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2017 April Meeting Prize and Award Speakers

By Rachel Gaal

Together with exhibits, plenary talks, and poster sessions at the 2017 APS April Meeting (January 28 - 31), over 200 invited speakers will be sharing their latest research and career insights. Among the distinguished guests are many of the spring 2017 APS prize and award winners.

"Each year, the American Physical Society recognizes leading physicists through a variety of prizes and awards," said APS President Homer Neal in a press release announcing the awards. "We are proud to honor a spectrum of recipients, including outstanding early-career researchers, exceptional communicators and educators, and accomplished theorists and experimentalists working in every major field of physics."

The Julius Edgar Lilienfeld Prize honors a single individual who has made an outstanding contribution to physics and who has exceptional skills in lecturing to diverse audiences. Martin J. Rees of the University of Cambridge was the 2017 honoree "for his contributions into the understanding of the universe and its high-energy contents." He is also being recognized for his skill as a science communicator. Rees will be speaking on Sunday, January 29, during the session: "Prize Talks: Black Holes and Cosmic Explosions."

Another award-winner, Carl M. Bender of Washington University, received the 2017 Dannie Heineman Prize for Mathematical Physics. His publications in this field advanced the theory of Parity-Time (PT) Symmetry in quantum systems, and his work was cited for "inspiring generations of mathematical physi-

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Institute for Advanced Study Named Joint EPS-APS Historic Physics Site

EPS-APSBy Rachel Gaal

(Left to right) EPS President Christophe Rossel, 2016 APS President Homer Neal, APS CEO Kate Kirby, and IAS Director Robbert Dijkgraaf

In 1930, the Institute for Advanced Study (IAS) was established near the grounds of Princeton University to act as the "department store for the freedom of ideas." The original and often speculative thinking that the Institute encouraged over the years made it one of the world's elite intellectual centers, supporting over 33 Nobel Laureates and scores of medalists and winners of prestigious awards.

This year, APS teamed up with the European Physical Society (EPS) to recognize IAS for its pivotal involvement in the advancement of theoretical physics, naming IAS their inaugural joint historic physics site in the U.S.

"We are very pleased to be partnering with the European Physical Society in selecting the first ever Joint Historic Site for physics in the United States," said 2016 APS president Homer Neal. "The Institute for Advanced Study has been one of the premier centers for theoretical physics in the world, hosting physicists in all stages of their careers."

Among these physicists was

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Science in the Trump Administration

By Rachel Gaal

On Sunday night, November 14, CBS broadcast an exclusive interview with President-Elect Donald Trump to millions of American homes. The one-on-one segment with correspondent Lesley Stahl featured an array of questions on various topics, which Trump had no qualms about answering.

"I want to focus on jobs, I want to focus on healthcare, and I want to focus on the border and immigration," Trump said. "We want to have a great immigration bill, and I want to focus on all of these other things that we've been talking about."

But in all of the discussions with the president-elect, science and science policy have come up rarely if at all.

As the media exploded this election with hot topics like immigration, health-care reform, and tax spending, one topic in particular was missing from the stump speeches — science and technology. *ScienceInsider* reported "almost no interaction" between the science community and the campaign over the election season, and researchers and analysts are now scrambling to fill in the blanks.

Scores of sources are attempting to predict whom Trump and his transition team will appoint to the science-related leadership positions in the federal government. With no major statement on his campaign page that explains his plans for science, even the experts are empty-handed in predicting the future of research and development in the coming years.

"For all the professors, students, and teachers out there right now, I think you would have to mark this as an 'incomplete' right now," mentioned Bart Gordon, former chairman of the House Committee on Science and Technology. He was speaking to people involved in academia, private sector groups, government, and biotech research, all participating live in the American Association for the Advancement of Science (AAAS) webinar, *S&T Policy and R&D Funding: A Post-Election Analysis.*

Gordon and three other policy experts, the AAAS Chief Executive Officer Rush Holt and Chief Operating Officer Celeste Rohlfing, along with David Goldston, former chief of staff of the House Committee on Science, participated in the one-hour webinar and answered questions from the audience.

"This is a work in progress right now and we're going to have to follow it," continued Gordon. The policy group all agreed, and were eager to add their thoughts to the discussion.

"[But] science and engineering do not go away just because there is a change in administration," asserted Rohlfing. "And with respect to some of the initiatives started under President Obama, some … are reshaped, … some are definitely ended, but … I would

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Research News: Editors' Choice

physics.aps.org

A Monthly Recap of Papers Selected by the Physics Editors

The Dynamics of Plunge-Diving Birds

Some seabirds hunt for food by plunging into the water at high speed, yet they avoid neck injury.

Some species of seabirds are known for their unique hunting skills — diving headfirst at speeds over 20 m/s, they then pack a punch when hitting the waters below. Sporting long, slender necks, it was a mystery how these birds could avoid injury during this endeavor. As reported in the *Proceedings of the National Academy of Science,* (doi: 10.1073/pnas.1608628113), researchers have now identified the dynamics behind a seabird's plunge-dive. Using simulations with a cone attached to a rod, along with a salvaged seabird carcass, Change et al. studied the mechanisms of the fast dive and identified the axial forces affecting the skull and neck during the dive. These turned out to be primarily hydrodynamic drag on the skull during water impact, and hydrostatic pressure on the neck, caused by an air pocket created after the cone-shaped skull became fully submerged. This phase, which researchers called the "air cavity phase," showed that the bird's neck would be less affected by hydrostatic pressure as the size of the skull and the length of the neck decreased, and the impact speed increased. In theory, the added stability from the bird's neck muscles should reduce the likelihood that the neck would buckle under increased drag during the dive. According to their analysis, the team determined that these plunge-divers could keep up the daredevil acts without sustaining injury, provided their speeds were less than 80 m/s.

Galaxy Rotation Links Dark and Visible Matter

A newly derived universal law shows that the rotation of disk galaxies is determined entirely by the visible matter they contain, even if they are mostly filled with dark matter. As reported in *Physical Review Letters*, McGaugh et al. have investigated 153 disk galaxies spanning four orders of magnitude in mass and three orders in density. Using available observations, the team determined the rotational acceleration as a function of radius, as well as the radial distribution of visible matter, for each galaxy. They found that the two distributions display a remarkably simple relation that holds for all observed galaxies. Since dark matter is the main component of these galaxies—and thus the main determinant of galactic rotation — the result implies that the distribution of conventional matter in the disk specifies the density profile of the surrounding dark matter halo. While it was expected that more massive dark matter halos host more massive galaxy disks, the tight correlation between the radial distribution of dark and visible matter is surprising. Simulation work on galaxy formation will need to assess if this result is compatible with the standard cosmological model or requires its substantial revision.

(For more, see the Viewpoint in

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Revised 12/19/2016

Washington Dispatch

From the APS Office of Public Affairs

APS WASHINGTON OFFICE ACTIVITIES

PANEL ON PUBLIC AFFAIRS

Recommendations on all APS statements up for review in 2016 were presented to the APS Council of Representatives and Board of Directors at their November meetings. Statements 06.1, 06.2, 06.3, 01.1, 01.2, and 91.5 will remain active statements of the Society. Statement 96.2 — *Energy: the Forgotten Crisis* — has been rewritten; the Board has approved a proposed replacement statement. It will be sent to the full APS membership for comment in the coming weeks.

The APS Panel on Public Affairs (POPA) National Security Subcommittee is planning a workshop on the scientific obstacles and challenges to the elimination of highly enriched uranium in civilian applications, to be held in early 2017.

The POPA Physics & the Public Subcommittee is working to finalize a report on the obstacles and incentives for recruiting teachers in high-need STEM areas. The report is the product of a 2016 survey of current majors and recent STEM graduates in physics, chemistry, computer science, and mathematics, and was issued by APS, the American Chemical Society (ACS), the Computing Research Association, and the Mathematics Teacher Education Partnership.

