APSNEWS
A PUBLICATION OF THE AMERICAN PHYSICAL SOCIETY
WWW.APS.ORG/PUBLICATIONS/APSNEWS

March 2015 • Vol. 24, No. 3

White House Budget Request
Page 4

APS Names its First Chief Executive Officer

The newly-restructured APS Board of Directors voted on December 15 to select Kate Kirby as the first chief executive officer (CEO) of APS effective February 2. The appointment was announced on February 5 by 2015 APS President Samuel Aronson in an email to APS members and staff.

"I am honored to be appointed as the first CEO of APS, managing the operations of the Society, and partnering with the elected leadership during this exciting time," Kirby said. "I am deeply committed to the success of APS in all its many facets."

Kirby has served as executive officer of the Society since July 2009. Along with the editor in chief and treasurer/publisher, the executive officer has managed the day-to-day operations of the APS.

In November 2015, APS members approved and the APS Council adopted sweeping changes to the APS governance structure. The changes included reconstitution of the APS Council and Executive Board as the new Council of Representatives and Board of Directors. The restructuring also created the new CEO position in charge of all aspects of Society operations.

Kate Kirby

Before coming to APS, Kirby served as senior research physicist and associate director of the Harvard-Smithsonian Center for Astrophysics (1988-2001), heading the Atomic and Molecular Physics Division. From 2001 to 2008, she served as director of the NSF-funded Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP) at Harvard-Smithsonian. She earned her bachelor's degree in chemistry and physics from Harvard and her Ph.D. from the University of Chicago. Kirby is a fellow of both APS and the American Association for the Advancement of Science.

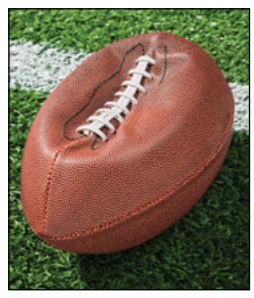
"Because of her experience and the trust that members, staff, and leadership have in her, we enthusiastically recommended to the new APS Board of Directors that Kate Kirby be hired as the first CEO to quickly and smoothly implement the transition to our new gover-

KIRBY continued on page 6

Early Fumbles in "DeflateGate"

By Michael Lucibella

Just weeks before fans settled in for the U.S. National Football League's Super Bowl game, physicists made headlines in the sports pages as the world was transfixed by the mystery of underinflated footballs. Scientists willing to weigh in on the burgeoning "DeflateGate" controversy were highly sought after in the news media, but even some of the country's top science communicators tripped up early on.



The controversy started on January 18, 2015, when Indianapolis Colts linebacker D'Qwell Jackson reported that the ball he intercepted during the American Football Conference championship seemed soft. After the game, the NFL announced that it found that eleven of the twelve footballs handled by the New England Patriots were underinflated by as much as almost two pounds per square inch, though it came out later that most were only off by a fraction of one psi.

Cheating allegations against the Patriots flew. NFL lawyers approached Columbia University experts, while numerous scientists weighed in publicly on the pressure inside the cold footballs.

In a series of hastily-put-together news conferences, New England Patriots coach Bill Belichick denied any impropriety and said that rubbing the balls coupled with the day's

FUMBLE continued on page 6

Balancing Freedom of Information and Academic Freedom

By Michael Lucibella

A recent report on the harassment of scientists through abuse of public disclosure laws highlights the tension between academic freedom and the public's right to government transparency.

In February 2015 the Union of Concerned Scientists (UCS) released the report *Freedom to Bully,* which examines the effect of freedom of information laws and calls for a broad effort to address how such laws should be applied to researchers. Speaking at the 2015 meeting of the American Association for the Advancement of Science, experts agreed that changing such laws would be difficult, but disagreed as to what should be done, or even whether laws should be changed.

Freedom of information laws, sometimes called sunshine laws, are intended to ensure that government activities remain open and accountable by allowing any citizen to request and receive certain government documents, including some emails. This means that if requested, researchers who receive government grants or work at public universities and institutions could potentially be compelled to release some of their records. These laws vary state by state, and the documents included or exempted vary as well.

"The use of open-records laws to access the email correspondence and other private information of scientists and other researchers is becoming more common," said Michael Halpern from the UCS. "While these laws are important for public accountability, excessive disclosure can chill scientific speech and make collaboration between researchers considerably more difficult."

The UCS report highlighted about a dozen researchers over the last 20 years from a variety of disciplines who have been the subject of massive records requests that Halpern characterizes as harassment. Few physicists seem to have been the target of such wide-ranging requests, but in principle any scientist with federal support, or in some jurisdiction, state or local government support, could be affected.

The primary targets have been researchers engaged in controversial work, including climate change, the health effects of tobacco, and animal experimentation. Professors at academic institutions have been forced to turn over every related document and email, written over many years, which disrupts their work in the process.

"Sunlight is good, it's helpful. We use Freedom of Information Act [FOIA] laws and open records laws all the time to find out how government does business," Halpern said. "[But] too much scrutiny can really constitute harassment."

Climate scientist Michael Mann at the University of Virginia is the highest-profile case. After having his email account hacked in 2009, an incident that became known as "ClimateGate," the same files were

FREEDOM continued on page 7

APS Fellow Alan Alda Brings Science to Life

*Alan Alda, one of Hollywood's most celebrated actors and writers, has a parallel career — communicating science and helping scientists communicate. Most famous for his role as Hawkeye Pierce in the acclaimed TV show M*A*S*H, Alda has gone on to win numerous awards for his acting and writing over a career spanning more than 50 years. He hosted PBS's* Scientific American Frontiers *for 15 years where he shared the work of scientists around the world, and starred in the early 2000s as Richard Feynman in the Broadway play "QED."*

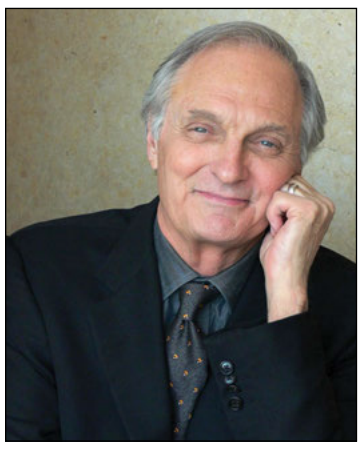
In 2009, he founded the Alan Alda Center for Communicating Science at Stony Brook University to help scientists learn how to better communicate their work to a wide audience. In 2012, he kicked off the "Flame Challenge," an annual contest in which scientists answer a seemingly simple but deep question posed by an eleven-year-old student — "*What is a flame?*" *or* "*What is sleep?*" *are examples. Alda recently spoke with Michael Lucibella of* APS News*, after being elected a 2014 fellow of APS for his contributions to science education and communication.*

What's the root of your passion for science? Where did this interest in science come from?

You know I get asked that a lot and I don't really know because I always had it. As a kid I used to do what most kids do, what I thought were experiments, mixing tooth paste and my mother's face powder to see if I could get it to explode.

Did it ever work?

My parents would explode sometimes. I was an amateur inventor. I drifted away from my interest in science with some not-so-happy experiences with biology teachers who didn't appreciate questions. But since my early twenties, I just read about science because it's thrilling. It's a great adventure and it's a wonderfully engaging detective story that never ends. I just love it.



centerforcommunicatingscience.org

Alan Alda

What made you decide on a career in show business and then why did you circle back to do more with science?

First of all, I grew up in show business. My father was an actor, and I stood in the wings watching him and other actors since I was about two years old. I have very vivid memories of that, and that's how I knew what I wanted to do in my life. And to write — I wanted to write even before I became an actor. When I was asked to do the television show *Scientific American Frontiers*, I don't think they realized I really had an interest in science and they were I think kind of surprised when I asked if I could not just read a narration, but actually interview the scientists on camera. Because that way I knew I would get a chance to spend a day with them and find out more about their science than just a glancing encounter with a narration. That was twenty or twenty-five years ago, and since then I have been working really seriously in trying to help scientists communicate with the public and with policy makers and with one another in fact. I'm really very excited about the progress that we've made.

Is there a particular story or encounter that really sticks in your mind from your time at *Scientific American Frontiers* that exemplifies why science communication is important?

Surprisingly, you might expect me to refer to a time when communication wasn't so good. In fact it was the times that it was terrific that made me realize I had something that I could offer to scientists. That was because the conversations between us were true conversations. They were warm and human, and they weren't conventional interviews where I just tossed questions to them and they could go into lecture mode. They actually had to contend with me really wanting to know and to understand. That warmed them up to me in a way I had never seen in a

ALDA continued on page 6

Members in the Media

"I think Belichick is better at keeping pressure on the passer than passing a physics test."

***Robert Kirshner**, Harvard University, on the explanation from the coach of the New England Patriots of the air pressure changes in their footballs,* The New York Times*, January 27, 2015.*

"I'll be entirely straight and upfront with the president and make my advice as cogent and useful to him in making his decisions as I can."

***Ashton Carter**, during the Senate hearing to confirm him as secretary of defense,* The New York Times*, February 12, 2015.*

"I feel that very rarely have I done any work in my life. I have a good time. I'm exploring. I'm playing a game, solving puzzles, and having fun, and for some reason people have been willing to pay me for it. Officially, I was supposed to retire years ago, but retire from what? Why stop having a good time?"

***Charles Townes**, University of California, Berkely, who died on January 27, 2015, in an interview with* Esquire Magazine *in 2001,* The New York Times*, January 28, 2015.*

"Even 50 years later [the discovery] remains one of the profound mysteries of the early universe."

***A. J. Steward Smith**, on the discovery by Val Fitch and James Cronin of CP symmetry violation. Fitch died on February 7, 2015,* The Washington Post*, February 8, 2015.*

"We were largely left alone. … We did our own thing, and no one came around and asked any questions. We just sat there and watched the mesons go by."

