen, Bob Kamper, Wes Hoyt.



Dennis S. Friday, 75, of Boulder died at home on Sept 3, 2015. He was born in Norristown, PA to Sigmund and Frances (Konieczna) Friday. He received his B.S. in Electrical Engineering and his Ph.D in Mathematical Statistics from Penn State University. He married his wife Virginia in Seattle and they volunteered with the Peace Corps in Swaziland, Africa where he developed a program in power generation and carried out the funding, construction, and stocking of a technical library at the Swaziland College of Technology.

His early career included working for General Electric, Boeing, and Bell Research Laboratories.

Dennis joined the Statistics Division at NBS/Boulder in 1979. From there he transferred to the Electromagnetic Fields Division, where he worked on statistical characterization of electromagnetic interference and compatibility. In 1988 he became Deputy Division Chief under Ramon Baird and also served in this capacity under Allen Newell.

After a year in the Program Office in Gaithersburg, he assumed the duties of division chief when Allen Newell retired in 1996. The division went through several major reorganizations and name changes (Electromagnetic Fields, RF Technology, Electromagnetics) during his tenure as division chief. Dennis served as division chief until his retirement in 2008.

Dennis was much appreciated for unwavering support of staff and division programs. During his tenure, he supported many new programs including millimeter- and terahertz- wave metrology, millimeter-wave extrapolation, microwave imaging, test-zone characterization, non-linear network analysis, probe-position compensation, microwave materials properties, meta materials, quantum field strength probes, and scanned-probe microscopy.

Dennis was always passionate about knowledge, and strove to have an in-depth understanding of as many topics as he was able. He was a lifetime student and loved staying active, traveling, mountain climbing and exploring the wild parts of the world.

He is greatly missed. He is survived by his wife of 48 years, three children, three grandchildren, a brother, a sister, nieces, nephews, and many cousins.

Sources: Ron Wittmann, Mike Francis and the *Boulder Daily Camera*, September 27, 2015.

Anthony (Tony) Goodwin spent two 2-year periods as an early career researcher in the Thermophysics Division at NIST. The first (1987−88) was as a postdoctoral guest scientist in the group of Mike Moldover where he worked with spherical acoustic resonators, applying them to the determination of thermophysical properties of alternative refrigerants. He also participated in the primary acoustic thermometry program, working, in particular, on the highly precise determination of the thermal expansion of a spherical acoustic resonator by means of microwave resonance measurements. Returning to NIST (1991-1992) he worked on the development of a low-flow Doppler flow meter and the application of radio frequency re-entrant cavity resonators to the measurement of dielectric constant, phase boundaries, and density. During this two-year period, Tony took on the determination of low frequency relative permittivity, notably of water, and measurements of the dipole moment and vapor pressures of alternative refrigerants. Some 18 papers emerged from the work initiated in these few years at NIST.

In 1993, Tony was appointed as Assistant Director of the internationally renowned Center for Applied Thermodynamic Studies (CATS) at the University of Idaho, and as Affiliate Professor of Chemical Engineering and Adjunct Professor of Mechanical Engineering. He joined

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Schlumberger in 1998 as a Research Scientist and became a Scientific Advisor in 2007.

Anthony (Tony) Goodwin was born in 1961. On December 12, 2014, he died at the age of 53 from complications due to diabetes. He was an innovator and leader in the field of thermophysics, especially in its experimental aspects, and had a distinguished career as an author, journal editor, and leading member of the thermophysics community. The special December 2015 issue of the *Journal of Chemical and Engineering Data* was published in his memory for his "significant contributions to the advancement of experimental methods for the measurement of the thermophysical properties of fluids and to the advancement of chemical thermodynamics."

Source: *Journal of Chemical and Engineering Data*, December 2015.[45]

Edmond L.Graminski was born on October 14, 1929 in Dunkirk, NY. He died of cardiovascular disease on November 13, 2015 at his home in Adelphi, MD. He was 86.

Graminski completed a B.A. in chemistry (1952) and a Ph.D. in organic chemistry (1956), both at the University of Buffalo. He worked for Olin Mathieson Chemical Corporation (1955-1960) where he was a senior research chemist. His primary field of research was with boron and aluminum hydrides, organo metallics, and polymer synthesis, characterization and grafting. From 1960-1964 he worked for Harris Research Laboratories as a senior research chemist where he investigated organo sulfur chemistry, the chemistry of hair and textiles, and the mechanism of thiopyrimidine oxidations.

In 1964 Graminski joined the Applied Polymer Standards and Research Section of the Polymers Division in the NBS Institute for Materials Research. He conducted investigations on the relationships between the micro structure and the macro-properties of paper; the development of a mathematical model for paper; and and on measuring pulp fiber morphology by image analysis. In one specific project he and Russell Kirsch showed that by scanning photomicrographs of paper fibers, measurements could be made on them that would predict their properties when used to make recycled paper.[46]

In 1978-79 he participated in the Commerce Science and Technology Fellowship (ComSci) Program. He worked on the Policy Coordinating Committee staff and was a staff scientist on the subcomittee on Mines and Mining for the House Committee on Interior on Interior and Insular Affairs.

About 1980, Graminski transferred to the Bureau of Engraving and Printing, where his focus included anti-counterfeit measures to protect paper U.S. currency. He retired in 2001.

The author of numerous technical reports and papers, he was a member of Sigma Xi, the American Chemical Society, and the Chemical Society of Washington.

