New Director of ARPA-E on Transformative Technology

On December 8, 2014, Ellen Williams was confirmed as the director of the U.S. Department of Energy’s Advanced Research Projects Agency – Energy (ARPA-E). She received her Ph.D. in chemistry from the California Institute of Technology, and previously served as the senior advisor to the secretary of energy and as the chief scientist for BP. She is currently on a leave of absence from the University of Maryland, where she is a distinguished university professor in the Department of Physics. Alaina G. Levine interviewed Ellen Williams for APS News to discuss goals for her new job and what lies ahead. The full version of this edited interview is online.

AGL: I’d like to ask you about your physics background and why you chose physics in the first place. How has your physics background and the skepticism that you have brought to your discipline have been incredibly important to me all throughout my career.

EW: To a certain extent, I would say that I didn’t actually choose physics, I think physics chose me. I don’t have a degree in physics. My undergraduate and graduate degrees are in chemistry. When I was in graduate school, I was very interested in some problems in physics, so when I graduated, I took a position in a physics department. The physical chemistry discipline and the physics discipline aren’t so different that that’s impossible to do, but it’s not that easy either. But physics is a great background. The rigor and discipline of physics and the skepticism that you have to bring to your discipline have been incredibly important to me.

AGL: It’s interesting that your background is chemistry but you identify yourself as a physicist. So far in your career, what have been your proudest accomplishments, those that you’re most excited about?

EW: A big accomplishment for me was pulling together an interdisciplinary team to form the Materials Research Center at the University of Maryland. That was both an accomplishment, and very much represents a way of doing science and a way of thinking about research that I think is crucial for DIRECTOR continued on page 6

Breeding a Better Robot

By Shannon Pates

April 2015 • Vol. 24, No. 4

APS Panel on Public Affairs (POPA)
Draft Climate Change Statement:
See Special Insert Inside

APS March Meeting: Know When to Fold ‘em

At the APS March Meeting 2015 researchers showed how origami can inspire new devices. A group at Leiden University reported that 2D panels joined along fold lines (top) can pop in and out of stable 3D configurations. A similar toggle effect was seen with joined tiles (middle). A team at Cornell and the University of Massachusetts, Amherst, used a square-twist pattern to create structural toggle switches in paper (bottom) and in microscopic gel sheets that are actuated by temperature changes.

Manufacturing Revolution May Mean Trouble for National Security

By Michael Lucibella

March Meeting 2015 — Additive manufacturing, more popularly known as 3D printing, could be the future of industrial manufacturing while possibly undercutting national security, experts said at the APS March Meeting 2015. This technology was the central focus of several of the industrial physics sessions, highlighting both its commercial promise as well as its policy implications. “The early promise of this technology has been demonstrated,” said Prabhjot Singh, director of the U.S. Department of Energy’s Advanced Research Projects Agency-Energy. “All by itself, additive manufacturing can just as easily be used to surveil as to build solid manufacturing processes that stack thin layers to carve a part out of a raw form. By computer-controlled machines to produce an object. Though there are a variety of methods, generally a nozzle scans a surface, following instructions in a 3D “build” file, and squirts out a micron-thick filament as it builds up the object. Plastics were some of the first materials available, but recent developments opened up the process to a range of metals and ceramics as well.

In contrast, traditional subtractive manufacturing uses computer-controlled machines to carve a part out of a raw form. By working from the ground up, additive manufacturing can build solid shapes that were impossible with older manufacturing methods, while almost totally eliminating waste. Though originally promoted as a means for rapidly prototyping products, 3D-printers are now producing the products themselves. Enterprises both large and small are now directly marketing 3D-printed products to consumers.

One of the fastest growing markets is fulfilling orders for obscure parts that would have been uneconomical to mass-produce using traditional machining. “The worldwide prototyping market is limited, but the important thing is manufacturing,” said Michael Cima of MIT. “The entire system was commercialized because there was a quick way to make a few key parts.”

