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Inside the Oil Spill Commission
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Congressman "Lights Up"

Photo by Michael Lucibella

At a reception on Capitol Hill on April 6, the Science-Engineering-Technology Working Group (SETWG), to which APS belongs, presented two members of Congress with the George E. Brown, Jr. Leadership Award for their work on issues related to science, technology and engineering. In the photo, APS Head of Public Outreach Becky Thompson (right) gives an LED "throwie" to Congressman Daniel Lipinski (D-IL), one of the Award recipients. At the reception, APS distributed throwies, which are battery-powered LEDs with magnets attached, to the attendees in 3 patriotic colors, red (for the Republicans), white (for the independents) and blue (for the Democrats). The second Brown Award recipient was Senator Kay Bailey Hutchison (R-TX).

The following day was Congressional Visits Day, sponsored by 31 professional societies and related organizations, in which some 270 members of the science and engineering community came to Washington from all over the country to participate. They visited an estimated 350 different Congressional offices (out of a possible 535).

Promise Lies Ahead for Superconductivity After 100 Years

The centennial celebration of superconductivity was the talk of this year's March Meeting. Both researchers and historians took time to reflect on the serendipitous discovery of superconductivity, and speculate about its future promise for the world. The Kavli Foundation sponsored two sessions on the history and future of the effect, one of which featured five Nobel Laureates. Dozens of sessions focused on applications and basic research in the field. Even before the meeting started, the Industrial Physics Forum, organized by the American Institute of Physics, highlighted current and future areas of research and industrial applications.

A common theme for those speaking was how the story of superconductors has been filled with unexpected discoveries. In 1911, Heike Kamerlingh Onnes, the Dutch physicist who would later win a Nobel Prize for liquefying helium, was measuring the resistance of mercury when his instruments showed that it dropped to zero at four degrees Kelvin. At first he thought the results stemmed from a short in his equipment because it was an effect that no one had predicted.

Once he realized that his experiments were sound, this unexpected effect became the focus of intense study. From the start, the promise of dissipationless electricity was evident. Laura Greene of the University of Illinois at Urbana-Champaign pointed to a press release from Onnes' lab in 1920 that said superconductivity would lead to "better energy storage, better magnets and helping the energy crisis."

Today superconductivity continues to be an active field of research. Five Nobel prizes have been awarded for research on understanding the mechanisms behind superconductors. Materials physicists the world over have been working to develop high temperature superconductors.

"Materials are very important for superconductivity. In fact they drove most of the advances in the last century," said George Crabtree of Argonne National Laboratory. "Superconductivity has in many ways led the field of condensed matter physics."

An ultimate goal is to develop a material that superconducts at room temperature. It's been a long and difficult search. Researchers have been pushing the envelope slowly but surely. For the first seventy years or so, the high temperature limit of superconductors kept climbing on average of about a degree a year.

Then in 1986, scientists at IBM's Zurich Research Lab discovered that copper-oxide-based materials can superconduct at temperatures warmer than any previously known. Soon there were examples above the temperature of liquid nitrogen. The goal of a room temperature superconductor seemed tantalizingly

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Fukushima Disaster Alters Dialogue at Nuclear Session

By Eric Betz

With a nuclear meltdown underway at the Fukushima Nuclear Power Complex in Japan, a previously planned session at the March Meeting on the future of nuclear energy took on a decidedly different tone than the presenters had planned, and one of the presenters, Toshikazu Suzuki, of Japan's National Institute of Radiological Science, was forced to cancel because of his role in the nuclear remediation efforts at the ailing plant.

The Tuesday session was titled "Drowning in Carbon: The imperative of nuclear power," however, the focus turned to fallout from the nuclear disaster.

"Everything worked exactly as it should," said Raymond Orbach, director of the Energy Institute at the University of Texas at Austin, "except for the tsunami."

Orbach, who had served as Under Secretary of Energy for Science in the George W. Bush administration, broke down a blow-by-blow sequence of the partial meltdown and said that much of the problem stemmed from the fact that the spent fuel being stored in the reactor building was four times larger than that actually in the reactor. Instead of transporting the spent fuel away from the site or storing it in a nearby cooling pond as is done in the US, the Japanese had simply kept the material in the building.