He is survived by his wife, Marla Reynolds Graminski; eight children: Jeanne Graefe, Gerard Graminski, Mary Livingston, Marla Levinsohn, Susan Mckee, John Graminski, Deborah Werden and Michael Graminski; 18 grandchildren; and two great-grandchildren.

Source: *The Washington Post*, November 16, 2015.

William "Mickey" Haynes*, a long-time SAA member and contributor to the *SAA Newsletter* died February 25, 2106. He was 73. We received news of Mickey's death too late in the production cycle of this newsletter to prepare a full obituary.

A memorial service will be held 11:00 a.m., March 21 (Monday) at the Mountain View United Methodist Church in Boulder.

We will run a full tribute to Mickey in the upcoming June 2016 *SAA Newsletter*.

Paul H. Krupenie, 84, died December 9, 2015. Born April 7, 1931 in New York, he was the son of Herman and Hilda Krupenie.

Over the course of his 32 year career at NBS/NIST he worked in the Heat Division (1957-1969), Optical Physics Division (1969-1977), Center for Consumer Product Technology (1978-1982), Law Enforcement Standards Lab of the National Engineering Lab (1983-1985), and Office of Weights and Measures (1986-1989). For part of his career he was associated with Arnold Bass and other UV/visible molecular spectroscopists. In 1966 he wrote a National Standards Data Reference report, "The Band Spectrum of Carbon Monoxide" which was widely cited.

Paul was a wine enthusiast and an expert speaker at many wine events in the Washington area. More than 40 years ago, he was a founding member of the NBS/NIST Wine Society (an extramural fellowship held in members' homes to learn more about wines and the grapes that go into them), which still exists today.

45 American Chemical Society *Journal of Chemical and Engineering Data*, December 2015, Memorial Issue in Honor of Anthony R. H. Goodwin, <http://pubs.acs.org/doi/abs/10.1021/acs.jced.5b00913>.

46 "SEAC and the Start of Image Processing at the National Bureau of Standards" by Russell Kirsch, NIST Virtual Museum, <http://museum.nist.gov/panels/seac/SEACOVER.HTM>.

He is survived by his wife, Norma S. Krupenie; children Madeline (Steven) D''Alessio and Robert (Ana) Krupenie; and four grandchildren.

Source: *The Washington Post,* December 11, 2015.

Herman Lee "Pete" Lantz, 88 of Thurmont, MD, died November 22, 2015. Born June 10, 1927 in Lantz, MD, he was the son of the late Milton and Pauline (Willard) Lantz. Pete joined the U.S. Army in 1950 and after completing his army service he worked at the Thurmont Shoe Company.

In 1967 he went to work for NBS and spent most of his career there in the Radiation Source and Instrumentation Division. He retired in 1989.

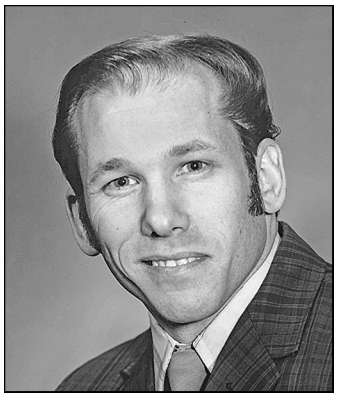
Pete was a life member and past commander of Edwin Creeger Post #168 of Thurmont where he proudly served in the Color Guard for over 50 years. He was an active member of the Thurmont AMVETS, Emmitsburg VFW, South Mountain Rod and Gun Club, Blue Ridge Sportsman's Association, Eagles Club, and The Owl's Club.

He loved working in his garden and giving his vegetables, especially his potatoes, to his friends. He always looked forward to spring when he could go mushroom hunting and loved to make homemade horseradish. The highlight of every year for Pete was when he held his annual crab party for his family and friends. His wife, Betty "Boots (Sweeney) Lantz died in 2006.

Pete is survived by one daughter, Lisa (Craig) Weant; one granddaughter; and many nieces and nephews.

Source: *The Frederick News-Post*, Nov. 25, 2015.

Owen Brede Laug* died January 27, 2016 at his home in Barnesville, MD. He had worked for NBS/NIST from 1959 to 1998 as a full-time employee, and then as a contractor until last year.



Born June 16, 1937 in Washington, DC, he was a long time resident of Montgomery County, MD first living in Rockville and then moving his family to Barnesville in 1975. He attended the University of Maryland at College Park where he was part of the Gymkana gymnastic troupe and received a B.S. in Electrical Engineering in 1959.

Owen interned at NBS during his college years and upon graduation was hired full time in the Electricity Division. In 1961, he transferred to the Instrumentation Division, where his work on fault isolation techniques for the Navy resulted in US patent 3490041.

Owen transferred to the Measurement Engineering Division in 1969, where he designed instrumentation to support other NBS researchers. He also worked on a tamper-resistant TV monitoring system for the US Arms Controls and Disarmament Agency and used by the International Atomic Energy Agency to support nuclear nonproliferation treaties. He designed an airspeed display indicator for the Navy (US patent 4415974), which later was used aboard aircraft carriers during the Gulf War. His work was recognized by a DOC *Silver Medal Award* in 1973.

Moving to the Center for Consumer Product Technology in the mid-1970s, he developed safety and efficiency test techniques for home appliances and aluminum wiring.

In 1981, he joined the Electrosystems Division in CEEE. Assisted by co-worker, Robert Palm, he designed and constructed a number of voltage and current power amplifiers—used in NBS/NIST power/energy, voltage, current, and phase angle projects and calibrations. His high-current, wideband transconductance amplifier, awarded US patent 4965529, became a commercial product that is still in use today.