Have a suggestion for a POPA study? Contact Jeanette Russo with your idea at russo@aps.org.

MEDIA UPDATE

Simon R. Bare, co-chair of the committee that produced the APS, ACS, and Materials Research Society (MRS) helium report *Responding to the U.S. Research Community's Liquid Helium Crisis*, published an op-ed October 19 in *The Hill* newspaper, citing ways scientists can help abate the helium crisis, as outlined in the report. Read the piece at go.aps.org/2gJdXAy

Chemistry World published a news story October 20 on the helium report produced by APS, ACS, and MRS titled "U.S. urged to address helium cost increases."

Chemical & Engineering News also published a story on the helium report October 10, titled "Societies recommend ways to address helium shortage." Read the article at go.aps.org/2gJix1m

Have something important to say? APS Members have a resource in Press Secretary Tawanda W. Johnson. Contact her with your story at tjohnson@aps.org.

ADMINISTRATION OUTREACH

Working with the Physics Policy Committee, the Office of Public Affairs is developing an informational document for the Trump Transition Team.

ADVOCACY

At the 2016 APS Division of Plasma Physics Meeting, 408 attendees contacted Congress about the priorities of the physics community. The message addressed the need to pass a longer-term federal spending bill and increase support for the federal science agencies.

At the end of October, Greg Mack was a colloquium speaker for the University of Tennessee's chapter of the Forum on Science, Ethics, and Policy, where he addressed an audience of undergraduates, graduate students, and professors about how APS and its members decide which policy issues to investigate or act upon; the importance of advocacy and different levels of APS member involvement; and ethical considerations for these decisions.

If you'd like us to visit your home state and provide resources for grassroots advocacy, contact Greg Mack at mack@aps.org.

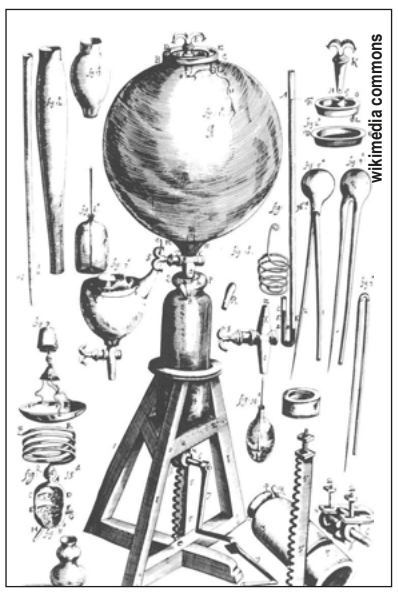
This Month in Physics History

December 31, 1691: Death of Robert Boyle

One of the oldest and most venerated scientific associations is the Royal Society of London, established in 1663. Its founding brought together various groups of natural philosophers that met regularly in London and Oxford, keen on exploring the "new science" espoused by Francis Bacon. One of those founding members was Robert Boyle, often called the first modern chemist. But he is best known for formulating a physical law on the relationship between absolute pressure and the volume of a gas.

Boyle was born in Ireland in 1627, one of 14 children. His father was the Earl of Cork and a wealthy landowner. Young Boyle was raised by a local foster family until the age of eight, and was fluent in Irish as well as Latin, Greek, and French. He went to Eton College when his mother died, with an Irish-speaking tutor in tow, although Boyle was apparently not much interested in practicing his mother tongue, preferring French and Latin. A trip to Florence, Italy in 1641 while living abroad introduced the precocious 14-year-old to the work of Galileo, who died while Boyle was there. He returned to England with a passion for science and math. He also had the means to pursue that passion when his father died and left him substantial property in both England and Ireland.

Robert Boyle



Engraving of Robert Boyle's "pneumatic engine" air pump and related instruments

Initially Boyle sought to be a writer, experimenting with many different forms, such as a treatise on morality and the pursuit of virtue. But then he built a home laboratory and began experimenting with microscope observations and chemical experiments. While he resided briefly in Ireland, he found it difficult to perform his chemistry experiments there. He spent much of his time in Oxford or London, becoming a member of a group of like-minded natural philosophers who dubbed themselves the "Invisible College." The group's core values were observation and experimentation, not just logical reasoning. Its motto: *nullus in verba*, or "Take nobody's word for it." It would eventually become the Royal Society of London for Improving Natural Knowledge.

In 1650, scientists across Europe were electrified at news of the world's first artificial vacuum, created by a German scientist named Otto von Guericke. He fit together two large copper hemispheres and used a vacuum pump — which he also invented — to pump out all the air, so that the surrounding air pressure continued to hold the hemispheres tightly together. To demonstrate just how strong that force was, von Guericke harnessed two teams of eight horses each to each hemisphere and set them moving in opposite directions. Even this didn't separate the hemispheres.

Boyle was intrigued by the reports and set about building his own "pneumatic engine" with Robert Hooke, then Boyle's assistant, whose gift for instrumentation proved useful in getting the rather awkwardly designed apparatus to work. They conducted many different experiments to determine the properties of air, specifically how "rarefied air" affected things like combustion, magnetism, sound, barometers, and various substances. Those observations became the basis for his 1660 book, *New Experiments Physico-Mechanicall, Touching the Spring of the Air, and its Effects (Made, for the Most Part, in a New Pneumatical Engine)*.

Although it received high praise upon publication, the book was not without its critics, most notably a Jesuit priest named Francis Linus. This was a time when many scientists believed the vacuum did not exist, arguing that Boyle's observations must be due to a previously unknown force. Boyle's exchanges with Linus resulted in a second edition in 1662, including an appendix addressing Linus's critiques with a reference to what we now call Boyle's Law (even though it was first formulated in 1661 by Henry Power): The volume of a gas varies inversely with the pressure of the gas.

Following that initial success, Boyle continued conducting chemistry experiments and publishing the results for the rest of his life. He expanded upon his vacuum pump work in *A Defence of the Doctrine Touching the Spring of the Air, Experiments and Considerations about the Porosity of Bodies*, and *Experimenta and Observationes Physicae*. He also wrote several medical treatises, and did experiments on crystals, electricity, color, hydrostatics, and the expansion of freezing water.

Among his quirkier contributions: a "wish list" of 24 possible inventions that eerily foreshadowed

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CIFS Briefs: Connecting Human Rights and Science for the Physics Community

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. In this column, CIFS describes some of the issues that the Committee is monitoring as well as the Society's other human rights activities.

Turkey

CIFS has been monitoring with concern the ongoing situation in Turkey, where thousands of academics have been removed from their positions and many universities have been closed following the attempted coup in July. CIFS is aware of at least 25 physicists who have lost their positions. In addition, one Turkish-American physicist, Serkan Golge, was arrested while visiting family in Turkey in July shortly after the coup attempt. The U.S. State Department has confirmed that it is aware of his situation and is actively working on his case.

In February 2016, APS President Homer Neal wrote to Turkish President Recep Tayyip Erdoğan to express the Society's concern about the detention and interrogation of signatories of the "We will not be a Party to This Crime" petition that called for an end to military operations in southeast Turkey. As a result of signing the petition, more than 1,000 academics were subjected to administrative and criminal proceedings. APS defended the right of free expression of scientists and researchers, and asked Turkish authorities to end all proceedings against these individuals. In August, APS signed a letter to President Erdoğan with the American Association for the Advancement of Science (AAAS) and other scientific associations that expressed concern for human rights after the coup attempt. The letter stated in part that "[t]he future prosperity and security of any nation depends on its ability to be a knowledge-based, innovative society and to a considerable extent on the work of its scientists, engineers, academics, and researchers."

Omid Kokabee

CIFS was elated when APS member and physics graduate student Omid Kokabee was released on parole in August after having served half of his ten-year prison sentence. He is recovering from kidney cancer that he was diagnosed with while in prison; he had a kidney removed in April.