"There needs to be some movement of spent fuel rods away from the facility," said Orbach, "and that was not done."

Photo by Mary Catherine Adams

Panelists from the "Drowning in Carbon: The Imperative of Nuclear Power" session answer questions from the audience. From left to right are Robert Rosner (U of Chicago), Lee Schroeder (LBNL and TechSource), Victor Reis (Department of Energy), and Jay Davis (Hertz Foundation and formerly of LLNL). Raymond Orbach of the University of Texas spoke at the session but had to leave before the panel discussion.

According to Orbach, the plant survived the earthquake in good shape, but after the tsunami hit, all the back-up generators failed and the batteries were soon exhausted. The power company then tried to alleviate the problem by venting steam from the reactor, which also didn't work, he said. At that point, a process called core oxidization started occurring rapidly, creating corrium–a lava-like mixture of materials that forms inside a nuclear reactor during a meltdown–which generated huge amounts hydrogen inside the building until it finally

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New Awards Issue a Call for Nominations

Several new APS awards are making their debut this year, and those interested are urged to get them off to a good start by nominating worthy candidates.

First up is the Stanley Corrsin Award in Fluid Dynamics, intended as a mid-career award, for which the nomination deadline is May 31. Two new awards with deadlines of July 1 are the Landau-Spitzer Award in Plasma Physics, which will be administered jointly with the European Physical Society, and the Henry Primakoff Award for Early-Career Particle Physics, which will recognize outstanding research in elementary-particle physics performed by a physicist who has held the PhD for no more than 7 years, plus any career breaks.

A new dissertation award in theoretical particle physics, with an October 1 deadline, will complement the Tanaka Dissertation Award for experimental particle physics.

Information about all of the awards mentioned above, as well as instructions for nomination, can be found in the prize and award section of the APS website at www.aps.org (under "Programs"). In addition, an award administered by the Committee on Education will recognize programmatic excellence in undergraduate physics education. More information about it can be found in the Education Corner column in this issue of *APS News*.

March Meeting Teems with Graphene Talks

By Eric Betz

Few discoveries in physics have yielded a Nobel prize as quickly as Konstantin Novoselov and Andre Geim's 2004 breakthrough in graphene. Research on the subject has exploded in the seven years since then, and this year's March Meeting strongly reflected that trend.

"It opened up this Pandora's box" said Novoselov in his lecture at the meeting. "I'm sure it will keep us busy for quite a few years because of that."

So many wanted to attend Novoselov's lecture that the center divider had to be removed between the lecture hall Novoselov was scheduled to speak in and the room next door. Even then, many sat on the floor or leaned along the walls.

Beginning his lecture by chiding other graphene speakers for skipping their introductions because they said everyone else had already given one, Novoselov took the time to trace a history of the two-dimensional substance from the discovery of graphite 500 years ago, through buckyballs and carbon nanotubes and on to the current status of graphene research.

"Each of you has synthesized graphene many times," he told the audience, adding that "every time you use a pencil, you create one-atom-thick layers of graphite on

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"The idea is pretty simple. It posits that social groups that have more members are going to be more attractive to join, and it posits that social groups have a social status or utility. For example in languages, there can be greater utility or status in speaking Spanish instead of [the dying language] Quechuan in Peru, and similarly there's some kind of status or utility in being a member of a religion or not."

***Richard Wiener**, Research Corporation for Science Advancement, on why belief in religion is on the decline,* BBCNews.com*, March 22, 2011.*

"If you're positioned between two major financial hubs, you may be far out of the way, rather far from population centers, maybe economically poor, but because of your unique position, that could be a natural resource."

***Alexander Wissner-Gross**, Harvard University, on developing a global stock trading system,* BBCNews.com*, March 22, 2011*

"You can only do your quantum magic as long as you have coherence… If you have a lifetime of milliseconds, that lets you do millions of operations."

***Sebastian Loth**, IBM's Almaden Research Center, on why diamond might be used to store quantum information in the future,* U.S. New and World Report*, March 24, 2011.*

"People have mainly looked at its biological applications, treating cancer and Alzheimer's and so on, but nobody has looked at making optical devices out of them."