With some improvement, the largely-automated technology promises to shrink the footprint of manufacturing. Entire machine shops staffed by a multitude of specialists could be reduced to a couple of machines overseen by a few technicians. General Electric REvolution continued on page 6


**Erwin Schrödinger**

**Shoelace**

Schrödinger, 1926: Schrödinger describes “Wave Mechanics” in a Letter to Einstein

Schrödinger described wave mechanics in a letter to Einstein in 1926. This concept revolutionized quantum mechanics and laid the groundwork for the modern understanding of quantum theory. Schrödinger's approach was to consider the wave function of a system, which encapsulates all possible states of the system, including those that are not immediately observable. This idea, famously encapsulated in the equation known as Schrödinger's equation, describes how the wave function evolves over time. It is this equation that allows for the concept of superposition, where a quantum system can exist in multiple states simultaneously until it is measured. Schrödinger's work on wave mechanics opened the door to a new understanding of the physical world, one that is fundamentally probabilistic and where particles can be in multiple places at once. This groundbreaking theory fundamentally changed the way we understand the quantum world and paved the way for future developments in quantum mechanics.

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**Advisors from other societies (non-voting)**

Heather D. DeCaire, APS; Mike Higginbotham, APS; John A. Ewell, APS; Philip A. Current (retired), APS; Michael J. Pope, APS

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This Month in Physics History

April 28, 1926: Schrödinger describes “Wave Mechanics” in a Letter to Einstein

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Planning Africa’s First Synchrotron

By Michael Lucibella

APS March Meeting 2015
San Antonio — Africa may get its first synchrotron sometime in the next ten to fifteen years, joining other nations that seek to bolster their scientific and technological development. At this year’s March Meeting, experts highlighted how scientists from across Africa and around the world are working to build the first such source on the African continent.

The project is still in its early phases, but scientists from South Africa, Morocco, Nigeria, and other nations have signed on. After convening an interim steering committee in August of last year, they announced that a major planning workshop will be held in November at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France.

The organization for the proposed African Light Source is patterned after the international collaboration building a third-generation synchrotron in Jordan: The Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) is a collaboration among nine member states to build a third-generation accelerator facility under the auspices of UNESCO.

The project for [the African Light Source] is really the SESAME project, which itself is modeled on CERN,” said Hermann Winick, professor emeritus at the SLAC National Accelerator Laboratory.

Winick was instrumental in getting SESAME off the ground, and he is now working with the newly-formed steering committee to do the same in Africa. He added that the demand for a user facility is there. South Africa recently signed on to SESAME as a member state to build a third-generation accelerator facility under the auspices of UNESCO.

“Africa is developing. It has major economic, environmental and medical area that can be addressed with synchrotron radiation,” Winick said. “It’s very relevant to have such a facility, so dedicated, motivated African scientists can work on biomedical [and] environmental problems that are of particular interest to that region.”

He added also that the team was hoping to construct the finished accelerator within ten to fifteen years.

Synchrotron facilities are both a hallmark of national development and a catalyst for it. Around the world, many countries that are ramping up their science programs build such machines to boost science and industry at home and keep their best-trained researchers from emigrating.

“That kind of scientific investment has worked for Brazil,” said Antonio José Roque da Silva, director of the Laboratório Nacional de Luz Síncrotron (LNSL), the only synchrotron in Latin America. That nation opened the LNSL in 1997 and is currently working on a cutting edge, fourth-generation synchrotron called Sirius, which will be one of the world’s best.

The synchrotron project in Brazil was the most successful scientific … [effort] that Brazil has gotten into,” da Silva said. “In about 30 years you start from nothing, no people, no technical training, and now we’re … able to try to compete with a state-of-the-art machine and collaborate all over the world.”

The original light source has been a big boost to the scientific infrastructure in Brazil, helping to make the state of Sao Paulo the scientific powerhouse of the continent. In fact, those three other labs, devoted to nanotechnology, microbiology and bioethanol research, have been built on the same campus as the synchrotron.

“Our major effort throughout these few years is to attract more users to our different areas,” da Silva said, adding that the brain-drain of scientists leaving the country for better facilities elsewhere in the world has slowed.