While in the Electrosystems Division, later renamed the Electricity Division, Owen and co-worker, Mike Souders, patented the design of an integrated circuit analog comparator that outperformed commercial products. It was used in the NIST Sampling Voltmeter and pulse generator calibrations. Owen also developed a flat pulse generator to support the NIST Sampling Waveform Analyzer.

After retirement in 1998, he continued at NIST until recently as a contractor to advance development of electronic instrumentation. His expertise was highly valued and he was asked to stay on, gradually tapering off his workload. He and Mike Souders developed a calculable dc to 1 MHz shunt (a major accomplishment in ac current metrology) and an improved integrated circuit comparator.

With the continued assistance of Robert Palm, he designed and constructed new transconductance amplifiers for the Quantum Watt and the Synchrometrology Projects.

Owen loved tennis, gardening, cruising the world, and ballroom dancing. He was a dedicated member of the Monocacy Lions Club.

He is survived by his wife Bette B. Laug; sister Ruth P. Laug; daughter Cynthia J. (Dan) Coon; two sons – Eric C. (Lena) Laud and Brian D. (Evie) Laug; and six grandchildren.

Sources: *Frederick News Post*, Jan. 31, 2016, Tom Nelson.
—Nile Oldham

Robert S. Levine* was born June 4, 1921 in Des Moines, IA. He graduated from Iowa State University in 1943 with a B.S. in chemical engineering. He earned a S.M. (1946) and Sc.D. (1949) in chemical engineering

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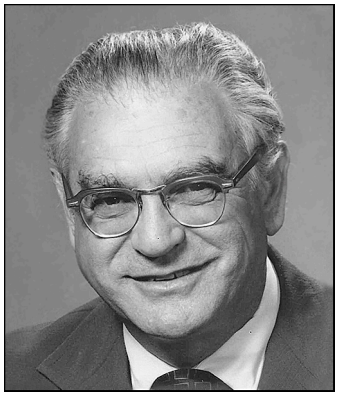


from the Massachusetts Institute of Technology.

After graduation from MIT he worked at the Rocketdyne Division of North American Aviation where he rose to be the Associate Research Director. In 1966 he moved to NASA to serve as chief, Liquid Propulsion Technology Branch in the Office of Advanced Research and Technology. In this role he planned and supervised the NASA program of liquid propulsion research related to liquid rockets, components and systems. In 1971 he shifted to the Space Applications Division at NASA/Langley.

Bob joined NBS in 1975 as the founding chief of the Fire Science Division of the new Center for Fire Research. In this role, he recruited and mentored the scientists who provided the foundations for the following decades of accomplishments of the fire program. In 1983 he became chief of the Office of Fire Research Resources which was responsible for the fire grants program. Subsequently, he served until his retirement in 1998 as a senior scientist.

The NBS/NIST fire program always has been a collaborative effort between fire science (seeking understanding of fundamental fire phenomena) and fire safety engineering (seeking effective and practical techniques to reduce fire losses including injuries and deaths). Bob's leadership, scientific knowledge, commitment to public service and effective teamwork contributed greatly to the accomplishments of the fire program.

In commenting on his death, John Lyons, said: "When I was putting together the CFR back in 1973-4, I went looking for someone to head up the Fire Science Division. After asking around, Bob's name came up. I talked to some colleagues who knew his work at NASA on jet engines and was told he had made a major contribution to solving a nagging problem with one of the launch rockets. His friends at MIT gave him a strong recommendation. I hired him as the division chief and the result was just as I had hoped. His role in building a world-renowned program in fire science at NIST and his role in riding herd on the many fire grants at universities and elsewhere made a lasting impact on the successes of the NIST fire research program. Bob was not only a good technical man but he was a kind gentleman, someone good to be with. He had an engaging smile, a good sense of humor, and had many good friends."

Jack Snell added: "Bob was an energetic scientist and a wonderful person. I entered the Fire Program in 1981 and got to know Bob quite well. He was active nationally in combustion research, and had contacts all over. In addition to his technical savvy, Bob loved people and and had a big heart and a persistent way of influencing others. For example, on my first visit to the Navy Fire testing labs in Norfolk, Bob insisted we stop by on the way to meet a good friend of his who, it turned out, was the President of Hampton University. It was a very special evening. Bob also maintained contact with the Soviet scientists he had become acquainted with over the early years of space technology development, and had little regard for those who harbored ill will towards the Russian people."

Dick Wright, who knew Bob both professionally and socially said, "I have known Bob as a scientist, manager, mentor, recruiter, friend and neighbor in Montgomery Village. He played a lead role in developing the fire-related chapters of the *BFRL History: 1975-2000* and crediting colleagues and collaborators for their contributions. His modesty seems to have kept him from emphasizing his personal contributions. The fire science team he assembled and led made possible today's performance-based fire safety engineering practices."

Bob died at his home in Montgomery Village, MD on January 29, 2016. He was 94. He is survived by his wife, Sharon L. (White) Levine, their chilldren, and grandchildren.

Sources: *The Washington Post*, Feb 3, 2016 and NIST archives.

Loren W. Linholm,* 70, of Ijamsville, MD died January 18, 2016 at Mercy Medical Center, Baltimore. The son of Earl Milward Linholm and Elizabeth (Harris) Linholm, he was born in Calexico, CA, November 14, 1945. He earned a B.S. (1968) and M.S. in Electrical Engineering from the University of California/ Berkeley and University of Mayland, respectively.