***Abhishek Kumar**, of the University of Massachusetts, Lowell, on using the curry powder curcumin to help detect traces of explosives,* BBCNews.com*, March 24, 2011.*

"It's not a magic bullet–there never is in this business… But I think as a general tool for art and art historical and archaeological exploration, it's the best new thing to come out in a very long time."

***Robert Thorne**, Cornell, on using high energy X-rays to find forged artwork,* United Press International*, March 28, 2011.*

"I think what happened is after Three Mile Island, that event actually spurred the nuclear industry and the regulatory agency to take a very thorough look at what they were doing. …Unfortunately, it took this Macondo accident to really open up the eyes for deepwater drilling safety."

***Steven Chu**, Department of Energy, comparing Fukushima to the Gulf Oil Spill,* National Public Radio*, March 31, 2011.*

"We haven't seen any of the heavier stuff that would come right from the core, which people saw 30 years ago during the Chernobyl accident."

***Andreas Knecht**, University of Washington, on the dangers of trace amounts of radiation detected on the West Coast,* U.S. New and World Report*, March 29, 2011.*

"The last three days we've had reassuring words, we've turned the corner, things are stable but it's on knife's edge, any small earthquake, any spent fuel pond boiling incident could cause the workers to evacuate."

***Michio Kaku**, City College of New York, on the ongoing Fukushima disaster,* ABCNews.com*, March 22, 2011.*

"Though we've developed these tools for black hole collisions, they can be applied wherever space-time is warped… For instance, I expect that people will apply vortex and tendex lines to cosmology, to black holes ripping apart, and to the singularities that live inside black holes. They'll become standard tools throughout general relativity."

***Geoffrey Lovelace**, Cornell,* MSNBC.com*, April 13, 2011.*

And finally, some comments on the announcement from the CDF collaboration at the Tevatron at Fermilab, concerning an anomaly recently found in their data:

"Nobody knows what this is… If it is real, it would be the most significant discovery in physics in half a century."

***Christopher Hill**, Fermilab,* The New York Times*, April 6, 2011.*

"This is huge–an unexpected discovery which could completely transform high-energy physics, and cosmology as well, as the two fields are joined at the hip… But there is one big IF–if it holds up

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This Month in Physics History

François-Marie Raoult and Raoult's Law: May 23, 1887

"He discovered a universal property of dissolved molecules and showed how to use it."

Full acceptance of the atomic-molecular theory of matter depended on the ability to relate familiar macroscopic properties to the properties of individual molecules. This began to happen when Amedeo Avogadro proposed that, under similar conditions, all gases contain the same number of molecules per unit volume. Building on this foundation, the Ideal Gas Theory initiated a flowering of activity and understanding in physics. In the ideal gas, molecules of any kind behave the same way. The universality embodied in this concept shows that there is underlying physics that covers a broad range of matter. Eventually, physicists found ways to determine the magnitude of Avogadro's Constant, the actual number of molecules in a given volume. Molecular weights could then be determined simply by measuring the density of a gas.

But the understanding of gases did little to advance our understanding of liquids, solutions, and condensed matter. Most molecules cannot easily be observed as gases. But, dissolved in a liquid, their aggregate behavior can be observed, as in the Ideal Gas Theory. How to do this awaited the work of the French scientist, François Marie Raoult. After years of careful experiments, he published a landmark article, "General Law of the Vapor Pressure of Solvents", in the French Journal, *Comptes Rendus*, in May, 1887. It contains the core idea of what is now recognized as Raoult's Law. He dissolved low concentrations of different non-volatile compounds; 5 kinds in water, and 14 kinds in each of 11 organic solvents, and measured the effect of the dissolved compounds on the vapor pressure of the solvent. He found the remarkable result that, within the range of his experiments, the presence of a given mole fraction of any dissolved substance in any liquid caused the same fractional reduction in the vapor pressure. Later confirmed by others, these experiments provided the kind of universality that Avogadro and the architects of the Ideal Gas Theory gave to the physics of their time. In other work, Raoult showed a similar effect for the reduction of the melting point of a liquid by dissolved substances. Subsequent theoretical work by Jacobus van't Hoff and Svante Arrhenius, confirmed Raoult's result, provided the thermodynamic basis, and showed how to understand what, at first, seemed to be exceptions.