Other countries are similarly following Brazil’s model. At the same time, Brazil started designing the LNSL, Taiwan and South Korea also were losing many talented young scientists to institutions abroad.

“Taiwan, Korea [and] Brazil started their discussions about national light sources in the 1980s,” Winick said, referring to facilities that became operational in the 1990s. “In the time since then … they’ve trained hundreds of Ph.D.s locally without losing them. They’ve attracted dozens of mid-career people to return.”

Iran and Turkey are currently designing and building their own national light sources. Even though both nations are members of the SESAME collaboration, the capabilities of the respective light sources are still lower than those of the Japanese-based machine.

Since its announcement in 2010, engineers working on the Iranian Light Source Facility completed a detailed plan and built a number of prototypes for nearly every major component of the injector and storage rings. The synchrotron will be located at the Imam Khomeini Science and Technology Park in Qazvin province. The original plan was to have the facility online by 2018, but the schedule has since slipped.

The Turkish Accelerator Center announced in 2009 that it is currently working on building the first of its three planned projects. The TARLA free electron laser is slated for completion in 2016, while the second phase of the project, the planned synchrotron, is still in the design phase.

“The community of users that need these machines is growing more rapidly than the available facilities and beamlines, so we need SESAME,” Winick said. “We need an African Light Source and we need more national light sources.”

National Academies Studies Institutional Influences on Ethics

By Michael Lucibella

A committee of the National Academies is preparing a report that will take a tougher stance on self-censorship and focus on attacking the institutional environment that often leads to it. The committee said that the issue has basically been seen as a failing of the individual, said Brian Martinson of the HealthPartners Research Foundation.

“There is not simply a failing of the individual; scientists simply don’t behave in a void.” At the American Association for the Advancement of Science meeting in San Jose, California, committee members outlined how they planned to update the 1992 National Academies report, Responsible Science — Ensuring the Integrity of the Research Process, Volume I, which helped codify what qualifies research misconduct.

The report in part defined research misconduct as “fabrication, falsification, or plagiarism,” a definition that was broadly accepted by the federal government in 2000. It also highlighted other “questionable research practices” that didn’t amount to outright fraud but skirted the line of impropriety. These include authorship abuses, exploiting research assistants, misleading statistical analyses, and withholding data, all of which fall short of falsification and fabrication.

“We suggested previously named ‘detrimental research practices,’ that we don’t equate in that case, and don’t suggest that by ‘questionable’ they might be ok,” said Paul Wolpe of Emory University.

“We want to take a stand and say no, let’s call them ‘detrimental research practices’ because we don’t want there to be any question about how we consider them and the damage that they do to science as an enterprise.”

Committee members are hoping for the Academic on page 7
Twenty-four years ago APS launched a major program dubbed the “Emergency Aid Program” (EAP) to help scientists from the former Soviet Union. They lost their funded programs as the Soviet Union came apart and 15 new nations came into being. EAP was successful. That the program support to the military-industrial establishment that scientists of the former Soviet Union had relied on disappeared.

Much has been written about the various programs that the West provided to Russian, Ukrainian, and other countries’ scientists, among them the Nunn-Lugar Cooperative Threat Reduction Program (CTR), created in 1991. The purpose of the CTR Program was to secure and dismantle weapons of mass destruction and their associated production facilitate the Observe of former Soviet Union states. Alongside the CTR, and the APS assistance program mentioned above, another important program was the International Science Fund (ISF), personally funded by financier George Soros, which dovetailed with the APS program and over a span of three years provided U.S. $100 million for research, teaching, and collaboration.

That was 25 years ago, but a new threat has arisen from Russia, affecting Ukraine’s security and economy, and the lives of hundreds of scientists and their families in eastern Ukraine. It all started with protests in Ukraine against a corrupt president, Victor Yanukovych, and his government. Soon the peaceful protests turned ugly and violent when the police resorted to live bullets. “Green Beret” contingent kidnapped, tortured, and killed over 100 innocent bystanders during the Kyiv “Euro-Maidan” protests. Included in these casualties was one of our own, Yuri Maidan, a scientist at Florida International University researcher Vashti Sawtelle. “It is very hard to imagine what it means to lose a ‘physics person’ with surveys, interviews, and an anthropological study of a physics department.”