From 1968 through 1978 he worked for the DoD at Fort Meade. In 1978 he joined the NBS Center for Electronics and Electrical Engineering where he became a stalwart of the semiconductor metrology program.

In 1987, he received a *Silver Medal Award* for his "innovative leadership of a multiyear effort to provide the U.S. semiconductor industry with test structures for improving quality control and manufacturing efficiency in the production of integrated circuits. He has also been eminently successful in directing the transfer of this technology to industry, including DoD contractors for military applications." In 1998, Loren was elected a Fellow of the IEEE in recognition of his contributions to developing innovative microelectronic test-structure-based measurement techniques and procedures for monitoring semiconductor processes.

In 1984 he co-founded the *International Conference on Microelectronic Test Structures*, which has since met annually alternating between Japan, the United States, and

Europe. He had numerous publications in the semi-conductor field and on several occassions won best paper awards. Loren retired in 2003.

Loren was a quiet, modest man with a warm sense of humor. He leaves behind his wife of 47 years, Ruth Ann Linholm; son, Steven Loren; daughter, Emily Ann (George) White; two grandsons; sister, Linda (Mickey) Western; and numerous nieces and nephews.

Source: *The Frederick News-Post,* Jan. 20, 2016

Leo Joseph Maloney, 95, died peacefully at home on December 8, 2015. Born December 23, 1919 in Jersey City, NJ, Leo fell in love with the West as a member of the Civilian Conservation Corp. After serving in the WWII European theatre with the U.S. Army Air Corps he earned a degree in Electrical Engineering from the University of Colorado. There, he also met his future wife, Helene Joyce Gillis (now Relora Joyce) and they married in 1950.

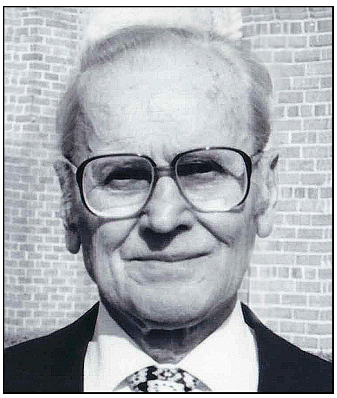
He spent most of his working life developing and building communication systems in Southeast Asia and Europe. He had some memorable stories about his experiences - including catching a cobra in the Philippines.

In 1951, he went to work for the NBS Central Radio Propagation Lab at the Cheyenne Mt. Field Station in Colorado Springs. He left NBS in 1970.

Leo helped co-found the NBS/Boulder Credit Union (now Elevations) and was a firm believer in giving back to the community. Following retirement, he volunteered for jail and hospital ministries and the Durango soup kitchen. He loved traveling and lived for several years in Costa Rica where, with the help of his sons, he constructed a house and farm in the tropical 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 (Mairi, Margaret, Monica, Matthew, Martin, Murdoch and Melanie); eleven grandchildren; and six great-granchildren.

Source: *The Daily Camera,* Dec. 18, 2015.



John Matwey,* 95, died November 12, 2015. Born on the Fourth of July, 1920 in Wilmington, Delaware, John served six years in the U.S. Navy on the battleship USS Alabama in both the North Sea and the South Pacific. John married Geraldine Conger in 1956 and together they raised three children. Geraldine died in July 2012.

John Matwey worked as an instrument maker and engineering technician at NBS from November 1948 to 1984. He was in the Shops Division until the late 60s when he moved to the Atomic Physics Division, and then in 1970 to the Analytical Chemistry Division.

Over his 36 year career at NBS as a highly skilled craftsman, John received several meritorious service awards. Descriptions of John's work in letters of commendation consistently include phrases such as: enthusiastic cooperation; unusual ability to plan and execute work to exacting dimensional tolerances; superior performance; careful planning; and great innovation,"

In 1961, John received a *Silver Medal Award* (group award with three others) "for outstanding accomplishments in supplying the mechanical support for the development of high precision instruments which substantially advanced scientific measurement research of international interest."

In 1977, he received a *Bronze Medal Award* for "excellence in the design and implementation of facilities and instrumentation in the Analytical Chemistry Division."

John retired in 1984. He is survived by his children: Ron (Faith) Matwey, Connie (Roger) Lipinski, and Patty Matwey; three grandchildren; and brother Benjamin.

Source: *The Washington Post*, Nov. 15, 2015 and NIST Archives.

Daniel Lewis Menis, 63, died unexpectedly in Indianapolis on November 30, 2015. Lewis. Born January 4, 1952 he was the son of Oscar and Ellen Menis. (Oscar joined NBS in 1965 as Chief of the Analytical Coordination Chemistry Section of the Analytical Chemistry Division. He died December 12 1979.)

Dan was educated at Carnegie Mellon University (B.S. chemistry, 1974) and Northwestern University (M.S. 1987 and Ph.D 1991, biological materials).

As a Research Assistant for the Paffenbarger Research Center of the American Dental Association, Dan worked at NBS in the Polymer Science and Standards Division from 1976 to 1984. After leaving NBS he worked for Northwestern University and the Harry J. Bosworth Co. in Chicago, as well as other dental manufacturers in Illinois and Indiana. During his career he earned multiple patents. He was a member of the American Chemical Society and an ASQ Certified Qaulity Engineer.

He is survived by his mother Ellen, sister Sara (Jay) Smith, and four brothers–Peter, Richard (Jane), Arthur, and Edward (Laurie Hoyt).