***Val Fitch**, Princeton University, who died on February 5, 2015, on his experiments with James Cronin that revealed violation of CP symmetry,* New York Times*, February 10, 2015.*

"For the past 35 years, theoretical physics has been an extravaganza of model-building, [and theories have] sort of run amok."

***Neil Turok**, Perimeter Institute for Theoretical Physics, on recent data ruling out claims of gravitational wave detection by BICEP2,* physicsworld.com*, February 3, 2015.*

"The fact that additional analysis makes BICEP's original measurement less significant should not be viewed as a failure of science. Indeed, I think it should be viewed as a strong affirmation of the scientific method."

***Don Lincoln**, Fermilab, on the results of further analysis of BICEP2 and Planck data,* nbcnews.com*, January 30, 2015.*

"I used to think I was taking the road less traveled … . But then I realized, I'm making the road."

***Ágnes Mócsy**, Pratt Institute, on her career path as a theoretical physicist and artist,* scienceline.org*, February 11, 2015.*

"I never considered my 1,500 unsuccessful experiments as failures, because there was development each time. I believed if I had enough time I could make it."

***Hiroshi Amano**, Nagoya University, on his research on light-emitting diodes that won him a Nobel prize,* South China Morning Post*, February 9, 2015.*

"When a chocolatier tempers chocolate, what he's doing is creating the right type of crystal structure, the type that melts in your mouth and not in your hand, the type that has that glassy appearance, the type that has that sharp snap when you break a piece."

***Joshua Erlich**, College of William & Mary, on applying physics to making fine chocolate,* smithsonian.com*, February 13, 2015.*

"We supposedly have a theory that tells us how these particles are supposed to behave and in principle it should open new doors. But in practice, our ability to calculate is quite limited."

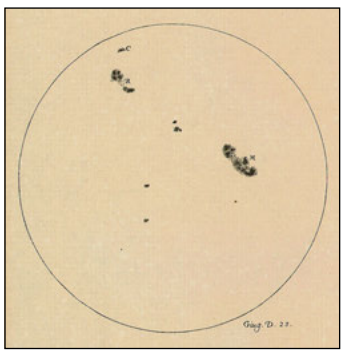
***Frank Wilczek**, MIT, on discovery of two new particles at the LHC,* scientificamerican.com*, February 12, 2015.*

This Month in Physics History

March 9, 1611: Dutch Astronomer Johannes Fabricius Observes Sunspots

Jules Verne's classic science fiction novel, *From the Earth to the Moon*, mentions a 17th century astronomer named Johannes Fabricius. In the novel, Fabricius claims to have seen through a telescope alien beings living on the moon. The aliens are fiction but Fabricius was real. The Dutchman was among the first people to observe sunspots through a telescope and the first to identify them as such — a small but vital contribution to astronomy when the field was at a crossroads between two competing models of the solar system.

The question of who first observed sunspots was the subject of bitter dispute in the early 17th century, although such arguments seem moot in light of so many earlier accounts by ancient astronomers. For instance, surviving Chinese records from 364 BCE indicate a possible sighting of sunspots, and by 28 BCE there were numerous mentions of the phenomenon in official records kept by Chinese astronomers. In 807, a Benedictine monk named Adelmus wrote an account of seeing Mercury pass in front of the sun, but in reality he saw a sunspot. There are similar sightings from the 12th century, also mistakenly interpreted as planetary transits. Johannes Kepler observed a sunspot in 1607 using a camera obscura. However, he too thought it was Mercury transiting the Sun.



The Galileo Project/galileo.rice.edu

One of the drawings made by Galileo during his observations of sunspots.

wikimedia commons

Title page of Fabricius' De Maculis in Sole observatis et apparente earum cum Sole conversione, Narratio (1611).

Historians generally agree that it was the English astronomer Thomas Harriot who first used a telescope to observe sunspots in late 1610. Galileo made similar observations around the same time, accompanied by elegant sketches of the sunspots, although he didn't study them seriously until 1612, and didn't publish his findings until 1613. So did a Jesuit mathematician named Christoph Scheiner in October 1611, equipping his telescope with colored glasses and publishing *Tres Episolae de Maculis Solaribus Scriptae ad Marcum* a few months later under a pseudonym. Scheiner argued that the sunspots were solar satellites. In his mind, the sun could not have spots on its surface, marring its perfection, in keeping with the Ptolemaic notion of a perfect, unchanging sky.

Galileo begged to differ, insisting in a series of three letters in 1612 that the spots were more akin to clouds and hence likely to be found in the atmosphere or the surface of the sun. So the motion was evidence of the Sun's rotation about its axis, thereby providing a key piece of evidence in support of the still-controversial Copernican model of the solar system. The third such letter may have been the first time the great astronomer expressed a positive view of the controversial Copernican system. But he was not the first to challenge the notion of sunspots as satellites — that honor belongs to Johannes Fabricius.

Born Johan Goldsmid in 1564 in a village called Osteel in northwest Germany, he was the oldest son of a Lutheran pastor and astronomer, David Fabricius. His father discovered the first variable star, Mira Ceti, in 1596. Initially, Fabricius senior believed he had seen a typical nova, but the star brightened again in 1609, and he realized this was a new kind of star.

Much of Johannes' early education in math and science took place under his father's tutelage, but the support of a wealthy patron eventually enabled the young man to pursue a more formal education, first at the University of Helmstedt, and then at the University of Wittenberg and the University of Leiden. It was in Leiden that Johannes encountered his first telescope — then an exciting new invention — and he brought one home to show his father in the winter of 1610.

On March 9, 1611, father and son rose at dawn and spied several dark spots on the surface of the sun through the telescope. But direct observation, even just before sunrise or sunset, caused considerable pain to their eyes. As Johannes later wrote, "For indeed it was to be feared than an indiscreet examination of a lower sun would cause great injury to the eyes, for even the weaker rays of the setting or rising sun often inflame the eye with a strange redness, which may last for two days, not without affecting the appearance of objects."

Given the risk to their eyesight, the duo switched to a camera obscura (a basic pinhole camera also favored by Kepler for solar observations) for subsequent sightings over the next few months, and began tracking the movement of the spots. The spots moved across the face of the sun, disappeared on the western edge, and then reappeared on the eastern edge two weeks later.

Johannes correctly concluded that the spots were on the sun's surface, rather than being the result of clouds or planetary transits. He wrote and published a 22-page pamphlet on their findings: *De Maculis in*

SUNSPOTS continued on page 3

APSNEWS

Series II, Vol. 24, No. 3
March 2015

Editor . . . . . David Voss
Staff Science Writer . . . . . Michael Lucibella
Art Director and Special Publications Manager. . . . . . Kerry G. Johnson
Design and Production. . . . . . Nancy Bennett-Karasik
Proofreader. . . . . . Edward Lee

APS News (ISSN: 1058-8132) is published 11X yearly, monthly, except the August/September issue, by the American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, (301) 209-3200. It contains news of the Society and of its Divisions, Topical Groups, Sections, and Forums; advance information on meetings of the Society; and reports to the Society by its committees and task forces, as well as opinions.

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding *APS News* should be directed to: Editor, APS News, One Physics Ellipse, College Park, MD 20740-3844, Email: letters@aps.org.

Subscriptions: *APS News* is an on-membership publication delivered by Periodical Mail Postage Paid at College Park, MD and at additional mailing offices.

For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Changes can be emailed to membership@aps.org. **Postmaster:** Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

Coden: ANWSEN ISSN: 1058-8132

Diversity Corner

2016 APS CUWiP Sites Announced

APS Conferences for Undergraduate Women in Physics (CUWiP) are three-day regional meetings for female undergraduate physics majors. The 2016 conferences will be held January 15-17, 2016, at nine regional sites.

- Black Hills State University
- University of California, San Diego
- Georgia Institute of Technology
- Ohio State University
- Old Dominion University/Jefferson Lab
- Oregon State University
- Syracuse University
- University of Texas, San Antonio
- Wesleyan University

For more information, please visit www.aps.org/programs/women/workshops/cuwip.cfm

M. Hildred Blewett Fellowship

APS is now accepting applications for the M. Hildred Blewett Fellowship. This award is intended to enable women to resume physics research careers after an interruption. The deadline to apply is June 1, 2015. For more information, please visit: www.aps.org/programs/women/scholarships/blewett/

Nominate a Women or Minority for an APS Honor

If you make a nomination for an APS prize or award or for APS Fellowship, please keep in mind possible women or minority candidates.

The criterion for election to Fellowship and further information on the Fellowship nomination process can be found online at www.aps.org/programs/honors/fellowships/

For information on nominating an APS member for APS prizes and awards, please visit www.aps.org/programs/honors/nomination.cfm

Physics Department Climate Site Visits

APS has a long-standing interest in improving the climate in physics departments for underrepresented minorities and women. The Committee on the Status of Women in Physics (CSWP) and the Committee on Minorities both sponsor site visit programs.

For more information on the Climate for Women in Physics Site Visit Program, visit: www.aps.org/programs/women/sitevisits/

For more information on the Climate for Minorities in Physics Site Visit Program, visit: www.aps.org/programs/minorities/sitevisits.cfm

Update Your Department's Female-Friendly Graduate Program Survey

CSWP has facilitated the collection of responses to a series of questions about graduate programs in physics that should be helpful to those interested in assessing the climate for women at various graduate schools. You can find department responses to a short series of questions at: www.aps.org/programs/women/female-friendly/

All responses are self-reported by department chairs (or their assignees). To update your university's responses, please contact women@aps.org.

SUNSPOTS continued from page 2

Sole observatis, et apparente earum cum Sole conversione, Narratio (*Account of Spots Observed on the Sun and of Their Apparent Rotation with the Sun*). His father, David, disagreed with his son's conclusion, still clinging to the old Ptolemaic cosmology.