What Makes a Physicist?

By Shannon Palus

APS March Meeting 2015 – How do you recognize a physicist at a cocktail party? What do they wear to work, and what do they do when they go on a vacation? To a packed room at the March Meeting — recognition beliefs — was the topic of a recognition talk at the APS March Meeting 2015 in Portland, Oregon. Geoff Potvin quantified the understanding of the “physics identity” and connected it to the likelihood that a student will pick physics as a career, examining factors: performance, interest, and recognition.

As expected, interest in physics is correlated with a strong physics identity. But for women, competence in physics was slightly negatively associated with the identity. “Just doing well is not enough,” Potvin explains. A student’s feeling of belonging — that they consider themselves a “physics person” — was the most important driver of the “physics identity.” Their interest in physics was dependent on having a strong physics identity. But for women, this was even more important, with women’s interest in physics being strongly negatively correlated with their physics identity.

The seminar was intended to inform the physics community, including current physics students, about the work that is being done to address the issue of diversity in physics. As Potvin explained, “The goal is to help students feel more comfortable in a physics classroom and to understand the importance of creating an inclusive environment.” The session’s title was “The Data that I have is good.”
The only physicist in the U.S. Congress is the House Committee on Science, Space, and Technology. Representative Bill Foster (D-IL), who holds a Ph.D. in physics and formerly worked at Fermilab, announced on Wednesday that he was appointed to serve on the committee.

“As a scientist, I know firsthand how important it is for the United States to sustain our position as the leader in science and technology,” Foster said in a statement. “Serving on this committee will allow me to help protect the vital investments in research and development and support Illinois’s national laboratories.

In Congress since his election in 2008, Foster previously had focused much of his attention on finance reform. In an interview with Science, he said that he wanted to counter some of the “attacks” on science by the policies of the committee in recent months.

Foster’s appointment comes as the house of Representatives, including Chairman Lamar Smith (R-Texas), pursues inquiries into about sixty grants issued by the National Science Foundation, a number of which he referred to as "questionable." The chair’s actions sparked controversy and led to accusations of losing track of basic research from the scientific community.

Before being elected to Congress, Foster was a high energy physicist

### NSP and Congress Seek Rapprochement

**By Michael Lucibella**

A new policy of the National Science Foundation (NSF) might settle the ongoing feud between the funding agency and the House of Representatives Committee Science, Space, and Technology over Congressional oversight of its grant-award process. In December 2014, the NSF formally adopted new rules requiring non-technical explanations and justifications for new grants. The new requirements update NSF’s Transparency and Accountability policy. Future proposals must include a non-technical description of the project, an explanation of its significance, and a statement of how the project carries out NSF’s mission, including the advancement of science.

At a subcommittee hearing in February, Chair Lamar Smith (R-Tex.) highlighted the similarities between these new requirements and ones in the Frontiers in Innovation, Research, Science, and Technology (FIRST) Act.

While no legislation has passed, the NSF has reacted to Mr. Smith with a series of reforms including the most recent: emphasizing that titles and abstracts of grant proposals need to be easy to understand, to be written to be easily accessible to the general public. Or, as Mr. Smith put it, as a public justification for NSF funding.

At a recent hearing France Cordova, director of NSF, stated she supports the policy provision requiring each grant funded by the NSF to be verified to be in the national interest. APS remains concerned that such a provision might at best be a meaningless waste of time as a checked box and, at worst, limit flexibility to pursue the most interesting scientific leads during a research project. Such flexibility has been a hallmark of NSF and a distinguishing feature of grants as opposed to contracts.

### Upcoming Legislation

Work on the Elementary and Secondary Education Act (ESEA) continues as both parties support the bill is finished. Sen. Alexander’s (R-Tenn.) office released a draft version of ESEA for a public comment period, which has since closed. The draft version, however, was not released as the Department of Education failed to provide a draft version of the bill. The Department of Education did issue a statement at the time saying it was working on the draft version.