Source: *The Washington Post,* Feb. 14, 2016 and LinkedIn

Vernon Leroy Plummer, 67, of Poolesville, Maryland died at his home on November 30, 2015. Vernon joined NBS in 1967 and worked in the Administration Services Division and then the Management Services Division for more than 35 years.

Vernon was born August 24, 1948 in Poolesville. He was the son of the late Roy and Gladys Plummer.

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In 1996 he recieved the *Crittenden Award*, established by NBS in 1967, for superior achievement by permanent employees who perform supporting services that have a significant impact on technical programs beyond their own offices. Vernon was recognized for "consistently high-level performance and quality of work in providing printing and duplicating services to NIST staff."

He is survived by three children (Leroy and Deana Plummer and Vernon Lyles); one step-son, Johnathan Lyles; six grandchildren; two great-grandchildren; and three siblings. He was preceded in death by sister Edith Turner and brother Robert Plummer.

Source: Tributes.com

Robert J. Schaefer, 76, of Mt. Airy, Maryland, died November 15, 2015. Born June 9, 1939 in New Rochelle, NY he was the son of Robert A. Schaefer and Mary L. Newhall. He graduated from from Harvard University with a B.A. (1960) and Ph.D. (1964) in Applied Physics

After graduate school he went to work at the Naval Research Laboratory from 1964 to 1979 where he carried out research on solidification kinetics, holographic study of crystal growth, and laser processing on metals.

In 1979 he joined the NBS Metal Science and Standards Division in the Center for Material Science to conduct research on solidification processes, particularly rapid solidification effects resulting from surface melting and subsequent rapid refreezing of alloys. Through his research he determined the critical alloy compositions and solidification velocities needed to produce stable solidification interfaces that lead to greater homogeneity and major improvements in alloy properties. He designed techniques for measuring energy input during electron beam processing and for analyzing the resulting surface modifications. He received a *Bronze Medal Award* in 1983 for his work on rapid solidification.

Schaefer worked for NBS/NIST for 30 years and retired from the Metallurgy Division, where he was the group leader of the Metallurgical Processing Group for a number of years, in 2009.

He was member of the American Society of Metals, Metallurgical Society of the American Instituite of Mining Engrs, American Association for Crystal Growth, AAAS, and Sigma Xi.

An explorer and adventurer at heart, he greatly enjoyed the outdoors and made numerous canoeing expeditions in Arctic and sub-Arctic wilderness regions, primarily in the Barren Lands of northern Canada, and two in Siberia. He was an avid, life-long birdwatcher, and made many birding trips abroad including Ecuador, Peru, and Australia. He was also very active in local environmental organizations and served as president of the Audubon Society of Central Maryland and the Frederick Bird Club, and in many other positions and volunteer activities with these organizations.

He is survived by his wife of 41 years, Karin Wuertz-Schaefer; his daughter, Sylvia Schaefer; his sister, Lucile Henricks; and his brother, John.

Source: *The Frederick News-Post*, Dec. 15, 2015 and NIST Archives.

Douglas Spencer of Frederick, MD died at his home on November 25, 2015. He was 59.

Douglas was a veteran of the U.S. Air Force. After his honorable discharge, he began a thirty year career with NBS/NIST in 1981 in the Facility Services Division. He retired in 2011.

He enjoyed fishing, cheering on the Washington Redskins and drawing. His wife, Sonya Marie Spencer, preceded him in death in February 2015. He is survived by two brothers, John Warren Spencer (Jessica) and Mark Alan Spencer (Myra), and six nieces and nephews.

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

Marvin Washington, accounting officer and chief of the OFRM Finance Division, died on Jan. 16, 2016, after a yearlong battle with pancreatic cancer. He was 52 years old.

Washington earned his bachelor's degree in public administration from Virginia Tech University. He went on to work for the federal government for 28 years, coming to NIST in August 2008 from the FCC.

At NIST, his responsibilities included planning, executing and managing a comprehensive accounting operation, and overseeing financial reporting and policy implementation for NIST and other DoC bureaus, including the International Trade Administration and the National Telecommunications and Information Administration.

"The one word that I can use to describe Marvin was dedicated," says NIST Chief Financial Officer George Jenkins. "He was thoroughly committed to and very proud of his family. Marvin was also a consummate professional at work and always strove for excellence. He was a loyal and warm colleague ready to help others in any way he could. His smile was infectious and his countenance open."

"Marvin Washington was the most relaxed (laid-back) leader I have worked for in my 23 years in the NIST Finance Division," says Travel Group Leader Sheila Cook, who reported to Washington. "If he ever let the day-to-day demands of being a leader stress him out, it never showed. In group-leader meetings, he would often remark, 'It's not rocket fuel science,' when a problem seemed overwhelming."

Washington enjoyed planning family trips as well as working on his Corvette. "He would often joke about his wife not giving him enough allowance to buy a new engine," says Cook.

In addition to his wife, Dorothy, Washington is survived by their children, Meghan, Stephanie and Michael. He is also survived by his father, sister and brother.

—Gayle Swenson

Source: NIST internal website.

We Also Note:

We have received word of the death of **Karen Johnson**, wife of SAA member Don Johnson. Karen died on December 30, 2015.

We recently became aware that we failed to run an obituary a year ago for **Robert Wallace Medlock** who died on February 13, 2015. Medlock joined the Radidation Physics Lab in 1953 and retired in 1976.

As we went to press we received word of the deaths of two colleagues: **Andrew Donald Hamilton** joined NIST in 1988 (Electron and Optical Physics Division) and retired in 1999. He died February 27, 2016. **Thomas H. Bremer** joined NBS (Diamond Ordnance Fuze Lab) and retired in the mid-1980s from the Radio Standards Engineering Division. He died November 24, 2015.