It was the first published scientific treatise on sunspots. But Johannes' pamphlet languished in obscurity, perhaps because he lacked a sufficiently influential patron and was rather isolated from the leading astronomers of the day. While Kepler read the pamphlet and admired it, Galileo and Scheiner were mostly likely unaware of its existence when they published their own sunspot treatises in January and March 1612, respectively.

Johannes died at 29 in 1617 from unknown causes. His father died the following year under bizarre circumstances: He denounced a local peasant for steeling a goose, and the enraged man killed the pastor by striking him on the head with a shovel. While neither achieved fame, there is a monument to them in an Osteel churchyard.

All those sunspot sightings, combined with the moons of Jupiter and other mounting evidence, constituted a tipping point among astronomers, including Scheiner, who abandoned his earlier stance that sunspots were solar satellites within ten years. The Copernican model of the solar system replaced the old Ptolemaic model within a generation. Sunspots have continued to fascinate scientists ever since.

Further Reading:

Mitchell, W.M. (1916) "The History of the Discovery of Solar Spots," *Popular Astronomy* 24: 22-ff.

Profiles In Versatility

A Sweet Sound: Physicists Reconstruct Primitive Recordings

By Alaina G. Levine

In the early 2000s, Carl Haber was quietly pursuing precision measurement projects at Lawrence Berkeley National Laboratory. An experimental particle physicist, he was spending most of his time designing and building optical devices to measure the telltale trajectories of particles as part of the ATLAS experiment at the Large Hadron Collider at CERN. The story goes that Haber had an epiphany while stuck in Bay Area gridlock listening to a radio interview with Grateful Dead drummer Mickey Hart.

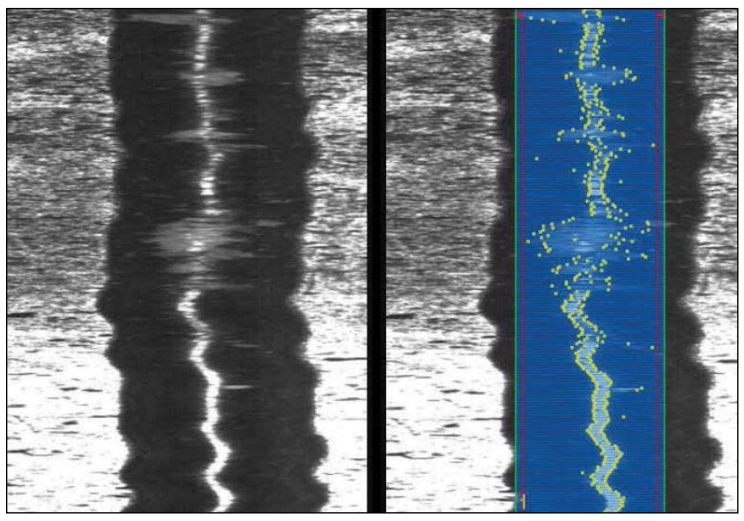
Roy Kaltschmidt/Lawrence Berkeley Laboratory

Carl Haber (left) and Earl Cornell developed techniques for recovering sound from old recordings.

Hart is an ethnomusicologist and recording preservation expert. He was explaining his frustration with handling and archiving old, delicate sound recordings recorded with obsolete technology. Listening to these relics today would be like trying to play eight-track tapes with your iPod.

"That was the moment I saw this connection between optical metrology and recordings," says Haber. Perhaps, he reckoned, some of the precision optical tools his team was using to analyze and construct the particle trackers could also be used to measure and image the sound recorded in the grooves on wax cylinders, foils, and other early recording mechanisms used since the 1800s.

Haber began exploring the topic of music preservation and the tools being used to listen to older recordings. "I started discussing the issue with Vitaliy Fadeyev, who was a postdoc working in our group on ATLAS," he recounts. Fadeyev was also very experienced with optical metrology, and in October of 2002, he tried an experiment to scan just a bit of a phonograph record he and Haber had been looking at, using one of the tools they had in the lab. "He showed that the process could work in principle," says Haber. "We then wrote a paper about this together and sent it to folks at the Library of Congress." The idea was "to acquire digital maps of the surface of the media, without contact, and then apply image analysis methods to recover the audio data and reduce noise," he writes on his website dedicated to the project (irene.lbl.gov). The Library liked the proposal and provided seed funding.



C. Haber, Phys. Today 67, 68 (2014).

Grooves in flat disc recordings encode sound in side-to-side oscillations (left) which can be mapped with software algorithms (right).

In collaboration with his colleague Earl Cornell, a nuclear physicist who joined the project in 2004, Haber used the financial support to develop different scanning systems to recover audio tracks from the two grooved media — discs and cylinders — utilized in early recordings. Their first device, which they dubbed Image, Reconstruct, Erase Noise, Etc. (IRENE), creates 2 D images of the discs (with grooves cut by a stylus that moved side-to-side) with microphotography. For cylinders (where the grooves were made by a stylus that moved in and out of the surface), they repurposed a confocal microscope to obtain better, more detailed images of the media in three dimensions, which microphotography could not do. Cornell created an extensive software package to analyze the data and handle the diverse formats and conditions of these media.

The technology that Haber and Cornell developed quickly became a game-changer in audio preservation. Not only did it enable sound from the earliest known recordings (made over 150 years ago) to be extracted and heard from extremely delicate media, but it also can help fix scratched or broken media. As they used it to rebuild sounds from the old media, they discovered a few surprises. They were able to hear the earliest known recording of Alexander Graham Bell and his collaborators. "One recording came from Bell's lab, and it was really clear they were testing stuff and something didn't work and they used a profanity," chuckles Haber. "It is one of the worst words in the English language."

The staff of the Museum of Science and Innovation in Schenectady, NY, heard about their efforts and approached them with early recordings made by a machine that Thomas Edison had built. The sounds had been recorded on embossed foil, and then wrapped around a cylinder for playback. But the foil had been folded and stored in an envelope, and by the time the team got hold of it, much of it was shredded. Still, using their device, they were able to transfer the sound to a digital file. The recording was originally made in June 1878.

"The history contained in these artifacts is interesting and we don't know how long they'll last," says Cornell. "Having digital representation is important … and it is [amazing] to hear Alexander Graham Bell's voice."

The Library of Congress partnership led to financial arrangements with the National Endowment for the Humanities, the National Archives, and the Smithsonian Institution. And in 2013 Haber was awarded a MacArthur Fellowship, which will provide his team $125,000 of unrestricted funds annually for five years.

So far, Haber and Cornell have built five systems, which are installed at Berkeley Lab, the Library of Congress, the National Audio-Visual Conservation Center (part of the Library of Congress), the Northeast Document Conservation Center in Andover, Massachusetts, and the Roja Muthiah Research Library in Chennai, India. "We could see a need for more machines here in the U.S., Canada, and elsewhere," says Cornell. The MacArthur Fel-

RECORDINGS continued on page 7

Smartphones in the Classroom Help Students See Inside the Black Box

By Tamela Maciel

Cell phones have proliferated among high school and college students, and these pocket-size computers have become essential tools in physics classrooms. Sporting a range of sensors, smartphones offer educators and students a familiar device that can perform many of the same functions as expensive lab equipment. However, advocates of smartphones in the lab are also stressing the need to teach students how phone sensors work in order to properly interpret their results.

"Ironically, nearly all students walk into [physics] laboratories in possession of a personal device with many — if not all — of the data collection capabilities they need: their smartphones," said Colleen Lanz Countryman, a physics education Ph.D. student and physics lab instructor at North Carolina State University.

Most smartphones today come equipped with internal sensors that can measure acceleration, orientation, audio volume, light density, and even magnetic field strength. Smartphone apps like SensorLog and AndroSensor can record and store data from the sensors for further analysis.

Lanz Countryman observes that limited funding is pushing teachers to think twice about investing in expensive lab equipment, and that smartphones may help fill the gap. She notes that, "In the past few years … I have noticed an increase in curiosity regarding the utilization of smartphones in labs." In the classroom, Lanz Countryman has observed that smartphone labs "spark initial excitement" among students who are curious to discover "unknown capabilities of their own devices."

Physics teachers and education researchers commonly believe that students learn a physics concept more deeply if it is explored experimentally with familiar everyday tools. "Results of pilot studies in physics (both high school and university level) show that using such devices as experimental tools could foster conceptual learning," said physics education researchers Jochen Kuhn and Patrik Vogt in an email. Kuhn and Vogt are also the editors of iPhysicsLabs, a column dedicated to smartphone physics in *The Physics Teacher* journal.

But the smartphone can become another black box in the lab. Recently Lanz Countryman wrote an article (1) for *The Physics Teacher* in which she highlighted the need for students to understand how their phones actually measure physical quantities. She noted that a "common 'tripping point' for students" is the fact that a stationary smartphone displays an acceleration of 9.8 m/s^2. By describing the internal acceleration sensor as a suspended test mass, a teacher can help students understand this measurement.

The adoption of smartphones

Colleen Lanz Countryman/NCSU

Physics lab students use the smartphone gyroscope sensor to measure angular velocity at North Carolina State University.

in the classroom has been growing over the past few years, and in 2012 *The Physics Teacher* started the iPhysicsLab column in order to highlight their use in introductory physics labs. The first article, by Kuhn and Vogt, described a simple way to study free fall and gravity by dropping a smartphone onto a cushion and recording data during the fall. Since then iPhysicsLab has featured a range of smartphone experiments, including measuring the speed of sound in a pipe, analyzing pendulum motion and decay, and even testing the laws of radioactivity with a smartphone camera sensor.

Once students have been introduced to a data collection app, some naturally take it out of the classroom. "In a self-reported survey, some students admitted to using the apps while skateboarding down a hill and riding in an elevator," said Lanz Countryman. Kuhn and Vogt have also described outdoor experiments on swings and amusement parks in the *European Journal of Physics Education* (EJPE) as well as in a variety of iPhysicsLabs columns.