The universality of Raoult's Law led to a burst of creative activity concerning liquids and solutions. For a given weight of a dissolved material of unknown molecular weight, including a polymer or other high molecular weight substance, Raoult's Law allows one to determine molecular weights by measuring the vapor pressure or other properties of the solvent.

Both Raoult's Law and the Ideal Gas Law apply only within a restricted range of conditions. For the gas law this means relatively high temperatures and low pressures. At higher pressures and lower temperatures, the Ideal Gas Law no longer applies. Different gases behave differently, often following the Van der Waals equation, with eventual condensation to liquid. A rich new physics was discovered by going beyond the conditions that led to the original law. Raoult's Law applies at limiting low concentrations for non-volatile solutes. At higher concentrations or with volatile solutes, different compounds behave differently. Exploring these conditions provides abundant data, the basis for fractional distillation and other industrial processes. Also, for several salts, such as sodium chloride in water, Raoult found about twice the expected number of molecules. This was an early clue that sodium chloride in water dissociates to sodium and chloride ions.

François Marie Raoult [1830-1901] was born in Fournes in the departement du Nord, son of a customs agent. He spent a brief period at the University of Paris, but lacked financial resources to continue. He then spent 14 years teaching physics and mathematics in several high schools. He worked full time teaching, over the years moving from one school to another. At the same time, on his own, at considerable hardship, he continued research on the energy relations in voltaic cells. This led to the *docteur ès sciences physiques* degree from the University of Paris. Though little noticed at the time, it was pioneering work. He was one of the first to show that the energy of the chemical reaction and the electrical energy of a voltaic cell were not identical. Recognition of the work would come only later when thermodynamic concepts of free energy and entropy were understood as they applied to electrochemical cells.

Finally, in 1867 he came to the Sciences Faculty in Grenoble to become Professor of Chemistry. There was some objection that he was really a physicist, but the appointment was finally approved, and he continued his research in Grenoble for thirty one years. The lab at the time was plain and simple. In her book, *Science in the Provinces*, historian Mary Jo Nye quotes Raoult's description; "Each professor possessed his own little table. This room which was a laboratory during the daytime served simultaneously as the living quarters for the concierge. Here the physics professor arranged his instruments; the zoology professor dissected his rabbits and fed his pigeons; ...the geology professor laid out his fossils;...and the chemistry professor carried out all his operations."

His life was one long struggle to do the work he loved and to see its merits recognized. He endured financial straits and hardship completing his doctorate; an extended apprenticeship of high school teaching; a slow start in a reluctant department at Grenoble. But ultimately, he received the recognition he deserved, first in other countries, finally in France.

On his death in 1901, *Nature* reported: "François Raoult, professor of chemistry at Grenoble, died there on April 1. In him, France has lost one of her most distinguished men of science, whose discoveries have supplied material for theoretical considerations, ... a most profound influence on chemistry and physics."

The 1901 Dutch Nobel Laureate, J.H. van't Hoff, said of Raoult "He lived in that somewhat out of the way town, Grenoble... the romance of his life was that almost sudden rise to fame, spreading from this nearly unknown corner, first over the frontier of his country, and then back to France, which made him one of the most prominent men of science of his age." His achievement lives on, a century later, in the law that bears his name.

***Ed. Note:** This month's column has been contributed by guest writer Richard Williams.*

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Education Corner

A column on educational programs and publications

Physics Education Funding and the Federal Budget
As details emerge about the bill that will fund the government for the rest of Fiscal Year 2011, it appears programs affecting science education have largely emerged unscathed. The budget of the National Science Foundation's Education and Human Resources (EHR) directorate, which administers a number of science education programs, lost only $10 million relative to FY2010, although its allocation is $29 million less than the Obama administration's FY2011 request. EHR's total FY2010 budget was $872.76 million.