Though similar to NSF’s new policy, the approach, the requirements outlined in the FIRST Act also highlight the need for a grant that promotes the country’s economy or national defense. Smith referred to its requirement that the public understands the investment that this country is making in science and engineering.

### WASHINGTON OFFICE ACTIVITIES

**Media Update**

Science Magazine and Chemistry World recently published stories about the latest report of the U.S. government’s science advisory body, the President’s Council of Advisors on Science and Technology (PCAST). APS Director of Public Affairs Michael S. Lubell and Tom Culligan, vice president of the Thirteenth Group, developed the idea. The story can be read at the following URLs: http://bit.ly/1MaUNdC and http://rsc.li/18DXK7/

**Panel on Public Affairs**

The draft Statement on Earth’s Changing Climate, described in the insert of this issue of APS News, is open to the APS membership for comment. Please check your email for a link to the statement and the comment site.

### UKRAINE continued from page 4

CRDF Global is consolidating funds and efforts to support scientists in Ukraine. Among their many efforts, they are working to identify the leaders in Ukrainian physics and identify new or used equipment to displaced physicists, chemistry, and biology departments, and seeking to provide emergency travel funds. Ukrainian physicists interested in helping should contact CRDF Global’s Ukraine team (Ukraine@crdfglobal.org).

I urge my fellow APS members to reach out to our Ukrainian colleagues. As an organization, APS can help by offering a variety of tools and technical assistance for the affected scientists to function in their temporary environments. Additionally, the APS can offer moral assistance by reaching out and making contact with Ukrainian colleagues. You can do this by contacting the APS info office (uxsos@aps.org) or individually if you have friends there. The UPS has organized a task force to provide assistance to the displaced physicists. Additionally, many Ukrainian scientists have recently immigrated to the U.S., including your colleagues who came here to study and are currently at universities and industry. Urgent help is needed and I ask you to reach out.

George Gamota is a former professor of physics at the University of Michigan, a former director of the APS Summer Undergraduate Research program, and founder and president of SfMTA LLC. He is an APS Fellow, an honorary member of the Ukrainian Physical Society, and a foreign member of the Ukrainian National Academy of Sciences.
to keep it alive. “At the end of the
where it controls the robot and tries
to do something with it,” explains Kim.

In simulations, thousands of sets
of robot brain “genes” each determine a
different network. Each brain is put in
a simulation that shows how it
would control the robot and try to
keep it alive. “At the end of the
network, you have the best brain — or brains — on real robots,” he explains. It’s a kind of natural selec-
tion in an artificial system.

He has already used the process
to create a simple robot that can
stay inside a circle. He envisions
that the process can work for very
complicated, multipurpose machines.

“When we turn them on, they will be
infants,” Adami says of highly
advanced robots. “We may have to
wait 10 years, 15, until they are
worth taking seriously.”

One government agency doesn’t
want to wait that long. The Defense
Advanced Research Projects Agency (DARPA) is pushing robots
to do useful things now. Accord-
ing to DARPA program manager
Gill Pratt, the agency will host the
DARPA Robotics Challenge in Pomona, California in June 2015.

Created in response to the Fukushima
disaster, the challenge offers
$2 million in prize money for the
team with a robot that can com-
pletely assemble a nuclear reactor
and rescue tasks.

The 25 humanoid contestants
can help to create a disaster rescue
team: traverse tough terrain, move
debri, cut a hole in a wall, adjust
da valve, climb stairs, and then com-
plete a suicide mission. These robots will have superpowers:
A human controller can assign tasks
and override the robot’s choices.

And poor choices by artifi-
cially intelligent robots could be
a problem. University of California,
Berkeley computer scientist Stuart
Russell espoused concern that fully
independent robots will make bad
decisions — from a human, and
moral, point of view — about how to
complete tasks. Last year, Russ-
ell co-wrote an opinion article
with Stephen Hawking, because they
thought a question about sentient
robots raised by the sci-fi box office
 flop Transcendence — Could a
hypertalented machine become an
uncontrollable force against humanity? — “deserve some serious thought.”