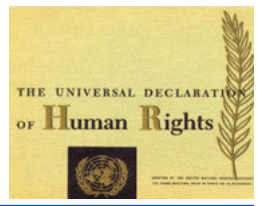
Smartphone-aided physics education is still relatively new, and Kuhn, Vogt, and Lanz Countryman are among the few researchers studying the impact of smartphones on student learning. Since 2010, Kuhn and Vogt have surveyed groups of both high school and undergraduate physics students and found that the groups using smartphones as experimental tools seem to have a greater sense of independence in the lab and a better conceptual understanding of physics; part of this work appeared in the EJPE early this year (2) and will appear in greater detail in a new book entitled *Multidisciplinary Research on Teaching and Learning* to be published by Palgrave Macmillan in April.

On the technical side, smartphone apps may soon be capable of much more. "The data collection apps currently available are only in their infancy," said Lanz Countryman. More creative and user-friendly data collection apps are sure to follow as interest within the physics teaching community grows.

References

1. *Phys. Teach*. **52**, 557 (2014).
2. *Eur. J. Phys*. **36,** 015004 (2015).

APS Committee on International Freedom of Scientists



Since its creation in 1980, the APS Committee on International Freedom of Scientists (CIFS) has advocated for and defended the rights of scientists around the globe.

Abduljalil Al-Singace

In December 2014, CIFS wrote to the King of Bahrain to express its concern over the poor conditions in which Abduljalil Al-Singace, a professor of mechanical engineering, is incarcerated. Al-Singace is a prominent engineer and human rights activist who has been imprisoned since 2011. He was sentenced to life in prison for allegedly plotting to topple the government of Bahrain. He has reportedly been tortured while in prison, and has been denied medical treatment and visits from his family. CIFS has requested that he be given a medical furlough to receive proper medical treatment.

Baha'i Educators in Iran

CIFS wrote to Iranian authorities in December 2014 to urge them to unconditionally release several educators from the Baha'i Institute of Higher Education (BIHE) who have been detained since May 2011. In Iran, members of the Baha'i religion are forbidden to pursue higher education, starting at the high school level. As a result, the Baha'i community has created BIHE - its own, informal higher education system. Several BIHE educators were arrested in a raid on over 30 homes in May 2011 and have been detained since. Since 2012, CIFS has urged the Iranian government to reconsider its policy of barring Baha'is from pursuing education and to release the imprisoned BIHE educators.

Sergey Kalyakin

Sergey Kalyakin, a Russian scientist who is an expert on the safety of nuclear reactors, was arrested in November 2013 on charges of embezzlement and fraud. He completely denies the charges and has received the support of over 700 members of his institute, who have called for an appeal of his case. In December 2014, CIFS urged Russian authorities to permit Kalyakin to remain at home prior to his trial so that he may recuperate from health problems that have worsened during his confinement.

Omid Kokabee

In February, the American Association for the Advancement of Science (AAAS) and APS sent a joint letter to Ayatollah Ali Khamenei, the Supreme Leader of the Islamic Republic of Iran, requesting that he release physics graduate student Omid Kokabee from prison on humanitarian grounds. On February 13, Kokabee received the 2014 AAAS Scientific Freedom and Responsibility Award. APS also recognized Kokabee's efforts when it awarded him the APS Andrei Sakharov Prize in 2014 for his refusal to "use his physics knowledge to work on projects that he deemed harmful to humanity, in the face of extreme physical and psychological pressure."

Andrew Sessler

As many *APS News* readers know, the physics and human rights communities lost a great advocate when Andrew M. Sessler, a former APS president, passed away in April of last year. In his honor, the AAAS-Andrew M. Sessler Fund for Science, Education, and Human Rights, established with a gift from his children, supports activities that spur interest in human rights among science and engineering students and increase the ability of human rights practitioners to bring scientific methods and technologies into their work in the field. On October 23, 2014 the AAAS Science and Human Rights Coalition, on the occasion of its fifth anniversary, offered a tribute to Sessler, presented by APS Director of International Affairs Amy K. Flatten and Juan C. Gallardo, who is the APS representative to the AAAS coalition and a former chair of CIFS. For more information on the fund, see www.supportaaas.org/AndrewMSesslerFund

President Proposes Increased Science Funding

By Michael Lucibella

The Obama administration called for a 5.5 percent increase in federal scientific research and development funding in its budget proposal for fiscal year 2016. The proposal, which was released on February 2, 2015, calls for rolling back spending caps imposed by sequestration, and increasing the discretionary budget by about 7 percent overall. "Sequestration" refers to automatic budget limits imposed by a law passed to avoid U.S. government default in 2011.

Altogether, the request calls for about $8 billion more for science and research than last year, bringing the total to $146 billion spread across a dozen or so federal agencies. The largest chunk of that, $76.9 billion, goes towards defense research and development, with $68.8 billion allocated for the non-defense agencies.

In effect, the budget request is the beginning of a long, often acrimonious negotiation between the White House and Capitol Hill. The document is a proposal sent from the administration to Congress outlining the priorities of the administration for the next fiscal year, which begins October 1.

This budget in particular has little chance of passing in its current form because of Republican resistance to increased spending. Already the Republican leadership in both houses of Congress has sharply criticized the proposal. After the recent change in leadership in the Senate, Republicans now control both houses of Congress and can pass their own version of the budget, which the president may veto.

The proposal shows a continued commitment to scientific research. The Department of Energy's Office of Science, the nation's biggest source of funds for basic physical science research, received an additional $272 million, a 5.4 percent boost over last year's enacted number, up to about $5.3 billion total. The Department of Energy's full budget received a 9 percent increase to about $29.9 billion overall.

The National Institute of Standards and Technology received a huge boost of 29.6 percent. Much of this increase is in the Industrial Technology Services section, which more than doubled from $138 million to $306 million. This directorate promotes research into advanced manufacturing, and is expanding with its new National Network for Manufacturing Innovation. NIST's Scientific and Technical Research and Services is also getting a healthy bump of 12 percent, from $675 million to $754 million.

The administration upped the National Science Foundation's budget by $379 million to $7.7 billion, an increase of 5.2 percent. Altogether, its six research directorates are getting a boost of about 4.3 percent up to $6.19 billion, while its education directorate would get an 11 percent increase up to $962 million. The Math and Physical Sciences directorate received the lowest requested increase, 2.2 percent, rising to about $1.37 billion. However, the Directorate for Social, Behavioral and Economic Sciences, which has been under scrutiny from the House Science Committee, received the biggest relative bump, up 7.9 percent to $291 million.

The increase in NASA's $18.5 billion budget request was relatively smaller than most other agencies, up only 2.7 percent over last year, but featured some program changes. Within NASA, funding for its science office increases less than 1 percent over last year. The request also included funding for a new mission to send a probe to Jupiter's moon Europa, but called for ending the Mars Exploration Rover Opportunity and the Lunar Reconnaissance Orbiter in 2016 and the orbiting Mars Odyssey probe in 2017, even though these programs faced termination but were saved.

The Defense Department's spending on foundational research stagnated. Its three fundamental science and technology divisions increased only by about 0.1 percent, from $12.25 billion to $12.26 billion. Within that, its investments in basic research dropped from $2.27 billion to $2.08 billion, a drop of about 8 percent.

APS Outreach Mini-Grants Marked by Wide Range of Projects

By Michael Lucibella

On February 9, 2015, APS announced the winners of this year's Outreach Mini-Grant Awards. Eight teams from across the country will receive up to $10,000 each for projects that bring the excitement of physics to the general public, including two associated with the International Year of Light (IYL) 2015.

"The idea is to encourage physicists to do more outreach and interact with the public," said Rebecca Thompson, head of APS Outreach. "Outreach is an important part of everyone's scientific pursuits." The main aim is to fund individuals and groups that may not have been able to start their programs without help.

The awardees include Emily Edwards of the Joint Quantum Institute for hosting "Schrodinger Session: Science for Science Fiction," a writing seminar at the University of Maryland that teaches physics to science fiction authors, and Brian Nord of Fermilab's "Cosmic Nightly News" for a series of satirical skits about astrophysics in the vein of "The Colbert Report."

Agnes Mocsy, of the Pratt Institute's project, "Science Behind Bars," will work with female inmates at Rikers Island jail in New York and share personal stories, social science research, and science history to overcome stereotypes and encourage better personal choices after the inmate's release.

The IYL-branded projects include one coordinated by Aimee Gunther of the University of Waterloo — "Light at the Museum," a hands-on exhibit about light for THEMUSEUM, an interactive children's museum in Ontario.

Another project, "Captain, We have Matter Matters," is an interactive sci-fi themed play about spectrometry, organized by Stipo Sentic of the New Mexico Institute of Mining and Technology. "We're especially excited to fund two proposals connected with the International Year of Light," Thompson said.

This is the sixth year that APS has offered the Outreach Mini-Grants, and this year APS is funding 11 projects, more than in any previous year. "We received an NSF grant, so we were able to fund twice the number of grants as we have in past years," Thompson said.

Other grant-winners this year include Enrico Fonda of New York University, who is putting together "Creative Turbulance," a multimedia art exhibition of five science and art collaborations. Tatiana Erukhimova of Texas A&M University is producing 20 short episodes of a physics reality show. And the University of Minnesota's Dan Dahlberg is producing a series of videos that highlight the benefits of energy-efficient technologies and the science behind them.

Chris Discenza of The Physics Factory, a non-profit team of scientists and educators, is taking his "Physics Bus" on the road to bring science demos to underserved communities in Florida. UCLA's Jia Ming Chen of "Nanoscience at the Mall" will set up booths with science demonstrations at high-traffic shopping-mall locations to reach a wide swath of people. Beatriz Gonzalez of the University of Valladolid in Spain will visit schools and use popular movies to introduce physics concepts to a range of age groups.

According to Thompson, each year there seems to be a wider variety in the kinds of projects receiving grants. "I think this is the first year we've had such a range," she said. "They're wonderfully all over the map."