APS members will recall that in 2011 Kokabee was arrested and detained in Evin prison in Tehran while trying to return to the University of Texas at Austin, where he was a graduate student. Kokabee has stated that Iranian authorities had asked him many times to participate in classified military research. However, he refused to engage in this research, resulting in his imprisonment. In 2014, Kokabee received the APS Andrei Sakharov Prize 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."

Imad al-Barghouti

CIFS is pleased that Palestinian astrophysicist Imad al-Barghouti — a professor at Al-Quds University in Jerusalem — was released from detention in Israel in November. He had been detained in April 2016 at a West Bank security checkpoint. CIFS had been concerned that he was being held without charge. In November, Barghouti was found guilty of "incitement" and sentenced to seven months in prison for posting information about politics in social media. However, he was released from detention for time served.

AAAS Science and Human Rights Coalition

APS will be represented at the next meeting of the AAAS Science and Human Rights Coalition that will be held January 26 - 27, 2017. The theme of the meeting is the Human Right to Water. Presentations will include examples of research that have informed policies to help prevent violations of this right. APS members

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modern technology. These included "the prolongation of life" and "the art of flying," as well as "making armour light and extremely hard" and "potent drugs to alter or exalt imagination." Almost all of his proposed inventions exist in some form today.

While he helped usher in the age of modern science, Boyle had a mystical bent, ever since he witnessed a particularly striking thunderstorm while traveling through Europe as a young man. He was a practicing alchemist, believing it was possible to transmute metals, even helping to repeal a statute prohibiting multiplying gold and silver, just in case he should succeed.

By 1669, Boyle's always frail health declined precipitously, to the point where he was unable to continue his involvement with the Royal Society, and he limited visitors to specific days in the London home he shared with his sister Katherine Jones, Lady Ranelagh — who shared his interest in science to such an extent that they edited each other's manuscripts. But he continued working privately on chemical experiments for the next 20 years, "as a kind of Hermetic legacy to studious disciples of that art." He died of paralysis on December 31, 1691, one week after his sister. And he contributed to science from beyond the grave, endowing the Boyle Lecture series.

Recommended Reading:

Brush, Stephen G. *The Kinetic Theory of Gases: An Anthology of Classic Papers with Historical Commentary*. History of Modern Physical Sciences Vol 1. Imperial College Press, 2003.

Canny, Nicholas, *The Upstart Earl: a Study of the Social and Mental World of Richard Boyle*. Cambridge: Cambridge University Press, 1982.

Profiles in Versatility

Mining Deep Space

By Alaina G. Levine

Stephen D. Covey is a grad school dropout. Inspired by the space race of the 1960s, he majored in physics at Wabash College, and then in 1971 joined the physics department at Ohio State University for a doctorate, all with an eye on a space-based career. "Unfortunately, we were also canceling the space program," he says. "I remember a lot of physics Ph.D.s were starting to push brooms because there weren't any jobs." A lover of both physics and computers, he ditched his doctorate dreams and joined a computing firm. "The easiest thing was to make my job in computer programming, and relegate my physics to a hobby."

He spent a good part of 25 years in computer consulting, database design, and operations for various companies. In 1996, a buddy approached him and asked him to join his telecommunications company, Applied Innovation, Inc., and Covey jumped at the chance "to come back into the physics world," he says. "I became Director of Research and Development (R&D) and got to play with lasers again." He remained with the firm for seven years, until the telecoms bust led to his layoff, and a subsequent call to his wife that they could finally move to Florida and retire.

But Covey isn't the retiring sort. Once in the Sunshine State, he became a licensed real estate agent and created websites to market golf course properties. But while he was busy helping sell habitats on Earth, ideas about habitats and travel in space continued to interest him. His mind stayed sharply tuned to opportunities where he could influence how humans interface with outer space and even move off-planet. "I was working behind the scenes on space stuff," he shares. He says that, in fact, he had never left the field entirely, reading the literature and staying abreast of research and scientific and technological innovations in and around the space industry.

In particular, Covey became captivated by an event that will happen on Friday the 13th of April, 2029. On that date, an asteroid will pass close (according to NASA) to Earth. Its name is 99942 Apophis, and relying heavily on his physics background, he began calculating how to change the trajectory of the asteroid or capture it entirely. This involved identifying one of the asteroid's "gravitational keyholes." If an asteroid passes through a small patch of space (the keyhole) just "behind" a planet in that planet's motion around the sun, the planet's gravitational force changes the asteroid's orbit, and a future pass through the same keyhole may cause an impact on the planet.

"I proposed targeting a keyhole that would pass close to the Moon in 2030 for a gravitational slingshot to capture Apophis into a very high Earth orbit," he says. "I recognized we can send a spacecraft up and make a small adjustment to put it into a very high Earth orbit for further study, or push it further away to prevent a future collision." Experts consulted for this article found Covey's proposals very speculative but possible in principle. They noted that the markets that would sustain this type of resource development have not yet been created. (The scientists preferred not to be identified to avoid promoting the activities of a particular company.)

Stephen D. Covey

He addressed his interests in space and asteroids on his blog, *Ramblings On the Future of Humanity*. But he also wrote up his calculations in a paper which he delivered at the 2010 International Space Development Conference (ISDC). There were other like-minded, science-educated space buffs in the audience, and they liked what Covey proposed. They all came together for coffee. They wanted to learn more. And it led to something very special. "We gathered as a group of individuals to discuss orbital changes, capturing asteroids, and space settlements. We were dreamers," he says. They called themselves the Asteroid Mining Group. "The original seven included four physicists and one of the world's greatest space artists, Brian Versteeg. There were also engineers and a lawyer."

This motley cosmo-crew continued their discussions over the next year, working out the details of the technological requirements of shifting and capturing asteroids. By the time the next ISDC rolled around, Covey wanted to use a 3-D printer in a space-based factory, with the raw material extracted from asteroids. "While we were at the Sheraton, I came up with a way to do it. There were no similar technologies," he says. The team filed a patent that day, for what Covey dubbed the MicroGravity Foundry. "It is the first 3-D printer that creates high-density, high-strength metal components even in zero gravity," he later wrote in a statement. "Other metal 3-D printers sinter powdered metal, which requires a gravity field and leaves a porous structure, or they use low-melting-point metals with less strength."

And a few days later, at the end of the 2012 conference, Covey and five other members of the Asteroid Mining Group met with some business executives and engineers, and together the group agreed to start Deep Space Industries (DSI). "It moved quickly." By the end of the year it was incorporated, and in January 2013, DSI announced its mission of developing the technologies to find, harvest, and supply the asteroid resources that will transform the space economy. It is one of a handful of companies operating in the sector dubbed "New Space," which focuses on unlocking the commercial potential of space-based resources and private spaceflight. Other enterprises in New Space include Planetary Resources, another asteroid mining firm, and Blue Origin.

Covey serves as DSI's Director of R&D and focuses on the production of marketable products from asteroid materials. Asteroids are rich in metal and water and if they could be mined, they might provide a supply of materials for space travel, habitation, and commerce. They could also serve to reduce the use of natural resources on Earth. So DSI is inventing technologies that can be used to identify and extract those resources from asteroids, and Covey is inventing mechanisms to build and sell products out of those resources.

For now, the plucky start-up is concentrating on building its exploration technology, intellectual property, winning government grants and commercial contracts, and attracting venture capital. It recently announced that it would be launching Prospector-X in 2017, a robotics spacecraft which will be used to test key technologies required for deep space resource exploration. The mission, supported in part by the government of Luxembourg, will operate in low Earth orbit and examine the viability of water-powered propulsion, radiation-tolerant deep space avionics, and optical navigation. The company is also looking to design products that can be used for customers interested in both earthly endeavors and star-bound enterprises.

One of Covey's current projects is partnering with NASA to develop a simulated asteroid material with which the agency can run spacecraft mission tests. "If you need tons of asteroid materials for tests, it doesn't work to just buy meteorites. It would cost more than a billion dollars for a ton. And no one would dream of gathering all of the meteorites and grinding them down," he says, somewhat jokingly. "My job for DSI is to develop the right mineral composition and turn the simulants into the right textures so they resemble actual asteroids."