If you ask a robot “to do some-
thing” by firing a laser or throwing a
mine-carrying drone or, calculate digits of pi, well, if that’s the only thing you ask it, it’s going to come up with ways of doing that optimally, which might involve converting all of the mass of planet Earth into computational
facilities,” says Russell. “Clearly
that’s not what we want.”

But Pratt’s vision for the smart
robots born from the DARPA chal-
lenge paints a hopeful picture for
AI. As he explains, “It’s robot and
a person working as a team, each
trying to do what they are best at.”

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The promise of additive manufacturing also includes the peril of easy-to-
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Pennsylvania demonstrated a 3D-printed gun, which uses a basic plastic
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Pennsylvania demonstrated a 3D-printed gun, which uses a basic plastic
retractable hull and plastic-feeding mechanism to fire plastic pellets.
Notice to Members: APS Annual Business Meeting, April 10, 2015
On April 10, 2015, the American Physical Society will hold its annual business meeting. The meeting will be held at 4:30 pm in the Hilton Baltimore Hotel just prior to the start of the APS April meeting 2015. Members may participate in person or electronically.

For more information visit: wwwAPS/about/governance/meeting.cfm

ANNOUNCEMENTS

Reviews of Modern Physics
Colloquium: 100 years of mass spectrometry: Perspectives and future trends
Simon Maher, Fred P. M. Jjunju, and Stephen Taylor
Mass spectrometry was established more than 100 years ago and has been an invaluable experimental tool for many disciplines in science and engineering. This Colloquium is not only a great resource to the mass spectrometry aficionado but also will be a useful reference for students and young researchers starting in this or in adjacent fields.

dx.doi.org/10.1103/RevModPhys.87.113

news
journals.aps.org/rmp

DISPATCH continued from page 5

The POPA Physics & the Public Subcommittee continues its work on a survey focused on overcoming the obstacles of recruiting teachers in the physical sciences. Two proposed APS Statements, one a revision of the APS Statement on Civic Engagement and the second on the Status of Women in Physics, will be made available for APS membership commentary later this year.

The POPA National Security Subcommittee is considering a proposal for a study to be held in partnership with the Ploughshares Fund, on non-weapons science conducted at the nation’s national security laboratories.

The POPA Energy & Environment Subcommittee has received approval for a study examining ways to address the long-term challenges of nuclear supply and pricing. As a way to address nearer-term challenges, the APS Office of Public Affairs continues its pilot test of a “helium brokerage” to help APS members manage helium supply delays and price spikes.

A template for study proposals can be found online, along with a suggestion for future POPA studies: wwwaps.org/policy/reports/popsa-reports/suggestions/index.cfm

IDENTITY continued from page 4

tion researcher Allison Gonsalves spent seven months in 2007 embed- ded in a physics department at a large North American university for her doctoral dissertation. She published some of that work in her 2014 paper, “Physics and the girly girl — there is a contradiction somewhere: doctoral students’ positi- tioning around discourses of gender and competence in physics.”

For her research, Gonsalves asked students to maintain a photo diary of what it meant to them to be a physicist. They brought her snapshots of tea and cookies, or a research department meetings, and of machines. One woman took a picture of her toilet, and explained that she had fixed it. A physicist, she explained, can fix things. “Being a good physicist entails performing physical acts,” says Gonsalves, “just in the same way that gender involves repeatedly performing things that signal our gender.”

There’s little consensus on how to attract more women to the field of physics. In a survey of 7,505 stu- dents, Potvin looked at the effects of several approaches: single-sex classrooms, women-student guest speakers, role models, and discus- sions of the problem. Discussing the issue of underrepresentation was the only method that increases the likelihood of pursuing a physics career.

For Gonsalves, looking at gen- der alone is not sufficient. “If you are really truly going to under- stand peoples’ experiences, you need to use a more intersectional lens.” That means taking forces like race and class into account, and expanding the diversity issue beyond just women in physics.

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200 worms around the clock — a substantial upgrade to the single- camera system that he used before.