Historic Preservation for the Atomic Age

By Michael Lucibella

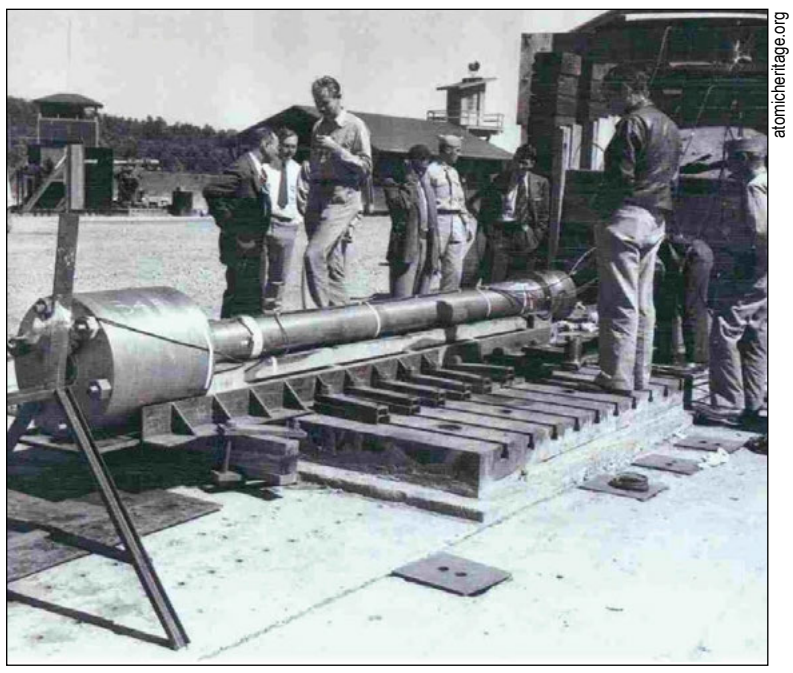
When President Obama signed the National Defense Authorization Act on December 19, 2014, it included a provision to establish a National Historic Park commemorating the Manhattan Project at sites in New Mexico, Tennessee, and Washington State. The Department of Energy (DOE), which owns and manages the sites, is now working with the Department of the Interior to create a plan to set up and administer the first historic park devoted to the effort to build the first atomic bomb.

"The first step in the process to create the National Historic Park is for the National Park Service [NPS] and DOE to develop an interagency agreement that spells out our roles and responsibilities," said Victor Knox, NPS associate director of park planning, who is heading the effort. "The park doesn't actually exist until the agreement is complete."

"The Department looks forward to partnering with the National Park Service to tell the story of one of the most significant events in 20th century American history to a wider audience," said David Klaus, the deputy secretary for management and performance at the Department of Energy.

The recent legislation sets aside historic buildings in Los Alamos, Oak Ridge, and Hanford for the Park Service to preserve and convert into museums and interpretive centers that present the history of the atomic bomb. But safety and security concerns present unique obstacles to the creation of the park.

"The Department of Energy has a high concern for protecting our nuclear installations, and that's also a great concern of ours, but they're the experts," Knox said. "That's different from what we've worked on in the past."



atomicheritage.org

The "Gun Site" at Los Alamos National Laboratory where the first atomic bomb dropped on Japan was assembled.

Los Alamos and Oak Ridge are still high-security areas that develop and store the nation's nuclear weapons. Hanford is a superfund site (a particularly-toxic waste site), which is the focus of the largest environmental cleanup in the country.

Several of the sites already have some public access. Hanford offers limited public tours, which include the B Reactor, the site of plutonium production for the "Fat Man" bomb dropped on Nagasaki, Japan. Oak Ridge runs a bus tour that includes the old X-10 graphite reactor that produced some of the Manhattan project's earliest plutonium samples, as well as the site of the former K-25 gaseous diffusion plant for uranium. Although Los Alamos National Laboratory currently has no public access, there are several historic buildings in the nearby town that are open to the public, including J. Robert Oppenheimer's old house.

"The sticky question that they have to address in the next year is public access, because many of the sites are behind security fences," said Cynthia Kelly, founder and president of the Atomic Heritage Foundation (AHF), which has been pushing for the creation of the park.

The legislation sets aside numerous properties at the three labs, including the B reactor at Hanford, the X-10 reactor and the K-25 site at Oak Ridge, and the Oppenheimer house and about 17 buildings in the National Historic Landmark District in Los Alamos. These include the V-Site where the Trinity bomb was assembled, the Gun Site where the Little Boy bomb was built and tested, as well as the so-called Slotin Building, which was the site of the criticality accident that claimed the life of physicist Louis Slotin.

The park is still in the early stages of planning, with DOE and NPS holding their first meetings in mid-February. The legislation says that they have until December 19 of this year to come up with an

ATOMIC AGE continued on page 7

INSIDE THE Beltway

Senate Majority Leader McConnell and House Speaker Boehner: No Bobbsey Twins They

by Michael S. Lubell, APS Director of Public Affairs

Poor Mitch McConnell (R-Ky.). Barack Obama used to be his punching bag, but that was when Kentucky's senior senator was in the minority. Now, he's majority leader, and his real nemesis is John Boehner (R-Ohio), a Republican compatriot and speaker of the House.

Why do I say that? First consider McConnell's impolitic imprecation to a *National Journal* reporter in 2010, "The single most important thing we want to achieve is for President Obama to be a one-term president." Well, McConnell lost on that score. But last year voters finally gave him a win.

Just a month before the election, in a speech at Northwestern University, the president had said, "I am not on the ballot this fall … . But make no mistake: these policies are on the ballot. Every single one of them." Voters rendered their judgment on his policies and handed Senate control over to Republicans.

Enter new Majority Leader McConnell. He secured his title, but with Senate rules requiring 60 votes to move any legislation, he has found himself with too few reliable boots on the Senate ground — 54 to be exact — to execute a Republican agenda. Just a year ago, McConnell was the master of "no," repeatedly orchestrating filibusters that shackled the Senate's hands. Now, he can only hope that Democrats will loosen the procedural bonds occasionally.

But so long as Boehner and his GOP House minions send over legislation that Democrats find completely unpalatable, McConnell will be in a bind, and the Senate will remain fettered. The recent Department of Homeland Security (DHS) appropriations bill is a perfect example.

At the end of last year's lame duck session, Congress — with Obama's characteristically dispassionate acquiescence — passed a "*CR*omnibus" bill that wrapped fiscal year 2015 funding for all federal activities, except the DHS, into an omnibus legislative vehicle. But Republicans, who found the president's executive orders on immigration abhorrent, if not unconstitutional, refused to fund DHS for the balance of the fiscal year, demanding instead that DHS be placed on a Continuing Resolution that would expire at the end February.

Absent further congressional action and a presidential signature, DHS would have to shutter its doors except for activities directly related to national security. House drafters began work on DHS appropriations as soon as the 114th Congress convened. And by the beginning of February, on a party-line vote, the chamber passed a bill that would fund the department for the balance of the 2015 fiscal year. But House Republicans added riders that would strip away all of the president's executive immigration orders.

Even before the legislative ink was dry, Senate Democrats warned they would filibuster anything except a "clean" funding bill. Boehner, they said was handing McConnell a poison pill. And so it was that well before Valentine's Day, McConnell called for votes on the DHS bill three separate times, and each time Democrats massacred the effort. Poor Mitch McConnell. Boehner's minions had sent him belladonna instead of roses.

You might wonder why the House speaker, who is no political novice, would have set McConnell up that way. The truth is that without Democratic votes, Boehner has a hard time getting any legislation through his chamber that does not pander to the far right wing of the party of the right.

How bad is Boehner's problem? Well, consider that without Democrats, he might not have been elected speaker at all. No, they didn't vote for him. But a score of them were in New York attending the funeral of former Gov. Mario Cuomo on the day the House voted. Boehner, who managed to secure only 216 Republican votes, would have needed two more if all members of the House had been present.

Add to that the new Freedom Caucus that Justin Amash (R-Mich.) and a cadre of ultraconservatives have established to hold Boehner's feet closer to the conservative fire than the conservative Republican Study Committee seemed willing to do. The new caucus anticipates having 30 members, without whose support the speaker would be unable to conduct House business — unless, of course, he decides to rely on Democratic support and risk his speakership by doing so. Don't hold your breath waiting for him to make such a bold move.

Instead, look for two years of a Boehner-McConnell mating ritual, one that could well end the way it does for praying mantises. In case you've forgotten, once mating is complete, the female eats the male. At this point, it's hard to say who winds up being eaten.

In such a high-stakes game, it's also hard to see where science fits. For McConnell and Boehner, who seem destined to be consumed by intra-party jousting for the next two years, it may simply be a misfit.

FUMBLE continued from page 1

cold weather could have caused the change in pressure. "Bill's press conference was a little confusing, to put it mildly," said Timothy Gay, physics professor at the University of Nebraska and author of the book *The Physics of Football*.

For science communicators, it was an opportunity to use football to talk about some of the science in sports. "I was very glad about it," said Ainissa Ramirez, a science communicator and co-author of the book *Newton's Football*. "Even though I knew in my heart it was a science story, I was glad it was under the guise of football."

She wrote up a post for her blog about the emerging controversy with a back-of-the-envelope calculation as soon as news broke. And Chad Orzel, a physics professor at Union College in Schenectady, NY, was asked by his school's communications department to weigh in on his popular blog.

"My initial reaction is 'I'm really busy'," Orzel said. After some convincing, he had the athletics department send over a few footballs and he stuck them in the freezer for an impromptu experiment. "I was surprised that there wasn't more of that … it's so easy to do the experiment."

His initial conclusion was that the change in temperatures alone between the locker room and the rainy playing field wouldn't be enough to account for the measured difference in pressure.

Other high-profile science communicators echoed Orzel's sentiments as well. Neil deGrasse Tyson, director of the Hayden Planetarium, tweeted that "For the Patriots to blame a change in temperature for 15% lower-pressures, requires balls to be inflated with 125-degree air."