One of the subjects that Covey dreams about is human habitation in the solar system. "Now I'm working on space settlement, which is my real passion," he says. "I'm a big believer in asteroid mining, but it's a way of supporting space settlement." With an eye on capturing asteroid resources and bringing them to near-Earth orbit, DSI could then develop products from those resources. For example, in principle, if the hydrogen and oxygen molecules from the water in the rock could be converted into rocket fuel without breaking

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Letters

Members may submit letters to letters@aps.org. APS reserves the right to select letters and edit for length and clarity.

What Robert Brown actually saw

The recent article on Robert Brown's discovery of Brownian motion (*APS News*, "This Month in Physics History," August/September 2016) states "Within those grains of pollen he noticed even smaller particles jiggling in seemingly random motions, as if they were alive."

That is incorrect. In a quest to understand plant reproduction, Brown had put some triangular shaped pollen of the plant Clarkia Pulchella into water. He saw through his high-powered one-lens microscope that the pollen burst at the corners. It ejected two kinds of particles, round ones and oblong ones, which then proceeded to undergo what we now call Brownian motion in the water. The fluid in the pollen is too viscous to allow Brownian motion to be observed within the pollen.

Brown pursued these observations with great avidity, which is why the motion is named after him. A major reason is that the round particles he saw appeared to be all the same size. This made him think for a while that, as atoms are the fundamental building blocks of inorganic matter, he had found the fundamental building blocks of organic matter — until he eventually found that all kinds of inorganic matter too, if ground small enough (including a fragment of the sphinx!), would move similarly.

Actually, the round particles are not all the same size, but are smaller than the wavelength of light, and Brown was observing their Airy diffraction disc. This point, as well as identification of the round particles (spherosomes, fat containers) and oblong particles (amyloplasts, starch containers) were made for the first time as part of an investigation into the history, botany and physics of Brown's discovery, detailed at physerver.hamilton.edu/Research/Brownian/index.html

This site also contains three brief videos of pollen bursting and the resulting Brownian motion, instructions how to build a microscope like Brown's from a readily available "ball lens," and photographs and analysis of observations made with this microscope, a modern optical microscope and an electron microscope.

A portion of the particularly physics-oriented material on this website was published as "What Brown saw and you can too," by P. Pearle, B. Collett, K. Bart, D. Bilderback, D. Newman and S. Samuels, *Am. J. Phys*. 78, 1278 (2010).

Phil Pearle
Clinton, NY,

Palestine Advanced Physics School

I was delighted to hear about the new Palestinian Advanced Physics School in West Bank, as described in the *APS News* article by Rachel Gaal. The Palestinians deserve a higher education as much as anyone else. It was a shame that the article had to be political in nature, discussing how the so called "Israeli occupation" is preventing access to students from Gaza. While it may be unfortunate that the Palestinian territories are not simply connected, I don't think that anyone would reasonably advocate for an open border policy at this time. Nobody expects the United States — or any other country for that matter — to have open borders, so I can't see why Israel should be the exception, especially given the tough neighborhood in which it is situated.

Wishing the best of luck to the new school, with hope that their travel complications are soon resolved.

Dov Rhodes
Falls Church, NY

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The article by Rachel Gaal entitled "First Palestine Advanced Physics School" in the October issue of *APS News*, tells of two successful gatherings of Palestinian students to hear about recent developments in physics. Requests by three students from Gaza to cross through Israel to attend one of the conferences were denied by Israel. This prompted David Marsh, one of the organizers of one of the conferences, to write:

"Access to higher education is a human right, and it is deeply regrettable that this right is not respected by the ongoing Israeli occupation."

The censure of Israel for violating the human right to higher education is disturbingly misplaced. Within its region, Israel is the only nation with successful affirmative action policies that have brought diversity and broad access to higher education. Judgments regarding travel to conferences in the Middle East cannot be made in isolation but must be balanced by the complexities of the security situation in the region.

Unfortunately, the students could not simply apply for a visa to travel through Israel to the conference since Gaza does not have diplomatic relations with Israel. This is because Gaza is committed via Hamas' founding charter and the organization of its society to the destruction of Israel. Nonetheless, Israel does grant travel permits for travel into Israel. It is hard to know why these were not granted in this case. But it might well have been because citizens of Gaza are taught, starting in kindergarten, that killing Jews is the way to glorious martyrdom. It is regrettable that the right of a nation to defend its citizens becomes for some an abuse of human rights when that nation is Israel.

Azriel Genack
Flushing, NY

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the bank, this could allow regular travel to Mars and beyond. "Our expectation is that we will bring the ores and the concentrates we take from the asteroids to the marketplace of Earth," he says. "We view ourselves as a commodity dealer. We are the grocery store of the [next] gold rush."

Education & Diversity Update

2017 APS March Meeting Childcare Grant: Application Deadline — January 10

The APS Committee on the Status of Women in Physics (CSWP) offers small grants up to $400 for meeting attendees who are bringing small children to a meeting or who incur extra expenses in leaving their children at home (i.e., extra daycare or babysitting services). Apply now at go.aps.org/Tcdl1h

2017 Joint Graduate Education and Bridge Program Conference: Registration Deadline — January 20

The 2017 Joint Graduate Education and Bridge Program Conference will be held on February 10 - 12 in College Park, Maryland. This conference will feature a graduate student poster session, networking opportunities, plenary talks on physics graduate education, and panels and discussions on diversity. Register now at go.aps.org/2gJgfPS

2017 PhysTEC Conference: Registration is Now Open

The 2017 Physics Teacher Education Coalition Conference will take place February 17 - 18 in Atlanta, GA. The annual conference of the Physics Teacher Education Coalition (PhysTEC) is the nation's largest meeting dedicated to the education of future physics teachers, and features workshops on best practices and panel discussions by national leaders, as well as excellent networking opportunities for physics teacher educators. Register now at go.aps.org/2gVWO9F

Meet the November Woman Physicist of the Month

Chiara M. F. Mingarelli is an Italo-Canadian gravitational-wave astrophysicist, currently based at the Max Planck Institute for Radio Astronomy (previously she was at Caltech), where she holds a Marie Curie Fellowship. Mingarelli received her Ph.D from the University of Birmingham (UK) in 2014. Her core research uses pulsar timing arrays to detect low-frequency gravitational waves and electromagnetic counterparts such as fast radio bursts. Mingarelli's thesis was published in the Springer Thesis Series (2015), and she is the recipient of numerous grants from the Royal Astronomical Society and the UK Institute of Physics for both research and outreach. She has written an invited guest article for *Scientific American*, and contributes to Amy Poehler's Smart Girls website.

Chiara M. F. Mingarelli

Nominate the next Woman Physicist of the Month at aps.org/programs/women/

CSWP Grants Funding to Women in Physics Groups

Congratulations to Women in Physics (WiP) groups at City College New York, Colby College, Drexel University, Georgia Tech, Rutgers, University of Colorado Boulder, University of Northern Iowa, University of Oregon, University of Wisconsin — Madison, Western Washington University, and the Virginia Military Institute! Each of these groups recently received funding from the APS Committee on the Status of Women in Physics to improve recruitment and retention of women in physics through the establishment of new WiP groups, expansion or strengthening of existing groups, and improvement in sustainability within new and existing groups. Applications are due in October of each year. More information about these grants can be found at go.aps.org/2gJgISt

1,600 Students Expected in January 2017 for Conferences for Undergraduate Women in Physics

This year, we received over 1,800 applications to APS Conferences for Undergraduate Women in Physics (CUWiP), which will take place simultaneously on January 13 - 15 at ten sites across the United States and Canada. We look forward to providing over 1,600 undergraduate women with the opportunity to experience a professional conference, information about graduate school and professions in physics, and access to other women in physics of all ages with whom they can share experiences, advice, and ideas. For more information about getting involved with a local CUWiP, please contact the local site organizers or women@aps.org

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cists." Bender will speak during the "Dannie Heineman Prize and Henry Primakoff Award Session" on Saturday, January 28.