The sliding six-camera system captures how the worms move, and how often they turn — their “roaming and dwelling” behavior — while recording unencoded, high-speed video. The extended time lapse gen- erate 2 terabytes of raw video per hour, so to save on storage space, the system identifies the worm’s motion and records it, while suppressing the background.

Eventually, Brown hopes to link that data to a new method that incor- porates and neural activity. For now, Brown is glad to have the upgraded instrument: “We’re really just at the stage of collecting good quantita- tive data.”

A standardized environment for burrowing creatures:

The long bodies of snakes and lizards come in handy when they need to burrow into sand. Dry sand is easy to work with a study of what hap- pens to women scientists in the field.

Dead frozen diving sea birds

to release the report this coming summer and plan to include a list of best practices that research institu- tions can adopt. In the works for years, the report comes after a num- ber of recent high-profile retractions over misconduct, most notably the stem cell controversy coming out of teams from Harvard and RIKEN.

“There’s really only been, rela- tively speaking, a few cases,” said Robert Nerem of the Georgia Insti- tute of Technology, and chair of the committee. “Even so, the media attention very much weakens the public faith in the reliability of sci- entific research.”

The extent of scientific mis- conduct is difficult to pin down precisely. In 2013, the last year that numbers are available, about 300 research articles were retracted out of the more than 1 million published across all scientific disciplines. I don’t think the system is as broken as it might seem, but more vigilance, and lets hope that is in fact what we are seeing,” Wolpe said.

The committee is in part draw- ing on current social psychology research that looks at the motiva- tions for improper behavior. Their approach puts a new emphasis on the influence that an institutional environment can have on a per- son’s actions.

“As we learn more, all the time, about the cognitive biases, the fal- lacies, the pressures, the incentives, and in particular the environments in which we operate, it means that we have to think a little differently about how we protect ourselves against the errors to which we are all prone,” said C. Kristina Gunsalus of the National Center for Profes- sional and Research Ethics.

She added that individuals tend to give into temptation when they and their peer groups are overly ambitious, promote a sense of enti- tlement, or work in obtuse systems with inefficient incentives.

“The amount of cheating which humans are willing to engage in depends on the structure of our daily environment,” Gunsalus said. “It is always possible to rationalize some- thing scummy you want to do.”

The committee hopes that by highlighting these root causes and laying the groundwork for an effort at research institutions to identify and address problems in their working atmosphere.

“Either the scientific commu- nity [and the research community address these problems, or the government will,” Nerem said. “Government intervention in my opinion would not be desirable, and I suspect that’s true of everybody in this room.”
In August 2014, I attended the 5th IUPAP International Conference on Women in Physics (ICWIP 2014) in Waterloo, Canada as part of the U.S. delegation of 215 female physicists and a few male physicists, all from 49 different countries. There were research talks, panels, workshops, breakout sessions and posters on issues related to career creation and advancement for women physicists.

A major focus of the conference was to address the many barriers that uniquely affect the advancement of women in physics worldwide. Barriers that were listed in the country reports included societal biases affecting women and accumulating over time from as early as adolescence, unconscious gender bias, and the effects of stereotypes. Also contributing are family responsibilities, unfriendly and unsupportive environments in physics departments, lack of mentoring, lack of a critical mass of women physicists, and some women are impacted so much that they even start questioning their own ability to ever be equal to or better than men in STEM fields.

In some countries such as the US, when women do not succeed in a science course, people often attribute it to their poor abilities; but when men do not succeed, people often attribute it to their lack of effort or poor teaching, but not to their lack of ability. Societal biases related to women not being smart enough to pursue careers in male-dominated STEM fields can impact women’s beliefs about their own capability and negatively influence whether women pursue STEM majors and how they perform in STEM courses. In some countries like the U.S., when women don’t succeed in a science course, people often attribute it to their poor abilities; but when men do not succeed, people often attribute it to their lack of effort or poor teaching, but not their lack of ability. This dichotomy has a negative impact on whether women who have failed once would want to pursue those subjects in the future (“failing could even be obtaining a B or a C grade in a course for an otherwise high-achieving woman”). Many women in male-dominated fields assume that small setbacks, e.g., getting one B or C grade in a physics course, are indicative of their lack of aptitude for physics. They are more likely to interpret success in the subject in which their male counterparts seem to have an edge in many countries like the U.S. many tend to step away, often because they unwittingly conform to societal gender stereotypes. Women in some countries like the U.S. are often victims of gender stereotypes from very early on, and some women are impacted so much that they even start questioning their own ability to ever be equal to or better than men in STEM fields.