We plan to run these obituaries in the June newsletter.

8. TRIBUTES

Robert John Soulen, Jr. succumbed to Parkinson's disease on November 19, 2015 after more than a decade of struggle with the ailment. Bob was born in Phoenixville, PA on July 16, 1940. He attended Rutgers University and was granted a B.A. degree in physics in 1962. He was awarded a Ph.D. degree in physics by Rutgers in 1966. Bob married Rosemarie Vosseler while in graduate school.

At Rutgers, Bob was Prof. Peter Lindenfeld's doctoral student, but he also benefitted from strong interactions with Professors E. A. Lynton, William McLean, and Bernie Serin. Including Lindenfeld, they were known as the Rutgers Superconductivity Group. Under their tutelage, Bob became a master at making electrical and thermal transport measurements at cryogenic temperatures. This experience led Bob to accept an offer of a position in the NBS Cryogenics Section of the Heat Division in 1968.

At NBS, Bob immediately began efforts to build or obtain commercially a 3He-4He dilution refrigerator (DR) that would eventually facilitate cryogenic studies at temperatures as low as 10 millikelvin (mK).

While working on his refrigerator quest, Bob collaborated with James Schooley in the development of a temperature reference device for the range 0.5 K to 7 K (ultimately to 9 K). The device contained five (later six) carefully annealed wire samples all enclosed within sensor coils; thus, the operator could monitor all of the individual transitions in one experiment. NBS registered the device as Standard Reference Material No. 767. It proved to be very popular within the cryogenics community. In 1976, a new provisional international temperature scale was created by the International Bureau of Weights and Measures (the French acronym is BIPM). The NBS SRM 767 device provided five of the eleven reference points on the scale.

Once his new refrigerator was operative, Bob developed another SRM, No.768, which could be used in the same fashion as the 767 device, but with five samples selected for the 16 mK to 200 mK range. Again, the SRM 768 offered easily observable, reproducible superconductive transitions for temperature references in a compact device.

Recognizing the significance of experimental work on noise thermometry performed in the NBS Boulder cryogenics laboratory during the late 1960s, Bob spent nearly twenty years applying the technique to the NBS low-temperature program. In this work, Bob collaborated with William Fogle and Jack Colwell, who were creating a composite temperature scale that involved the melting curve of 3He and the temperature dependence of paramagnetic salt susceptibility. The trio described their work in a pair of papers during a 1992 international temperature conference: "A new cryogenic temperature scale from 0.0063 K to 0.65 K" and "A decade of absolute noise thermometry at NIST using a resistive SQUID".

Following the meeting in 1992, the three scientists decided to pursue an absolute temperature scale that would extend deep into the millikelvin range. Their intention was to marshal all available very-low-temperature methods into one laboratory experiment, so as to minimize the level of experimental uncertainty. The results of this effort were encouraging. They recorded all of the experimental and theoretical progress in a 102-page paper that they published in the *Journal of Low Temperature Physics*. The paper included a thorough discussion of their resistively biased use of the Josephson junction and their experimental comparisons of temperature as derived from the SRM 768, from the Squid-based noise thermometer, from the 1976 provisional temperature scale, and from the 3He melting-curve results. Their work provided much of the basis for the international 2000 Provisional Low Temperature Scale from 0.9 mK to 1 K.

Bob's scientific reputation for excellence in his research grew throughout the cryogenics community. An adept experimenter, Bob also sought an understanding of the theoretical basis for his laboratory work. He was able in many cases to extend existing theory to new laboratory

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regimes. Bob received the 1976 NBS *E.U. Condon Award*, the 1979 DoC *Gold Medal Award* (shared with James Schooley), and the 2002 American Physical Society *Joseph F. Keithley Award for Advances in Measurement Science*. The Keithley citation reads "For developing low temperature noise thermometry to achieve an absolute thermometer which now defines the 2000 Provisional Low Temperature Scale between 1 mK and 1 K to an accuracy of 0.1 % and for other significant contributions to temperature measurement over a distinguished career".

Shortly after the discovery of high temperature superconductivity (HTS) in 1986, Bob moved to the Naval Research Laboratory (NRL), although he still participated in the cryogenic thermometry effort at NBS/NIST in his "spare time". Bob wanted to focus more intently on research in HTS. He brought with him his skills as a researcher and a leader. He quickly established a program focused first on vortex dynamics and the unusual behavior of the HTS materials in intense magnetic fields. Then, using his experience in noise thermometry, he turned to tunneling into magnetic and superconducting materials to gain a better understanding of the fundamentals of the superconducting state.

Although Bob spent the bulk of his career studying superconductivity, one of his major accomplishments in another area led to his most-cited scientific paper. Utilizing his knowledge of superconducting point contacts, he examined spin-polarized transport in magnetic metals. He performed a ground-breaking experiment that observed the transport of superconducting Cooper pairs into magnetic metals (Andreev scattering) that became a standard technique in the study of spin polarization in magnetic metals, including some novel materials called half magnets. Published in the journal *Science*, the paper, on which he was the lead author, has been cited more than 1000 times.

Bob and his colleagues also related their laboratory work to practical matters, including critical-current measurements, ac losses in superconducting tapes, and device characterization in the high-temperature superconducting space experiments (HTSSE).