The four coauthors of "The Higgs Hunter's Guide" were the recipients of the 2017 J. J. Sakurai Prize for Theoretical Particle Physics. Sally Dawson of Brookhaven National Laboratory, John F. Gunion of the University of California, Davis, Howard E. Haber of the University of California, Santa Cruz, and Gordon L. Kane of the University of Michigan, were honored for their "instrumental contributions to the theory of the Higgs boson." Each recipient will give a lecture in the same session on Monday, January 30, on the topics of "The Future of Higgs physics," "Extended Higgs Sectors," "Beyond the Standard Model," and the implications of an "M-Theory world."

Below is a list of invited spring 2017 prize and award winners who will be presenting their work at the April Meeting. Visit the meeting webiste for information on their scheduled sessions.

Hans A. Bethe Prize — Stuart L. Shapiro, "Cosmic Collisions Online — Compact Binary Mergers, Gravitational Waves and Gamma-Ray Bursts"

Tom W. Bonner Prize in Nuclear Physics — Charles F. Perdrisat, "The Elastic Form Factors of the Nucleon"

Edward A. Bouchet Award — Enrico J. Ramirez-Ruiz, "Heavy element synthesis in the Universe"

Joseph Burton Forum Award - Rush Holt - "Science Policy in the 21st Century"

Excellence in Physics Education Award — Howard Matis, "Contemporary Physics Education Project (CPEP) — an organization dedicated to presenting the latest physics discoveries in an understandable and colorful style"

Einstein Prize — Robert M. Wald, "Black Holes, Thermodynamics, and Quantum Theory"

Herman Feshbach Prize in Theoretical Nuclear Physics — Joseph Carlson, "Development of quantum monte carlo techniques"

W.K.H. Panofsky Prize in Experimental Particle Physics — Peter Jenni, "The Long Journey to the Higgs Boson: ATLAS," and Tejinder Virdee, "The Long Journey to the Higgs boson: CMS"

Francis M. Pipkin Award — Jens Dilling, "Nuclear physics mysteries revealed by precision ion trap measurements"

Henry Primakoff Award for Early-Career Particle Physics — Tracy R. Slatyer, "Constraint on the properties of dark matter using astrophysical and cosmological datasets"

Leo Szilard Lectureship Award - James Timbie - Technical Dimensions of Arms Control and Non-Proliferation Agreements

John Wheatley Award — Neil G. Turok, "How Physics Can Help Africa Transform, from a Problem to an Opportunity"

Robert R. Wilson Prize for Achievement in the Physics of Particle Accelerators — James Bjorken, "A Quantum Field Theory Approach to Intrabeam Scattering," Sekazi Mtingwa, "High Energy Approximations to IBS & Current Applications,"and Anton Piwinski, "Intrabeam Scattering and Touschek Effect"

2017 April Meeting website: aps.org/meetings/april/

International News

Theoretical Physics is Much More than Equations: Origins of the African School for Electronic Structure Methods and Applications

By Richard M. Martin

This story begins in 1987 when I moved to the University of Illinois at Urbana-Champaign, where one of my first students was Nithaya Chetty. He had grown up as "colored" in South Africa under apartheid, where success required the drive and strength that would also be needed years later. He excelled in school and was awarded a Fulbright fellowship that brought him to the University of Illinois. After postdocs in Denmark and at Brookhaven, he returned to South Africa in 1995 (after the end of apartheid) with the ambition to improve science education in South Africa and indeed in all of Africa.

Meanwhile I became involved in a program to provide clean water in Malawi, Africa, one of the poorest countries in the world. Our paths came together again in 1997, when I had the opportunity to travel to South Africa for a physics conference in the area of research that Chetty and I share. I went on to Malawi to help start the program for water wells. From this point on Chetty and I were drawn to work together because of our shared belief in the value of education and the need to provide opportunities for people in the developing countries of Africa — whether access to clean water or access to the world of research in physics.

The African School on Electronic Structure Methods and Applications (ASESMA) grew out of a confluence of events in the years leading up to 2008. South Africa was working to fulfill its opportunity to build up science in sub-Saharan Africa. Chetty had become president of the South African Institute of Physics and the first deputy director of the new National Institute for Theoretical Physics, among other roles. Scientists at the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, notably Sandro Scandolo, were committed to work in developing countries. In addition, they had developed computational codes for density functional calculations along with tutorials and workshop materials. Density functional theory had become one of the most widely-applied methods in physics with increasing impact in chemistry, materials science, and other fields. ASESMA emerged from the conviction that first-rate science could be done with limited resources by African researchers if they had the opportunity to learn and work side-by-side with others in the global endeavor of science!

The initial ASESMA workshop was held in 2008 at the African Institute for Mathematical Sciences in Cape Town, organized by Chetty, Scandolo, and myself, along with Daniel Joubert, a professor at the University of the Witwatersrand in Johannesburg. Students and scientists from many countries attended. After the workshop concluded, it became clear that many of the participants needed further help and interaction. This led to the vision of a series of workshops held every two years to foster collaborations and build up scientific infrastructure.

Paul Koutayi

Group Photo for ASESMA 2016 in Accra, Ghana, showing officials of the University of Ghana, participants, mentors and the lecturers who could be present the first day (The author is near the front in the red shirt.)

The foundation for a series of workshops until 2020 was the endorsement by the International Union for Pure and Applied Physics (IUPAP). This a story of how diverse physicists together make a difference. The joint support by IUPAP commissions on physics development, computational physics, physics education, and structure and dynamics of condensed matter came about only because of people like Peter Borcherds (University of Birmingham in England), Jim Gubernatis (Los Alamos National Laboratory) and Kennedy Reed (Lawrence Livermore National Laboratory), along with Chetty and Scandolo. Through the years the workshops have been supported by the ICTP and other agencies, including the South African National Institute for Theoretical Physics and the APS Division of Computational Physics.

Up to now ASESMA workshops have been held in Cape Town in 2010, Eldoret, Kenya in 2012, Johannesburg in 2015, and Accra, Ghana in 2016. (Unfortunately the 2014 school in Abuja, Nigeria was cancelled due to the violence in Nigeria and rescheduled in Johannesburg.) Each school enrolls about 40 participants; approximately half are attending their first workshop, and half are returning participants, who are developing new expertise and also helping the new students. In each case there have been participants from at least 10 different countries, with 13 sub-Saharan countries represented at the 2016 school in Ghana. (See photo.) There are now several groups actively working on electronic structure problems in various parts of Africa, and mini-ASESMA meetings have been held in Khartoum and Brazzaville.

Each ASESMA workshop has involved outstanding scientists from developed countries who gave their time and in many cases provided their own support. One aspect of ASESMA that is particularly notable is the role of "mentors,"

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CIFS BRIEFS continued from page 3

attending the APS April Meeting in Washington, D.C., January 28 - 31, 2017, are encouraged to attend the Coalition meeting, which will also be held in Washington, D.C., at AAAS headquarters.

The AAAS Science and Human Rights Coalition is a network of scientific associations and societies that facilitates communication and cooperation on the topic of human rights both within the scientific community as well as between the human rights and scientific communities. Coalition members recognize that there is a connection between science and human rights and that scientists have an important role to play in the realization of human rights.

Mikhail Danilov

In 2013, CIFS watched with concern when the Russian government proposed and subsequently passed legislation to reorganize the Russian Academy of Sciences (RAS). Many critics of the legislation had claimed that it would inhibit the independence of the RAS as well as counteract its attempts to uphold the high standards of Russian science. In response to his views concerning the controversial legislation, world-renowned experimental physicist Mikhail Danilov was forced to resign his position as Deputy Director for Particle Physics at the Institute for Theoretical and Experimental Physics (ITEP) in Moscow. He was subsequently fired from ITEP in 2015. Despite these circumstances, CIFS is pleased to report that Danilov was recently elected Academician of the RAS. We congratulate him and thank him for his commitment to science, especially under difficult circumstances.