Bill Nye "the Science Guy" took to the television program *Good Morning America* and called out Belichick, saying "to really change the pressure you need one of these," while holding an air pump, adding that atmospheric pressure changes wouldn't be enough to change the ball's pressure by up to two psi.

However, some of the experts who spoke up had done the calculation incorrectly. Ordinary pressure gauges measure only the pressure in excess of one atmosphere. When plugging the measured air pressure of the footballs into the ideal gas law, many neglected to add the measured air pressure of the ball to the existing atmospheric pressure.

"A lot of people came out and didn't really use the equation correctly. They forgot to convert the pressure into absolute pressure, so they were using gauge pressure, not absolute pressure," said Thomas Healy, a graduate student at Carnegie Mellon and researcher at HeadSmart Labs.

When word of this misconception spread, a number of scientists had to go back and revise earlier calculations. Tyson ultimately released a retraction of his earlier tweet. "I made that mistake too," Ramirez said. Orzel added that it was a common misconception that was likely compounded by years of word problems in school that overly simplify what gauges really do.

On January 29, the *New York Times* ran an article highlighting the misconceptions of the ideal gas law. It also covered the experiments of Healy at HeadSmart Labs, which seemed to exonerate the Patriots. HeadSmart primarily focuses on developing sports equipment to prevent concussions, but Healy and his team had redirected their investigations to football air pressure.

"What our research brought in was you can't only look at the temperature, you have to bring in the fact that it was raining," Healy said. "Our hypothesis was that when leather gets wet, it starts to expand some, which increases the volume and decreases the pressure."

Healy and his team did their best to recreate the changes in temperature and moisture the ball underwent from the warm locker room to the cold rainy field. They soaked the footballs in water with a damp rag and stored them in a 50-degree room for about two hours. "In that time we saw that there was an on average 1.8 psi drop in the footballs," Healy said.

Timothy Gay gives the work a thumbs up. "The one credible experiment I saw done was by [Healy]," Gay said.

On the morning after the Super Bowl, the NFL released a statement saying that only one ball had been measured at two psi below the limit, and that most were just a fraction of one psi below the limit.

For the scientists participating in the public discussion, the focus on ball pressure was a chance to talk about science in a context where it often doesn't come up.

"Every now and again physics stories come around, and it's always nice to see stories about physics showing up in the media," Orzel said. "This is one of the sillier ways to see it show up. It's also one of the more bizarre sports scandals that I've seen pop up in the last few years."

However, others saw it as an incomplete discussion. Martin Schmaltz of Boston University spoke to the *Boston.com*, *Fox News*, and a Minnesota National Public Radio affiliate. He was somewhat disappointed with the coverage, saying that most of his interviews with journalists were about how he felt about Belichick "behaving as if he's a scientist," rather than the science itself.

"They're afraid to touch the science really," Schmaltz said. "I could not get the journalist to actually write down the equation himself."

He added that he had become involved in part also because he had seen other journalists confusing weight with pressure measured in pounds per square inch. "I thought it would be nice to see a little more science applied to everyday discourse between people on the street and in newspapers," Schmaltz said.

Ramirez saw it as a call to action for more scientists to take advantage of news events like this to bring science to the public. She added that she was disappointed that more scientific societies didn't post anything to their homepages or offer up experts. She said also that she hoped scientists could react more quickly next time a science question bubbled up. "These news science hooks are going to happen more frequently," she said.

ALDA continued from page 1

lecture and it made them more available to the audience. So I thought, what could I do to help them have that warm tone and that communicative stance when I'm not there or somebody like me is not there, pulling it out of them? I realized we could train them, for instance in the techniques of improvisation, which makes you relate to the other person. No matter how well you relate, it makes you relate better than you ever did before. It's just amazing what it does. It transforms you a little bit. And that's just one of the techniques.

What is it that you bring from your career in show business to science communication? What were you able to draw on and bring to scientists?

One of the tools that actors have is listening. I learned as an actor that really listening is being willing to be changed. The other person says something and forces you to respond, and that response comes from the fact that the other person had an effect on you. So listening isn't just waiting for your turn to talk, but that's true in life and it's true in an odd way when you're trying to communicate with somebody. If you think of it as a two-way street, where the person you're trying to communicate with — the state of mind they're in is as important, if not more important than the state of mind you're in. It matters less what you have to tell them, than how they're receiving it. Listening being a dynamic relationship, and listening therefore being a form of relating to the other person, really taking them into your consciousness, is something that I learned in acting and I think applies to all kinds of communication. And it even applies, not just when you're talking in person to an audience, but when you write for a reader, you have to track what's going on in their minds. You can't say things that they have no chance of understanding, then blame them for not understanding. These are the things that we teach at the Alda Center for Communicating Science.

The philosophy behind the Center for Communicating Science is to bring this to scientists. Is it your experience that scientists are particularly receptive to learning about communicating and receptive to what can scientists themselves bring that traditional "science communicators" can't?

There are wonderful science journalists and they perform a really important function. Something that they can't do though, that a scientist can do, is convey to the public the scientists' own state of excitement about their work. Scientists are excited about their work. I must have interviewed about 700 scientists, and I find them incredibly passionate about their work. They wouldn't put in the hours that they do, they wouldn't engross themselves so deeply in it if they weren't passionate. And that passion gets lost in translation. If they can get comfortable with letting people see and realize how passionate they are, the public's understanding of science will grow, their own interest in it will grow and the acceptance of science and the funding of science well get better.

Have you been able to track scientists who have gone through the program and seen them grow because of it?

We get mostly reports from them and they're extremely positive so were very encouraged about it. This is a great honor to be named a fellow of the APS. But I think of it as an honor that comes to all of us at the Center for Communicating Science, because we're all engaged in the same effort to extend the reach of scientists around the country and around the world. I'm so proud of how terrific everyone is at the center in doing that.

How did the Flame Challenge come to be?

It came to me while I was writing a guest editorial for *Science* magazine. I was asked to write something about communication and I was about halfway through it, and I thought, "This is a little dry. I'm not following my own advice, which is to tell a personal story. What personal story do I have?" Then it suddenly hit me — I had this kind of groundbreaking event that happened to me when I was eleven. I was fascinated with what flame was at the end of a candle and I asked the teacher, "What's a flame? What's going on in there?" and all she could tell me was "It's oxidation," which left me completely in the dark. I had never heard that term before and that's all she said. All these decades later, I used that to start this little essay on communication, but by the time I got to the end of the page, I realized I had a contest here. I thought it would be a really interesting experience for scientists to see how hard it is to communicate lucidly about something as complex as a flame, so that eleven-year-olds can understand it and maybe even be delighted by the answer. The kicker would be the entries would be judged by real eleven-year-olds. It turned out to be a really fascinating experience for the scientists to get intrigued by how hard it is to do that. It turned out to be a really good learning experience for the kids, because having the power to judge made them pay extra attention to the entries. And because they saw entries coming in, covering the subject from two or three angles, they got to learn more about it so they could judge the entry more accurately and more fairly. Each year we've had a different question. This year's deadline was February 13, and we [wanted] people weigh in on "What is sleep?" You don't have to be an expert in that field of research, because you're being tested not on your knowledge of it, but on your ability to communicate about it. Of course it has to be accurate, it's vetted for accuracy before it goes to the kids.

How do you decide on the topics for these contests?

They're suggested by eleven-year-olds. This one was suggested by a kid in a school in Long Island. I loved it. He was quoted in the newspaper as saying "I hope the answer is clear and short and accurate so I won't have to keep thinking about it."

Why is it important for scientists to get their message out and for the public to know what's happening in science?

It's important because the public needs to understand what scientists are doing so that they can support it when it's in their interest. If they're concerned about it, they need to be able to ask pertinent questions about it, and not questions that drive the science off a cliff. Scientists need to obviously be able to explain their science to funders, policy makers, and so on so that they can understand what they're funding. Nobody would fund something that they don't understand, and yet there's a lot more work that can be done in making it clear — making it clear and not dumbing it down, not representing it as something that it isn't. That takes work, it takes a new way of looking at things. And the third reason is more and more work is being done in collaboration among different disciplines, and they have to be able to talk to one another. I'm sorry to say, I've heard stories where hours or days were wasted in a collaboration because the same word meant different things to the different participants.

What's next for you?

I'm going to London to see a production of a play I wrote about Marie Curie, called Radiance. That's been done in the states once, and I've rewritten it a lot so I'm curious to see it over there.

Is that coming back to the United States?

It might. I hope it plays all over. Marie is another person I want to see audiences learn more about.

KIRBY continued from page 1

nance and executive structure before we turn our attention to the longer term," said APS Past President Michael Turner, chair of the CEO "pre-search" committee.

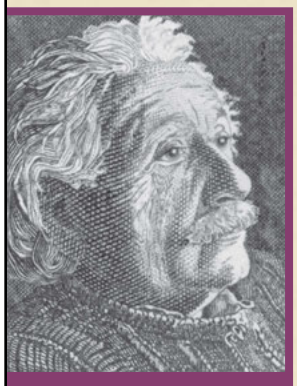
The Board acted on the recommendations of the pre-search committee, which called on APS to finalize its new leadership as quickly as possible. This was a shift from the original transition plan, which outlined a longer process involving a wide search for potential CEO candidates. "The committee made a very compelling case," said Aronson.

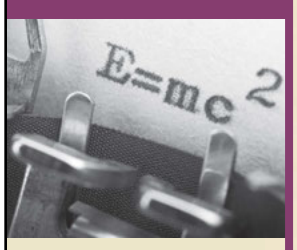
He added that it was important to have someone head the organization who knows its culture and how it works. In addition, with the role of CEO filled, it would help expedite the searches to fill senior staff positions, such as publisher and chief financial officer. The Board's vote to adopt the committee's recommendations was unanimous. "She's the right person at the right time for this job. We're fortunate that she is serving as APS's first CEO," Aronson noted.