The “leaky pipeline” prevents women physicists in all countries from reaching the highest levels of our profession. The amount of leakage and at what stage it occurs varies significantly from country to country. In the U.S., women’s participation in physics decreases precipitously from high school to college level and then again in the top leadership positions in physics. However, unlike the situation in many men-dominated fields, in the last couple of decades, there is no leak from the undergraduate to graduate to assistant professor level in physics — the percentage of women at each of these levels has hovered around 20%.

Regardless of the country, the common theme at the conference was that women are highly underrepresented in leadership positions and decision-making roles.

Regardless of the country, the common theme at the conference was that women are highly underrepresented in leadership positions and decision-making roles. The overall proportion of female researchers in Estonia is over 40% and exceeds the European average, but the gender imbalance in the researcher population increases with age. Women physicists from some Asian countries, e.g., China, noted that everything was fine up to graduate school, and there was no significant barrier for women in physics until they obtained their PhD. After the Ph.D., there is a perception that women do not have the ability to be good physics professors, researchers, or scientific leaders, or that they should focus on their family responsibilities rather than pursuing a high-profile career as a physicist. The glass ceiling was cited as a major factor why women fail to reach the top in physics across the world.

In 2012 the American Institute of Physics released the results of the Global Survey of Physicists, which was completed by 15,000 female and male physicists in 2009-2010, analyzed by regions, and restricted to 12 countries with sufficient data. Staff member Casey Tesfaye described how in nine of the analyzed countries, women had fewer opportunities than men, and in a different nine-country subset they had fewer resources than men. Regarding career progression, women physicists were promoted more slowly than men in eight of the analyzed countries.

Women physicists, especially, from some African countries, noted that taking an interest in physics is also perceived to diminish their female attractiveness. In fact, even in the U.S., the stereotype portrayal of female scientists by popular media (e.g., the TV show “The Big Bang Theory”) which make them look unattractive, does not help in encouraging more young girls to pursue physics. Eileen Pollack, who wrote an opinion piece in The New York Times (October 13, 2013) about why there are so few women in science, attended this ICWIP 2014 conference as a panelist and raised the point that the paucity of women going into physics is exacerbated by the stereotypical portrayal of female scientists.

Women physicists from Iran noted that more than 60% of B.S. and M.S. students, 47% of Ph.D. students, but only 18% of faculty members in their physics departments are currently women. These high percentages of female physics students are partly because men in Iran are often more interested in engineering, because the career prospects are better. Women from Egypt noted that the reason many women do not take comparable jobs to men, even after obtaining their Ph.D., is that they want to be closer to home in order to take care of their families, so they have lower aspirations professionally in order to balance work and family. What was clear is that in many of these non-Western countries, the women physicists have greater difficulty balancing family and work. Not only are they responsible for their children and family, but also have a significant number of hours work brought home. They have much less time for research, teaching, but not to their lack of ability. This dichotomy has a negative impact on whether women who have failed once would want to pursue those subjects in the future (“failing could even be obtaining a B or a C grade in a course for an otherwise high-achieving woman”). Many women in male-dominated fields assume that small setbacks, e.g., getting one B or C grade in a physics course, are indicative of their lack of aptitude for physics. They are more likely to interpret success in the subject in which their male counterparts seem to have an edge in many countries like the U.S. many tend to step away, often because they unwittingly conform to societal gender stereotypes. Women in some countries like the U.S. are often victims of gender stereotypes from very early on, and some women are impacted so much that they even start questioning their own ability to ever be equal to or better than men in STEM fields.

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