Because of his inherent managerial ability, Bob was asked to head the NRL Material Physics Branch, with responsibility for directing research in magnetic materials, sensor materials, and materials synthesis and characterization. Administration was not Bob's "cup of tea", but his leadership in the multidisciplinary physics area was successful over a period of several years before he decided to return to his laboratory studies.

Bob's calm demeanor masked his many passions, his drive, and a well developed sense of humor. Besides physics, he enjoyed softball, fly fishing, fine wines, and good cigars. He shared his hobbies with family and friends, especially fishing and softball. His sense of humor once brought him to make a presentation while wearing hip waders during a laboratory review. The program manager had emphasized "come as you are" dress for the review, and Bob took him at his word.

For years, Bob and several colleagues enjoyed running at lunchtime. These events came to be known as "Bob runs", because the group often slowed to a walk while discussing family matters, recollections from his trips to China and Finland, details of tying fishing lures, and, of course, physics. In a single "run", it was not unusual for the conversation to include electron-phonon interactions, woolly bears (fuzzy caterpillars), and Voltaire.

Bob is survived by his wife of 52 years, Rosemarie; two daughters, Stephanie Harrington and Heidi Clark; and three grandsons. In the early 1970s Bob and Rosemarie lost an infant son, Robert John Soulen III.

As noted above, Bob contracted Parkinson's disease more than a decade ago, but he refused to capitulate to the ailment even as its symptoms became debilitating. An article in *The Washington Post* (June 29, 2010) described Bob's devotion to softball during the later stages of his affliction. He used a walker to approach home plate in games played in the 60-and-older Senior Montgomery County Softball League; he was a designated hitter in the lineups for both teams. Even as the Parkinson's disease progressed to its final stages, Bob wrote two books (self-published on Amazon) about his passion for softball and fly fishing.

Bob also continued to exercise his hobby of tying fishing flies, using feathers obtained from birds. The feathers also found places on the covers of specialty cigar boxes that he decorated for friends, and as components of artistic bird montages. We will not soon forget his scientific abilities, his friendship, his wit, his passion for life, and his courage in the face of certain death. We grieve for his family, but we rejoice in the life that he led.

—Jim Schooley, Don Gubser, Mike Osofsky,
Bill Fogle, and Stu Wolf

9. ASSOCIATION NEWS

Election Results

The proposed slate of nominees was elected in the voting for 2016-2017 SAA Officers. The terms run from April 2016 to April 2017.

President:	Jeffrey Horlick
VP:	Bettijoyce Lide
VP:	William Ott
Director:	Herbert Bennett
Director:	Harry Hertz
Director:	William Kirchhoff
Director:	Michael Kurylo

Portrait Gallery Ceremony Programs

We have a few copies of the 2015 NIST Gallery of Distinguished Scientists, Engineers and Administrators

program available on a first-come basis. If you would like one, contact the SAA Office.

SAA Membership

The SAA[47] currently has 480 members. Both retired AND current NBS/NIST staff are eligible to become members of the SAA and all are invited and encouraged to join.

Annual members	301
Life members	113
Honorary members	12
Spouse alumni	54

The annual SAA membership dues is $25.00. Or, you may purchase a Lifetime membership with a one-time payment of $20 times the number of years difference between your current age and 90 years. (At age 90, members are awarded Lifetime membership and no longer need to pay dues.)

In addition to the benefits of membership (e.g. quarterly newsletter, quarterly meetings and speakers, easy access to NIST and its library, the annual Portrait Gallery Awards Ceremony, and oral histories) you will also have opportunities to see longtime and new colleagues, to keep informed of NIST activities, and to make direct contributions to the SAA.

10. HISTORY

Whistle Why While You Work

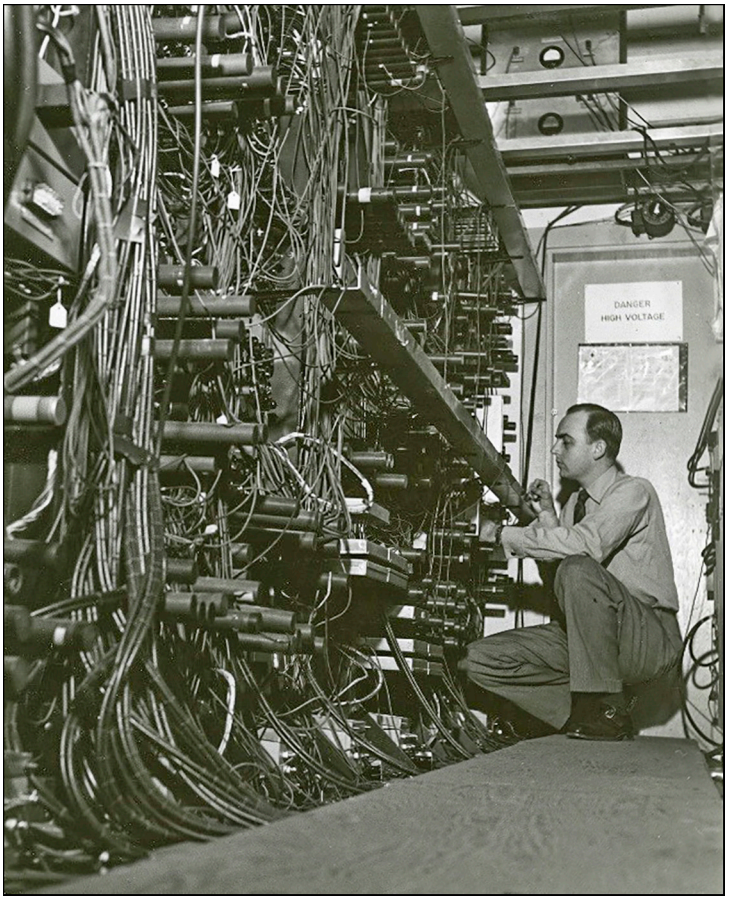
When Museum Curator, Kristen Frederick-Frost gave a presentation to the SAA meeting on January 14, one of the things she talked about was the SEAC (Standards Eastern Automatic Computer) built at NBS in the early 1950s and how she values the stories that provide context to artifacts in the museum collection.