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Albert Einstein, who joined as one of the Institute's first professors just three years after its establishment. Einstein remained at the Institute until his death in 1955, leaving a 20-year legacy in the history of the Institute's growth and reputation.

"One thing Einstein did here was his work on the EPR (Einstein-Podolsky-Rosen Paradox), so I feel in some sense we are appropriately awarding the entangled lives of European and American physics," joked the Director of the Institute, Robbert Dijkgraaf, at the ceremony.

"As many of you know, a year ago we had a celebration of the first APS-EPS joint site in Switzerland at the Einstein House," added APS CEO Kate Kirby. "Now to a certain extent, this [ceremony] completes the journey of Einstein here to the U.S., and we are delighted to be recognizing the Institute."

Created in 2004, the APS Historic Sites Initiative was started by the APS Executive Board to raise public awareness of physics. In pursuit of this mission, the Society established a Historic Sites selection committee to evaluate potential historic physics sites in the U.S. When a site is chosen, a ceremony is arranged at which a plaque is presented by members of the APS presidential line.

"The APS historic sites initiative started 12 years ago, and since then it has recognized about 40 sites around the U.S.," Kirby continued. "Its focus is on bringing significant events in physics to the public's attention, which I think is a great tradition."

Author and historian George Dyson gave a public lecture at the ceremony. His father, Freeman Dyson (who attended the ceremony), joined the Institute as professor of physics in 1953. George was born the same year, and eventually became the Director's Visitor at IAS between 2002 and 2003, where he spent his time exploring the Institute's archives.

His presentation, titled "The Institute for Advanced Study: The First 100 Years," encapsulated his story of how and why the Institute came into being. As a witness to historical firsts in science research and significant events at the Institute, he attracted a large crowd.

One of the major innovations that stemmed from the Institute was John von Neumann's Electronic Computer Project. With no laboratory facilities at Neumann's arrival in 1945, his idea was forced to slowly take shape in the basement of the Institute's Fuld Hall.

"[John von Neumann, Oswald Veblen, and Frank Aydelotte] were proposing to do what we take for granted today — they wanted to build a global model of all the weather in the world," explained Dyson. "This grand vision, that the weather in the world could be modeled inside these digital vacuum tubes faster than the weather itself … [to eventually] run the model and then make predictions."

In recognition of the joint honor, the president of EPS Christophe Rossel presented both Neal and Dijkgraff with individual copies of *Albert Einstein*: *Those Happy Bernese Years*, by Ann M. Hentschel, Gerd Grasshoff, and Karl Wolfgang Graff.

The plaque is located at the entrance of Bloomberg Hall, and was officially commemorated on November 9, 2016. To watch the recorded lecture, visit the IAS webpage at go.aps.org/2gJiiUc

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expect [some] to survive in one way or another into the future."

Initiatives related to climate change, including the Clean Energy Investment Initiative and the National Climate Assessment, face stronger political headwinds; Trump's plan to cancel billions in payments to U.N. climate change programs and instead use the money to fix America's water and environmental infrastructure is likely based on his statement in *sciencedebate.org* that "There is still much that needs to be investigated in the field of 'climate change.'" In social media venues, Trump has stated his belief that human-caused climate change is a "hoax," however in a recent *New York Times* interview he said that there is "some connectivity" between climate change and human activity.

Funding for climate research may end up shrinking or being left for private funders to pick up, given that the Competitive Enterprise Institute's Myron Ebell will head Trump's Environmental Protection Agency (EPA) transition team. The future of EPA is uncertain, and there is related concern about Ebell's intentions if he serves in the administration. A C-Span interview back in August 2015 featured Ebell asking for more funding for coal companies to "combat the nonsense put out by the environmental movement."

For other areas of science, and especially the physical sciences, it is hard to estimate where things are headed. The Trump campaign did not respond to APS' five questions on topics of interest to the physics community in September 2016. And the APS Physics Policy Committee is now preparing a "transition document" with a list of science policy recommendations for the new administration.

Pieces of the NASA puzzle are slowly fitting together, with Trump's recent announcement that Christopher Shank will head the transition in space activity. Known as an "insider" to space agencies, Shank worked for NASA between 2005 and 2009, where he was responsible for the agencies' budget and strategic communications. This choice comes to a relief for many worried about Trump's plans to shift NASA research away from earth science research to space exploration. Bob Walker, a senior Trump campaign advisor, told *The Guardian* that "Earth-centric science is better placed at other agencies where it is their prime mission."

Among other clues are Trump's statements in *Aerospace America*'s "10 Questions for the Candidates", where he asserted his priority is "to restore a strong economic base" to the country. "Then, we can have a discussion about spending… [And] we can take a look at the timeline for sending more people into space," he told Aerospace America.

Spending as a whole for R&D covers much more than space exploration — scores of government funding agencies supply money for the biological, geological, and technology-driven research, to name a few.

"I think there [are] a couple of things to keep in mind," commented Goldston during the AAAS webinar. "In terms of budget, the greatest determining factor in the size of research spending is what happens to [the] budget for domestic spending as a whole."

The settled budget for Fiscal Year 2017 tops out at just over $4 trillion, with over half allocated for mandatory spending, and about $1.2 trillion left over for discretionary costs. Trump's "Penny Plan" to shrink all non-defense discretionary spending by one percent per year, as opposed to letting the whole budget grow roughly with inflation, could likewise force federal R&D spending to shrink in relation to defense budgets. Over half of the discretionary budget goes to military funding, and the rest must pay for all other domestic projects. The resulting effect on funding for federal science agencies has become a hot topic among young researchers concerned about their future grant proposals.

"Grants from scientific funding agencies, such as NSF, tend to be three to five years in duration, so any effect, especially a decrease, will be spread out over several years," assured Rohlfing during the AAAS webinar.

Holt added, "I think it depends how soon the administration appoints a science advisor and what kind of portfolio they are given." He has urged Trump to "appoint a respected scientist or engineer" as the director of the Office of Science and Technology Policy (OSTP) for immediate input on decision-making in his early administration. The AAAS recently teamed up with the leaders of 29 U.S. scientific and higher education organizations, including APS, to formally ask the President-elect to "quickly appoint a nationally respected leader with appropriate engineering, scientific, management and policy skills to serve as Assistant to the President for Science and Technology", and requested a meeting to suggest candidates to fill the role.

Besides a statement reported by *ScienceDebate.org* that Trump wants to commit to "invest[ing] in science, engineering, health care, and other areas," there is little evidence to gauge Trump's plans for pushing forward with science R&D that is federally funded.

The American Institute of Physics (AIP) science policy bulletin, *FYI*, is also involved in post-election analysis. Mike Henry (the director of science policy for AIP) and his team of policy analysts are looking back on the roles of past OSTP directors to best assess what the science advisor's role will look like:

"Beginning with Franklin Roosevelt, who was advised by Vannevar Bush, every president has had a science advisor," Henry told *APS News*. "Since 1976, the advisor has also served as director of the White House Office of Science and Technology Policy. Whether Trump continues this long presidential tradition and elevates the role of science in the nation's governance remains to be seen. … A big question is whether this will change when Trump is in office and would benefit from the counsel of scientists."

Some notable advocates of R&D, like Senator Barbara Mikulski (D-MD) and Representative Mike Honda (D-CA), will not be returning after the lame-duck session concludes. Mikulski announced her retirement at the beginning of the fiscal year 2016, while Honda lost his re-election bid, and now their positions on the committees that appropriate science funding are up for grabs.

"It really is important how an administration is populated, not only at the cabinet level … but at some of the less visible levels," Goldston added. "[Trump has] 4000 appointments he can make … those people really make a difference."