ANNOUNCEMENTS

General Relativity Centennial Events – Please Join Us!

This year is the **100th anniversary of Einstein's presentation of the field equations of general relativity to the Prussian Academy of Sciences**. To celebrate, the gravitational physics community is organizing events at national scientific meetings, through online social media engagement, and with lectures and visits to communities throughout the United States.





On Twitter use these hashtags:

- **#EinsteinTweets**
- **#GRCentennial**
- **#GR100**
- **#100YearsOfGR**

or by following GGR on Facebook (APSgravitation) and Twitter (@APSgravity)

While many special sessions and invited speakers are scheduled in 2015, the big event will be the **April APS Meeting in Baltimore (April 11-14)**. There will be

- Plenary talks, invited sessions, and more than 20 parallel sessions sponsored or co-sponsored by the APS Topical Group in Gravitation (GGR).
- Special panel discussions about gravitational wave detection and quantum gravity
- Public lecture by professor and author David Kaiser (MIT), entitled "Einstein's Legacy: Studying Gravity in War and Peace."
- GGR will host a Monday evening banquet to celebrate 100 years of general relativity and 20 years of GGR.

GGR has also organized the Centennial of General Relativity (GR100) Speakers Bureau offering experts to visit colleges, universities, schools, and communities around the country. Partial travel funding for the speaker is available, especially for minority-serving institutions and for schools with little or no research activity in physics and astronomy. For more information visit apsggr.org/?page_id=24

The GR Centennial activities are being spearheaded by the APS Topical Group on Gravitation, which recently reached the membership threshold (after year one) for elevation (after year two) to a full division of the APS.

FREEDOM continued from page 1

subpoenaed by then-Virgnia-attorney-general Ken Cuccinelli and later requested by the Energy & Environment Legal Institute, which is connected with the conservative funders Charles and David Koch.

Ultimately, after years of litigation all the way up to the Supreme Court of Virginia, Mann's personal emails were exempted from disclosure under the law. "When you become a symbol in the climate change debate, there are those that try to knock you down," Mann said.

The report calls in part for universities to clarify how they respond to what they consider overbroad requests, so that a researcher's ability to continue working is not compromised. "State legislators also need to examine their open records laws to ensure that they include appropriate exemptions but are not so broad as to compromise accountability," the report reads.

Changing the laws in all fifty states would be difficult. The experts agreed that it would require a massive effort to bring all state laws in line with each other. "As much as it makes sense to attack the problem where it starts, which is state FOIA laws, it may be almost impossible to get anything done in that regard," said Alan Morrison, a law professor at the George Washington University School of Law.

In addition, freedom of information laws are often publicly and politically popular. "Most state governments right now are very keen on transparency, so you don't want to be seen as trying to roll that back," said Emily Grannis, a legal fellow at the Reporters Committee for Freedom of the Press. She added that most sunshine laws have exemptions that scientists could use to protect their private information, making modification of current laws unnecessary.

So-called deliberative process exemptions give decision makers some degree of privacy for frank discussions. In effect, the data that leads to a decision is on the public record, but the internal discussions among policy makers leading up to those decisions are not. "That could be a very useful exemption for university professors," Grannis said.

Preemptive disclosure of relevant data is another possible way to limit some of these overly broad information requests. "My suggestion is that the federal government get together and try to prepare some guidelines on what should be expected of scientists when they accept a grant or contract to engage in scientific activity for publication," Morrison said. "In the end, the government would adopt a set of protocols that would require that significant materials be made public as a condition of obtaining a federal grant or contract."

The federal government is already moving towards requiring more disclosure of raw data. A memo from the White House Office of Science and Technology Policy from February 2013 outlined its Open Data initiative, which required that all federal agencies develop a plan for making accessible the raw data of research published with federal funds. Part of that memo spells out how documents like personal communications aren't considered data and thus are not subject to public access.

One of the most contentious issues was whether the intent of the requestor should play a role in what is or isn't disclosed. "I'd suggest that there's no public interest in disclosure when there's credible evidence that the primary purpose of a request for records is to do something illegal, to harass and encourage violence, when the only or overwhelming purpose and usefulness of a disclosure is to embarrass, [or] when the records are raw preliminary research data that could easily be taken out of context, misused and cause harm," said Jamie Lewis Keith, general counsel for the University of Florida.

Halpern disagreed. "Open records request[s] really should be complied with regardless of intent," he said. "When you start to figure out what somebody is looking for, it's a little bit of a slippery slope."

Grannis concurs and cautioned that changing public disclosure laws to incorporate a requestor's intent would be unprecedented. "The reason we don't look to motive is so the government doesn't have to make a decision about whose motives are pure or whose speech is more valuable," Grannis said. "We don't want the government telling us whether we need to know something."

She added that changing such laws in such a way could have a broader effect on freedom of speech. "So we need to make sure that there's no chilling effect on what scientists are willing to say in research, but at the same time you don't want to chill the public either," Grannis said. "You don't want to create a situation where the public is afraid to ask for information, or is afraid to talk about a particular topic, because in general we take the view that more speech is better."

RECORDINGS continued from page 3

lowship "helps us spread the word about the applications of physics to the humanities," adds Haber. "It also gives us a little more wiggle room, but for the project to be healthy, we need more funding."

Haber and Cornell are expanding their work to include reproducing "field recordings," which were made in the nineteenth century and the beginning of the twentieth century by ethnographers, anthropologists, and linguists who studied indigenous cultures. "These were cultures that were changing because of modernization," describes Haber, and scientists made thousands of recordings of people discussing their experiences and cultures, always in their native languages. "We are able to move them into this accessible regime," he continues, which allows modern ethnographers to listen and examine Native American languages, some of which are either dying or are no longer spoken at all. The recordings are additionally being used to promote language revitalization. The researchers are also reaching out to Europe, where there is a "huge, untapped repository of historic recorded sound," says Haber. "We would love to get a foothold in the EU and present solutions for European archives."

A nice benefit of their collaboration is that it has contributed to physics research. "Some of the techniques we've developed we have sent back to particle physics," says Haber, such as the ability to do large-scale scanning. Their solution will be integrated into the large-scale fabrication and precision inspection needs of the major upgrade of ATLAS that is planned for operation in the mid-2020s. But ultimately, they are strongly motivated by the desire to do good for society. "We very much believe that the methods and approaches of the physical sciences and the rest of the STEM fields [science, technology, engineering and math] and have a tremendous amount to offer the world across a variety of disciplines and problems," says Haber. "Society supports blue-sky research, and if we can give back to show how STEM fields benefit other fields, like humanities, it is important."

Alaina G. Levine is president of Quantum Success Solutions, a science career and professional development consulting enterprise. She can be contacted through www.alainalevine.com

ATOMIC AGE continued from page 5

agreement. "We're very optimistic we can make that date," Knox said. "We do hope that there will be some additional enhanced public access we can put in place before the agreement's done."

Once the agreement is in place, the two agencies will develop a general management plan that will address the more specific logistics of park operation. "That type of planning will be useful to create the vision for what is the appropriate public use, what's safe and what benefits the public, and where else … we put our energies in interpreting the park," Knox said. "We need to develop that in cooperation with the communities."

In addition to lobbying for the creation of the park, Kelly and the AHF have been publishing information about the sites and the history of the project for years. The organization produced five guidebooks, more than a dozen short films about the sites, and a smartphone "Ranger in Your Pocket" app for virtual tours of the site. In addition, the Foundation partnered with the Los Alamos Historical Society to produce, collect, and archive hundreds of oral histories from people connected with the Manhattan Project over the years. "We are going to be as helpful as we can. We have very good relationships with the Park Service," Kelly said.

As the design of the park moves forward, Knox said he hopes to incorporate the work of the Foundation. "They've put together some really great interpretative materials that will be of huge assistance to the National Park Service," Knox said. "We don't have to start from scratch."

The Back Page

A Scientist in Hollywood

By Kip Thorne

[Excerpts from Kip Thorne's book *The Science of Interstellar,* published by WW Norton (2014) to accompany Christopher Nolan's movie *Interstellar*.]

I never imagined myself helping create a movie. I never coveted a presence in Hollywood, beyond a vicarious one, through [my good friend and Hollywood producer Lynda Obst's] adventures. But working with Lynda appealed to me, and her ideas involved wormholes, an astrophysics concept I had pioneered. So she easily lured me into brainstorming with her.

During the next four months [from October 2005], over a few dinners and emails and phone calls, we formulated a rough vision for the film. It included wormholes, black holes, and gravitational waves, a universe with five dimensions, and human encounters with higher-dimensional creatures.

But most important to me was our vision for a blockbuster movie *grounded from the outset in real science*. Science at and just beyond the frontiers of human knowledge. A film in which the director, screenwriters, and producers respect the science, take inspiration from it, and weave it into the movie's fabric, thoroughly and compellingly. A film that gives the audience a taste of the wondrous things that the laws of physics can and might create in our universe, and the great things humans can achieve by mastering the physical laws. A film that inspires many in the audience to go learn about the science, and perhaps even pursue careers in science.

Nine years later, *Interstellar* is achieving all we envisioned. But the path from there to here has been a bit like the "Perils of Pauline," with many a spot where our dream could have collapsed. We acquired and then lost the legendary director Steven Spielberg. We acquired a superb young screenwriter, Jonathan Nolan, and then lost him twice, at crucial stages, for many months each. The movie sat in limbo, directorless, for two and a half years. Then, wondrously, it was resurrected and transformed in the hands of [Christopher] Nolan, the greatest director of his young generation. …

Steven Spielberg, the Initial Director

… At our meeting, I suggested to Steven and Lynda two guidelines for the science of *Interstellar*:

1. Nothing in the film will violate firmly established laws of physics, or our firmly established knowledge of the universe.
2. Speculations (often wild) about ill-understood physical laws and the universe will spring from real science, from ideas that at least some "respectable" scientists regard as possible.