Carla Messina, an audience member and former NBS "calculator" (her job involved using a paper spreadsheet to calculate thermodynamic properties), asked if Kristen knew that the SEAC whistled (she did not and was very interested!).

The whistling solved a practical problem. The SEAC used over 1,000 vacuum tubes and it was difficult to locate a broken tube (sort of like finding the problem bulb on a string of Christmas lights). Programmers came up with the idea of each row of tubes whistling when a tube in that row failed… they used the whistle tunes to determine if the iterations were converging (faster) or diverging (slower), making it much easier to narrow down the location of the problem.

The implications of the SEAC's musical ability were not lost on NBS staffers, and it was soon found to be carrying a tune. Carla reported that the SEAC whistled Dixie.

47 The SAA is an non-profit, 501(c)(3) organization.



Not to be outdone, soon enough the northerners on staff had SEAC whistling Yankee Doodle!

Kristen's NIST history talks are always fascinating, so mark your calendars for her upcoming colloquium with NIST Fellow John Butler about the history of forensic science at NIST on June 10. In the meantime, be sure to stop by the new exhibits in the hallway outside the museum… they relate to the context and meaning that accompanying notations or containers can give museum objects.

Source: NIST Library Blog

11. MISCELLANY

NIST Videos

There were two videos shown at the 43rd Annual NIST Awards Ceremony in December that members may be interested in.

The lead article in the December SA Newsletter was about the Preciaion Measurement Laboratory being named in honor of Katherine Gebbie. 'Katharine Blodgett Gebbie: A Tribute'[48] can be seen on nist.gov. In an ALLSTAFF email Willie May said "this video celebrates one of our most beloved NIST leaders and explains why we've tak-

48 "**Katharine Blodgett Gebbie: A Tribute**": <http://www.nist.gov/public_affairs/nist-boulder-lab-building-renamed-katharine-blodgett-gebbie.cfm>

(continued on next page)

en the unusual step (for NIST) of renaming the Precision Measurement Laboratory on our Boulder Campus in her honor."

'The Scope That NIST Built'[49] can be seen on NIST's YouTube channel. This video was created to highlight the large number of people across many different parts of our organization that are required to produce the world class research done at NIST – and to maintain our status as the World's foremost National Metrology Institute.

NIST Colloquium Series

The NIST Colloquium Series is NIST's premier distinguished lecturer series. The colloquium is an opportunity to hear the views of outstanding scientists, scholars, explorers, and technical leaders on technological areas of current interest. Colloquium speakers are invited on behalf of the NIST Director, and the talks cover a range of important technology trends and issues that impact NIST. All talks are scheduled at 10:30 a.m. ET in the Green Auditorium (VTC to Boulder and HML).

NIST Colloquium Series
2015-2016 (remaining) Schedule

March 25 **Elizabeth Baron**
Ford Motor Company
"Ford Immersive Visualization Env. Lab."

April 8 **Raj Khosla**
Colorado State University
"Precision Agriculture"

May 20 **Michael Riordan**
Physicist and Author
"A Bridge too far? The Demise of the Superconducting Super Collider"

June 10 **John Butler & Kristen Frederick-Frost**
NIST (co-sponsored by SURF Program)
"Washington's Detective X: Wilmer Souder and the Early History and Impact of NBS in Forensic Science"

The NIST Research Library has DVD copies of over 300 NIST colloquia going back 25 years. Recordings of current colloquia become available about a month after the talk. Employees may check out DVDs for a period of one week. Non-employees may listen to a recording using a computer in the Library. NIST has also begun to make videos of selected colloquia publically available on the NIST YouTube Channel.[50]

Source: NIST internal website.

49 "**The Scope That NIST Built**": <https://www.youtube.com/watch?v=G2Sku6jdoc4>

50 see youtube <http://www.youtube.com/playlist?list=PL10D71258D9D81CC3> for colloquia recordings.

When you come to a fork in the road, take it.

Huh!?!?!?!?

"Thanks," (we think) to Bill Gadzuk for pointing out this important traffic control sign by Gate F in Gaithersburg that he spotted around last Thanksgiving.

Bill initially credited it to someone channeling Yogi Berra's advice that "when you come to a fork in the road, take it" too literally.

However, after a few good natured rounds (of email, not drinks) between Bill and Rich Kayser (NIST Chief Safety Officer), the issue has been resolved successfully. Our thanks to Bill and Rich for this fun newsletter "filler"!!!

Yet, lest we leave this entire distracting issue unresolved in your minds, we should tell you that Rich reported that the sign has been removed and offered an explanation. There used to be a sign mounted above this sign directing incoming trucks to the right for inspection. When the decision was made not to use Gate F for truck inspections, the upper sign was removed. That deprived the lower sign of the context needed for it to make sense.

A good and reasonable explanation, but we are disappointed because we had hoped that like Elvis, Yogi was still alive and well somewhere.

So, do any members have other examples that Yogi might still be among us? Send them in if you dare!