The Obama administration's proposed FY2012 budget, released a few weeks ago, lays out some significant changes for science education programs. Within EHR, programs affecting undergraduate, graduate, and postdoctoral students would receive a substantial increase, whereas those affecting K-12 students would see a significant decrease. One new program to keep an eye on is "Teacher Learning for the Future (TLF)," to be funded at $20 million, which plans to "provide R&D awards to further understanding of the preparation and continuing education of STEM [Science, Technology, Engineering, and Mathematics] teachers," according to the directorate's budget document. Of course, it remains to be seen how much of the President's vision will make it into the budget that Congress eventually passes.

Committee On Education Departmental Award
The APS Committee on Education has established a new award to recognize departments and programs that support best practices in education at the undergraduate level. Programs will be recognized for a three-year term, acknowledged on the APS website, awarded a plaque, announced in *APS News*, and recognized at an annual meeting. These awards are intended to acknowledge commitment to inclusive, high-quality physics education for undergraduate students, and to catalyze departments and programs to make significant improvements. APS will recognize one to three programs and departments each year.

A full description of the award and the application are available at www.aps.org/programs/education in the "Undergraduate Physics" section.

Also, nominations for the APS Excellence in Physics Education Award are being accepted, at www.aps.org/programs/honors/awards/education.cfm

PhysTEC Conference
The 2011 Physics Teacher Education Coalition (PhysTEC) Conference will be held on May 23-24, 2011 in Austin, Texas, with the theme of Sustainability for Teacher Education Programs. The conference will feature plenary speakers **Carl Wieman**, Associate Director for Science at the US Office of Science and Technology Policy and a Nobel Laureate in Physics, and **Eugene Levy**, Professor of Astrophysics and former Provost at Rice University. The conference will be held jointly with the annual conference of The UTeach Institute, which is a national program to educate more math and science teachers.

M. Hildred Blewett Fellowship
APS is now accepting applications for the M. Hildred Blewett Fellowship (formerly the Blewett Scholarship). This award is intended to enable women to resume physics research careers after an interruption. The deadline to apply is June 3, 2011. For more information and the online application, go to www.aps.org/programs/women/scholarships/blewett

AAPT Summer Meeting
The American Association of Physics Teachers (AAPT) will be having its annual summer meeting in Omaha, Nebraska from July 30 to August 3, 2011. This meeting features sessions and workshops on a wide variety of physics education topics, and typically draws over 1,000 physics educators from universities, K-12 schools, and other institutions. The theme of this summer's meeting will be "Communicating Physics Outside the Classroom." For more information and registration, go to www.aapt.org/Conferences/sm2011

ALPhA to Offer "Laboratory Immersions"
During the summer of 2011, the Advanced Laboratory Physics Association (ALPhA) will be offering its second slate of "Laboratory Immersions." ALPhA's Laboratory Immersions offer an opportunity for participants to spend two to three days learning the details of a single experiment well enough to teach it with confidence. The 2011 Immersions will take place during July and August at a number of institutions around the country. For details and registration, go to www.advlab.org

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and is not explained by standard model physics."

***Michael Turner**, Kavli Institute for Cosmological Physics, University of Chicago,* MSNBC.com*, April 6, 2011.*

"If this thing is real, it is a new type of very heavy particle that is not one of the ones theorists have been sitting around thinking about…It would be very heavy, very interesting and very fundamental. It would turn over our understanding of particle physics."

***Michael Witherell**, UC Santa Barbara,* The Los Angeles Times*, April 7, 2011.*

"The unfortunate thing is, [the heavier particle] doesn't appear in other analyses where it might also be expected to appear… My personal opinion is that it will probably be understood in ways that are not new physics… But even if there is just a small chance that it is new physics, that is very exciting,"

***Mark Kruse**, Duke University, who led the team at Fermilab that detected the unexpected anomaly in the Tevatron's data,* The Los Angeles Times*, April 7, 2011.*

It's...Alive!