Steven seemed to buy in, and then accepted Lynda's proposal to convene a group of scientists to brainstorm with us, an *Interstellar* Science Workshop.

The workshop was on June 2, 2006 at the California Institute of Technology (Caltech), in a conference room down the hall from my office.

It was an eight-hour, free-wheeling, intoxicating discussion among fourteen scientists (astrobiologists, planetary scientists, theoretical physicists, cosmologists, psychologists, and a space-policy expert) plus Lynda, Steven, and Steven's father Arnold, and me. We emerged, exhausted but exhilarated, with a plethora of new ideas and objections to our old ideas. Stimuli for Lynda and me, as we revised and expanded our treatment [our description of the movie's venue, characters and story].

It took us six months due to our other commitments, but by January 2007 our treatment had grown to thirty-seven pages, plus sixteen pages about the science of *Interstellar*.

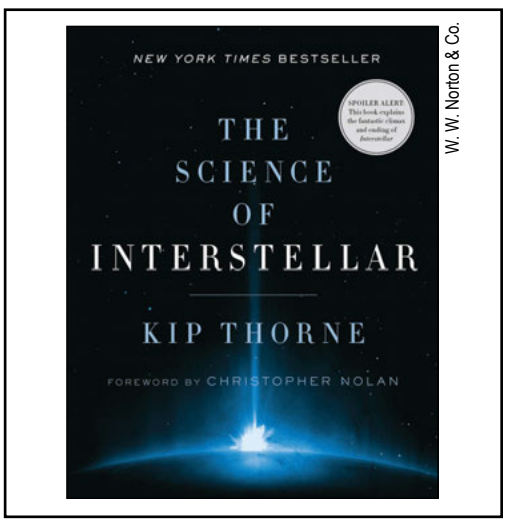
Jonathan Nolan, the Screenwriter

In parallel, Lynda and Steven were interviewing potential screenwriters. It was a long process that ultimately converged on Jonathan Nolan, a thirty-one-year-old who had co-authored (with his brother Christopher) just two screenplays, *The Prestige* and *The Dark Knight*, both big hits.

Jonathan, or Jonah as his friends call him, had little knowledge of science, but he was brilliant and curious and eager to learn. He spent many months devouring books about all the science relevant to *Interstellar* and asking probing questions. And he brought to our film big new ideas that Steven, Lynda, and I embraced. ….

By November 2007, Jonah, Lynda, Steven, and I had agreed on the structure for a radically revised story based on Lynda's and my original treatment, Jonah's big ideas, and the many other ideas that arose from our discussions — and Jonah was deep into writing. Then, on November 5, 2007, the Writers Guild of America called a strike. Jonah was forbidden to continue writing, and disappeared.

I panicked. Will all our hard work, all our dreams, be for naught? I asked Lynda. She counseled patience, but was clearly very upset. She vividly tells the story of the strike in scene 6 of her book *Sleepless in Hollywood*. The scene is titled "The Catastrophe."



The strike lasted three months. On February 12, 2007 when it ended, Jonah returned to writing and to intense discussions with Lynda and me. Over the next sixteen months, he produced a long, detailed outline for the screenplay, and then three successive drafts of the screenplay itself. ...

Then on June 9, 2008 with Jonah deep into draft 4, I got an email from Lynda: "We have a Steven deal problem. I'm into it." But it was not soluble. Spielberg and Paramount could not reach an agreement for the next phase of *Interstellar*, and Lynda couldn't broker a solution. Suddenly we had no director.

Interstellar was going to be very expensive, Steven and Lynda had independently told me. There were very few directors with whom Paramount would entrust a movie of this magnitude. I envisioned *Interstellar* in limbo, dying a slow death. I was devastated. So was Lynda, at first. But she is a superb problem solver. ...

Christopher Nolan, the Director and Screenwriter

... Only thirteen days after Lynda's we-have-a-Steven-deal-problem e-mail, I opened my e-mail queue to find a euphoric follow-on message: "Great talk with Emma Thomas ..." Emma is Christopher Nolan's wife/producer and collaborator on all his movies. She and Christopher were interested. Lynda was tremulous with excitement. Jonah called and told her, "This is the best possible outcome." But the deal, for many reasons, would not be finalized for two and a half years, though we were fairly certain Christopher and Emma were committed. …

[In December 2012 Christopher Nolan signed on to rewrite the screenplay and direct the movie, and he met with Thorne a few weeks later.]

As we talked, it became clear that Chris knew a remarkable amount of relevant science and had deep intuition about it. His intuition was occasionally off the mark, but usually right on. And he was tremendously curious. Our conversations often diverged from *Interstellar* to some irrelevant science issue that fascinated him.

In that first meeting, I laid on Chris my proposed science guidelines: Nothing will violate firmly established laws of physics; speculations will all spring from science. He seemed positively inclined, but told me that if I didn't like what he did with the science, I didn't have to defend him in public. That shook me up a bit. But with the movie now in postproduction, I'm impressed how well he followed those guidelines, while making sure they didn't get in the way of making a great movie.

Chris's ideas occasionally seemed to violate my guidelines but, amazingly, I almost always found a way to make them work, scientifically. Only once did I fail miserably. In response, after several discussions over a two-week period, Chris backed off and took that bit of the film in another direction.

So in the end I have no qualms about defending what Chris did with the science. On the contrary, I'm enthusiastic! He turned into reality Lynda's and my dream of a blockbuster movie with foundations of real science, and with real science woven throughout its fabric.

In the hands of Jonah and Chris, *Interstellar'*s story changed enormously. It resembles Lynda's and my treatment only in broadest brushstrokes. It is so much better! And as for the science ideas: They are not all mine by any means. Chris brought remarkable science ideas of his own to the film, ideas that my physicist colleagues will assume were mine, ideas that I said to myself, when I saw them, "Why didn't I think of that?" And remarkable ideas arose from my discussions with Chris, with Jonah, and with Lynda.

Paul Franklin, Oliver James, Eugénie von Tunzelmann: The Visual-Effects Team

One day in mid-May 2013 Chris phoned me. He wanted to send a guy named Paul Franklin [*Interstellar*'s visual effects supervisor] over to my home to discuss the computer graphics for Interstellar. Paul came the next day, and we spent a delightful two hours brainstorming in my home office. He was modest in demeanor, by contrast with Chris's forcefulness. He was brilliant. He showed a deep knowledge of the relevant science, despite having majored in the arts in college. …

In a video conference a few weeks later, Paul introduced me to the London-based leaders of his *Interstellar* visual-effects team. Most relevant to me were Oliver James, the chief scientist who would write computer code underlying the visual effects; and Eugénie von Tunzelmann, who led the artistic team that would take Oliver's computer code and add extensive artistic twists to produce compelling images for the movie.

Oliver and Eugénie were the first people with physics training that I had met on *Interstellar*. Oliver has a degree in optics and atomic physics, and knows the technical details of Einstein's special relativity. Eugénie is an engineer, trained at Oxford, with a focus on data engineering and computer science. They speak my language.

You cannot imagine how ecstatic I was when Oliver sent me his initial film clips. For the first time ever — and before any other scientist — I saw in ultrahigh definition what a fast-spinning black hole looks like. What it does, visually, to its environment.

Matthew McConaughey, Anne Hathaway, Michael Caine, Jessica Chastain

On July 18, [2013] two weeks before filming was to begin, I received an email from Matthew McConaughey, who plays Cooper: "per *Interstellar*," he wrote, "I'd like to ask you some questions and ... If you are around L.A. area, in person is preferable. Lemme know please, thanks, in process, mcConaughey." …

… It was one of the most interesting and enjoyable conversations I've had in a long time! We wandered from the laws of physics, especially quantum physics, to religion and mysticism, to the science of *Interstellar*, to our families and especially our children, to our philosophies of life, to how we each get inspirations, how our minds work, how we make discoveries. I left, two hours later, in a state of euphoria.

The next email, a few weeks later, was from Anne Hathaway, who plays Amelia Brand. "Hi Kip! I hope this e-mail finds you well. ... Emma Thomas passed along your email in case I had any questions. Well, the subject matter is pretty dense so I have a few! ... Would we be able to chat? Thank you very much, Annie."

We talked by phone, as our schedules couldn't be meshed for an in-person meeting. She described herself as a bit of a physics geek, and said that her character, Brand, is expected to know the physics cold — and then she launched into a series of surprisingly technical physics questions: What is the relationship of time to gravity? Why do we think there might be higher dimensions? What is the current status of research on quantum gravity? Are there any experimental tests of quantum gravity? ... Only at the end did she let us wander off subject, to music, in fact. She played trumpet in high school; I played sax and clarinet. …

On another occasion, I wrote dozens of equations and diagrams on Professor Brand's blackboards, and watched as Chris filmed in the Professor's office with Michael Caine as the Professor and Jessica Chastain as Murph. I was astonished by the warm and friendly deference that Caine and Chastain showed me. Despite having no role in the filming, I was notorious as Interstellar's real scientist, the guy who inspired everyone's best effort to get the science right for this blockbuster movie. ...

Now comes the final phase of Lynda's and my *Interstellar* dream. The phase where you, the audience, have become curious about *Interstellar*'s science and seek explanations for bizarre things you saw in the movie.

The answers are here. That's why I wrote this book. Enjoy!

Kip Thorne received his B.S. degree from Caltech in 1962 and his Ph.D. from Princeton University in 1965. Thorne's research has focused on Einstein's general theory of relativity and on astrophysics, with emphasis on relativistic stars, black holes, and especially gravitational waves. He was a cofounder of the LIGO (Laser Interferometer Gravitational Wave Observatory) Project, with which he is still associated. His current writing focus is a textbook on classical physics coauthored with Roger Blandford; he was science consultant and executive producer of Interstellar.