Holt pushed the webinar audience to participate and get involved. "The current transition is an excellent opportunity for young scientists and engineers to engage now with the public and many different audiences, to explain the work you do, and why it's important for expanding human knowledge and improving people's lives," he stated at the beginning of the webinar.

For now, many questions will remain unanswered until Trump and his team publicly announce their appointments.

Additional Resources

The AAAS webinar is archived online: go.aps.org/2gMKQMw

AIP's Federal Science Budget Tracker: go.aps.org/2gZeyAY

APS Office of Public Affairs: aps.org/policy/

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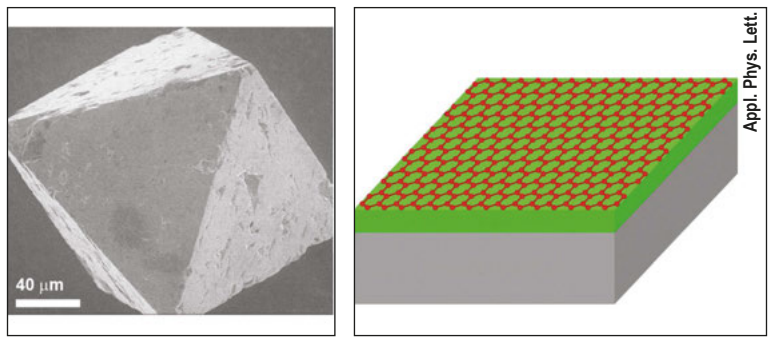
Physics "Connecting the Bright and Dark Sides of Galaxies" by Arthur Kosowsky at go.aps.org/2gJi9jq)

Diamond May Be Graphene's Best Friend

Researchers have grown high-quality graphene sheets on the surface of a diamond crystal, offering a robust new method for engineering graphene devices. Graphene is a one-atom-thick layer of carbon with amazing properties, such as high electron mobility, that make it potentially useful for touchscreens, solar cells, and many other electronic applications. However, one challenge has been finding a suitable support material. Simply placing graphene on top of an insulator, like silicon dioxide, can degrade its properties, whereas growing it directly on a substrate, such as silicon carbide, can introduce defects. As reported in *Applied Physics Letters* (dx.doi.org/10.1063/1.4964710), Gu et al. doped a single crystal of diamond with boron atoms. They were guided by their own first-principles calculations, which showed that carefully controlled boron doping can deform the crystal lattice such that the diamond surface forms a hexagonal structure — ideal for graphene growth. Using chemical vapor deposition, the team produced single-layer, as well as multilayer, graphene on their doped diamond. Spectral analysis revealed no sign of defects in the graphene, and electronic measurements confirmed that the sheets featured high electron mobility.



High-quality graphene has been grown on diamond substrates.

Cosmic Rays Punch Through Earth's Magnetic Barrier

New observations from the GRAPES-3 cosmic-ray telescope in India show that an unusually high flux of cosmic rays breached Earth's magnetosphere on June 21, 2015, following a violent solar flare, as reported in *Physical Review Letters* by Mohanty et al. (doi.org/10.1103/PhysRevLett.117.171101). The magnetosphere acts as a protective shield, deflecting bursts of plasma ejected from the Sun that cause electromagnetic disruptions on Earth. On this date, the geomagnetic storm was powerful enough to knock out radio transmission in North and South America and researchers observed a two-hour cosmic-ray shower. Numerical simulations performed by the GRAPES-3 collaboration, which includes researchers from India and Japan, suggest that the burst of cosmic rays was able to enter because the geomagnetic storm temporarily weakened Earth's polar magnetic field. This vulnerability can occur when magnetized plasma from the Sun deforms Earth's magnetic field, stretching its shape at the poles and diminishing its ability to deflect charged particles. The analysis performed by the GRAPES-3 researchers suggest that this is exactly what happened following the solar flare, allowing the cosmic-ray breach that their telescope detected. (For more, see the Synopsis "A Crack in Earth's Protective Shield" in *Physics* at go.aps.org/2gJbJRJ)

3D Holography From All Angles

Star Wars fans rejoice! Tabletop holograms like those of the Jedi knights in faraway galaxies are starting to approach reality now that researchers have created a 360-degree holographic viewing experience. Lim et al. published their results in *Optics Express* (DOI: 10.1364/OE.24.024999) describing an optical system consisting of four high-speed digital micromirror displays that formed a holographic image. This image is sent through a rotating mirror system that sweeps it horizontally so that viewers can see it from any position while walking around the device. The resulting hologram was just over an inch in size, so the team used additional optics to magnify it, almost tripling its size. Since this magnification system was composed of two confocal parabolic mirrors, the optical rays exiting such mirrors would be distorted at the angle of the observer. To get around this, the team inserted an aspheric lens between the mirrors, which compensated for the distortion. The next challenges to undertake are reducing the system to a practical size and adapting it to full-color operation.

ASESMA continued from page 5

advanced students and postdocs who work with the participants, providing a much richer and more valuable experience than just listening to lecturers. At first all the mentors were from Europe and the United States, but increasingly they are experienced Africans. More senior leadership is also increasing, most notably George Amolo, who organized ASESMA in Kenya in 2012 and who is now the head of its Executive Committee.

ASESMA has been a rewarding experience for everyone involved. I have been the primary organizer of the program, and it is heartwarming to get the messages from lecturers and mentors saying "Thank you for getting me involved!" (not to speak of the overflowing appreciation by the participants!)

Bringing together people from many African countries has effects I did not anticipate. For example, the organizers of the 2016 school arranged an excursion to the oldest "slave castle," Elmina Castle near Cape Coast, Ghana, where slaves were held until they were loaded onto ships for the Americas, at least those who survived the wretched slave dungeons. It was the first time that most of the African participants from other countries had visited such places, and it was a moving experience to be with them. On a happier note, the spirit of the participants has shown through at each school. In addition to traditional awards at the end of the school, like "best all around" and "most improved," one of the best is "most joyful," which represents a vital aspect of ASESMA!

Further information on ASESMA can be found at the website www.asesma.org which is maintained by Sinead Griffin, one of the outstanding mentors. There are also articles in *Physics Today*, *Nature Physics*, the newsletter of the APS Forum on International Physics, and other publications. Links to the articles are given at the ASESMA website.

Richard M. Martin is retired from the Department of Physics at the University of Illinois at Urbana-Champaign and is an adjunct professor in the Department of Applied Physics at Stanford University.

ANNOUNCEMENTS

APS physics MARCH MEETING2017

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GO.APS.ORG/MM17-REG

Reviews of Modern Physics

Strangeness in nuclear physics

A. Gal, E. V. Hungerford, and D. J. Millener

Everyday matter is made of the lightest up and down quarks. The strange quark is the third lightest of all quarks. Strangeness, a property of particles associated with the number of strange quarks, preceded the theory and discovery of the quark by about two decades. Recent experimental and theoretical developments in the field of strangeness in nuclei are reviewed. Topics include the production of strange particles, properties of hypernuclei, and strange dense matter.

doi.org/10.1103/RevModPhys.88.035004

journals.aps.org/rmp

NOMINATE A HISTORICAL PHYSICS LANDMARK

to be considered as an APS Historic Site

Each year, APS recognizes a small number of historic physics sites in the U.S. (and occasionally abroad).

Nominations received by January 15, 2017 are eligible for consideration in 2017.

go.aps.org/historic-sites-2017

2017 PhysTEC CONFERENCE

Preceding the AAPT Winter Meeting

February 17 - 18, 2017
Atlanta, Georgia

Attend the nation's largest meeting dedicated to the education of future physics teachers. Featuring:

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- Networking
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Physics Teacher Education Coalition

APS physics | NSF | AAPT PHYSICS EDUCATION

REGISTER BY FEBRUARY 3
phystec.org/conferences/2017

2017 - 2018 APS Congressional Science Fellowship

THE AMERICAN PHYSICAL SOCIETY is currently accepting applications for the **Congressional Science Fellowship Program.** Fellows serve one year on the staff of a senator, representative or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows have the opportunity to lend scientific and technical expertise to public policy issues.

QUALIFICATIONS include a Ph.D. or equivalent in physics or a closely related field, a strong interest in science and technology policy and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be members of the APS.

TERM OF APPOINTMENT is one year, beginning in September of 2017 with participation in a two week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

A STIPEND is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

APPLICATION should consist of a letter of intent of no more than two pages, a two-page resume with one additional page for publications, and three letters of reference.

For detailed information on materials required for applying and additional program information visit **aps.org/policy/fellowships/congressional.cfm**

All application materials must be submitted online by 5:00 PM EST on January 13, 2017.

As the year-end approaches and you are faced with numerous charitable requests, please keep APS at the top of your list. Donations to APS allow us to continue to run outreach and education programs of the highest quality. PhysTEC, for example, is designed to address the severe, long-term shortage of qualified high-school physics teachers in the U.S.

Please make your contribution now at **aps.org/donate**

Or, to learn more about other ways to give, including planned giving, please contact Irene I. Lukoff, APS Director of Development, at lukoff@aps.org or (301) 209-3223.

APS physics | National Mentoring Community

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The Back Page

Celebrating a Century of Optics Innovation – Parallels of OSA and APS

By Robert L. Byer

Physics and optics have always been intertwined. APS was founded in 1899 and The Optical Society (OSA) in 1916 for similar purposes — to share research and offer opportunities for collaboration, thereby expanding the field of knowledge and raising the visibility of science. It was amid the backdrop of World War I that OSA's founder and optical physicist Perley G. Nutting, who had recently joined Eastman Kodak from the U.S. Bureau of Standards, was inspired to improve collaboration among industry, government, and academia to address changing market conditions. The United States lacked its own optical glass and optical manufacturing infrastructure, and scientific collaboration was a challenge. Nutting, along with 30 charter members including Adolph Lomb, who served as OSA's treasurer until his death in 1932, created a professional society to focus on advancing applied optics organized around the themes of photography, vision, optical materials and optical instruments.

Since that time, you could argue that optics has changed everything. Barcodes make shopping a breeze. MRIs detect injury and disease. Cameras capture life on Facebook and Instagram, as well as speeding cars. Telescopes found how big our universe really is and discovered that Pluto is a dwarf planet. Lasers confirmed the presence of gravitational waves, remove wrinkles from our skin, and restore our vision. Sensors adjust the headlights on a car, change the lighting in a room, and provide security. LIDAR systems guide autonomous vehicles. And these are but a few recent examples. For the last century, The Optical Society and its more than 19,275 global members have been at the forefront of these innovations — and often in partnership with APS colleagues, who number more than 50,000 around the world.

OSA CEO Liz Rogan, OSA President Alan Willner and U.S. Congresswoman Louise Slaughter pose with Nobel Laureates and students from East High School in Rochester after the Light the Future centennial program featuring futurist Michio Kaku on October 20, 2016.

Highlights in the Science of Light and Physics

Optics and physics share many historical firsts and common theoretical foundations. Among the many in color, spectroscopy, and optical fabrication, a few seminal discoveries are worth highlighting. Many more are listed on a timeline celebrating the 100th anniversary of The Optical Society.

Einstein earned the 1921 Nobel Prize in Physics for his work on the photoelectric effect, which described light, for the first time, in terms of photons rather than waves. Einstein's prediction of the existence of gravitational waves in 1916 was confirmed by LIGO using a quantum noise-limited ring laser (NPRO, invented by R. L. Byer) 100 years later in 2016. Max Planck won the 1918 Nobel Prize in Physics for his discovery that energy flowed in discrete packets that he described as quanta — signaling the shift between classical and quantum physics. Planck's constant, h, determines the amount of energy carried by a photon, which is a quantum of light.

In 1933, OSA established a colorimetry committee to update an out-of-print report on color. This led to 20 years of persistent work resulting in the landmark publication of The Science of Color in 1953, which realized eight printings, the last in 1999 — the year of APS' centennial.

A few other OSA firsts: The neon sign was invented by our founder in 1904. Edwin Land, who invented the Polaroid camera, demonstrated the technology in 1947 at an OSA meeting. Xerography, the commercial name given to electrophotography developed by Chester Carlson, was demonstrated at OSA's annual meeting in 1948.

Shared History of APS and OSA

The Optical Society's strength in its first half-century was applied optics. The post WWII "Big Science" funding supported the invention of the laser in 1960, and optics came into to its own for basic scientific research and discovery. The laser also impacted the scientific ecosystem, and APS established its Division of Laser Science (DLS) to address this transformational change. The laser spawned new journals such as *Applied Optics* and meetings like CLEO, as well.

Around the same time, science as a global enterprise was expanding. By 1965, OSA's membership grew to 4,429 members, including 328 individuals from 38 countries outside of North America — a tenfold increase from pre-WWII levels. Both OSA and APS recognize their unique positions in the global scientific enterprise, and their volunteer leadership reflects the diversity of their membership.

Although US-based societies, they actively foster a global reach in physics and optics through conference programming, journals, and awards. To engage the next generation of leaders, OSA and APS invest in students and early career professionals providing travel grants, awards, mentorship, and other professional development opportunities. The first OSA student chapter was founded in 1982 in Rochester, NY. Today, there are more than 350 student chapters around the world.

Both societies have also committed to advancing gender diversity in the sciences and helping women in STEM through programming and advocacy. APS and OSA are professionally managed by chief executive officers (CEOs) who have a long and successful history with their respective societies. Liz Rogan of OSA and Kate Kirby, the first CEO of APS, are exemplary role models for those interested in STEM fields of study.

The two societies also share a commitment to advocacy. In the United States, their public policy programs educate policy makers about the importance of federal investment in research and development and how innovation supports competitiveness. Both Rogan and Kirby have championed coalitions to advance the understanding of the role of science — be it physics, optics or medicine — with Congress and federal agencies as well as the general public. The Optical Society is a founding sponsor of the National Photonics Initiative (NPI), a collaborative alliance among industry, academia, and government to raise awareness of photonics and the impact of photonics on our everyday lives; increase cooperation and coordination among U.S. industry, government, and academia to advance photonics-driven fields; and drive U.S. funding and investment in areas of photonics critical to maintaining U.S. economic competitiveness and national security. APS is a sponsor of NPI.

APS led the establishment of Science Counts, a non-profit 501(c)(3) organization dedicated to enhancing the public's awareness of, and support for, federally-funded scientific research. OSA is a supporting partner. Both societies also participate in the American Innovation Task Force and the annual Science, Engineering, Technology Congressional Visits Day, as well as sponsor Congressional Fellows who serve as science advisors to members of Congress — ensuring that the voice of scientists are represented in the crafting of science policy.

While an anniversary is time to reflect on the achievements of the past, it is also an opportunity to address the future and potential challenges. For example, there remains a need to take special steps to support the scientific enterprise in less developed countries in the world. The continuing evolution of the publishing enterprise and the push for open access to scientific research also has the potential to impact all non-profit scientific societies. These and the continuing efforts to explain the fundamental benefits of scientific research to our economy, security, and quality of life are central to the mission of both societies.

As a past president of OSA and APS, as well as a member of OSA's Centennial Advisory Panel, I'm proud to have served the optics and physics communities. The strength of membership is the individuals sharing knowledge and helping deliver science to local constituencies — be that a geographic region or topical research area. The resources provided by science societies help us all deliver cutting edge research and develop new applications. For more than a century, both APS and OSA have been advancing the physical sciences. OSA has been the leading global society for the optics and photonics community and serves to promote the generation, application, and archiving of knowledge in optics and photonics and to disseminate this knowledge worldwide. I'm confident that the next century holds many more paradigm shifting discoveries, and that our science societies will be there to help navigate the path.

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