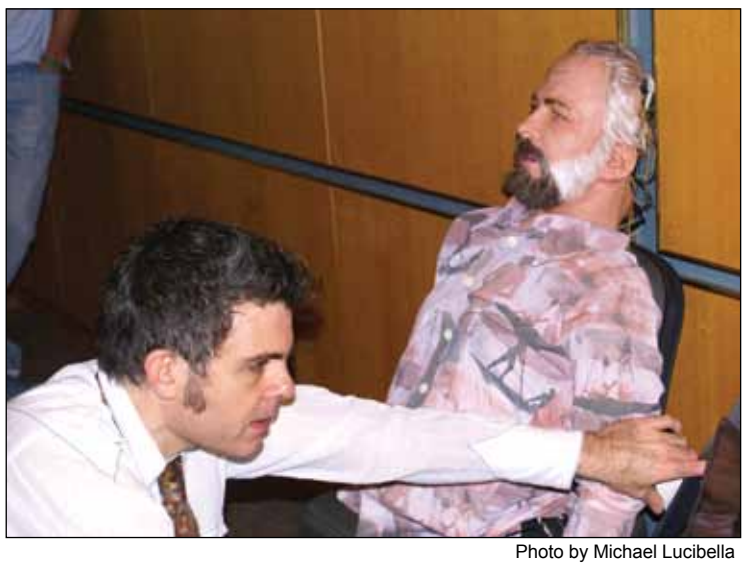

Photo by Michael Lucibella

The one on the left is, anyway. That's David Hanson, of Hanson Robotics, getting ready for his March Meeting talk on "Robotics in the World of Entertainment." Seated next to him is a dead ringer for famed science fiction writer Philip K. Dick, but, as a second look will confirm, actually a robot with wires for brains. The meeting session, entitled Science, Art and Culture, was organized by Brian Schwartz of CUNY, and featured, in addition to Hanson, Stephen Wharton of SkyCam Inc. on "XPower plus the Physics of Rodeo", Joe DiPrima of Arc Attack on "Singing Tesla Coils", and Davey Griffin of Texas A&M on "The Science of Barbecue (Texas Style)."

APS Website Hosts Ethics Training Materials

By Gabriel Popkin

Physicists looking for ethics training materials have a new tool in their repertory. APS has published an activity and discussion guide based on a series of case studies describing ethical issues that can arise in the process of physics research. The case studies, which cover topics such as data acquisition, mentoring, publication practices, and responsible conduct of research, are designed to help physics faculty and others provide ethics training to undergraduates, graduate students, and postdoctoral researchers.

Ethics became an issue of significant concern for APS after the physics community was hit by two high-profile cases of data fabrication early in the last decade. In response, APS convened an Ethics Task Force, which surveyed the society's junior membership about issues related to ethics. The task force found, among other things, that most survey respondents had not received formal ethics training; rather, they reported gaining exposure to the subject mostly through informal channels such as research group meetings or discussions with faculty or students. (see January 2004 article http://www.aps.org/publications/apsnews/200401/ethics.cfm for more information).

In response to the original task force's findings and recommendations, APS convened a second group called the Task Force on Ethics Education, with a charge to advise APS on encouraging physics departments to improve ethics training, and to develop materials that would aid physics departments in these efforts. This group's work culminated in a set of case studies describing hypothetical scenarios that might arise during the course of doing physics research, and in most cases a discussion of the various ethical issues that arise out of the scenario. The guide provides additional discussion, suggestions for activities such as role-plays, and further reading.

"My hope in developing these case studies was that we would not only raise issues but generate discussion," says J. Marshall Thomsen, a professor of physics at Eastern Michigan University who was on the task force that developed the studies. This is reflected in the discussion sections that follow many of the scenarios in the studies, where multiple perspectives and courses of action are offered. "There are a number of situations where reasonable people can disagree about ethical issues," says Thomsen.

The APS case studies also fill a need for ethics training materials that are relevant to physics—a need made more urgent by new requirements that all projects with funding from the National Science Foundation include provisions for ethics training. As Thomsen pointed out in a recent *Physics Today* blog post, much of the existing training material in science research ethics focuses on topics like human subjects research that are more common in biology. "Most physicists place a high priority on relevance when it comes to ethics," writes Thomsen. He worries that without more relevant materials, "physicists will regard the required RCR [responsible conduct of research] education as an irrelevant bureaucratic exercise."

Although no high-profile fraud cases in physics have surfaced since the two incidents in 2002, it is important that the physics community not become complacent about ethics, says Kate Kirby, APS Executive Officer and a member of the original Ethics Task Force. "APS has a critical role to play in continuing to raise the community's consciousness about these important issues," she says. "The ethical questions that arise in the course of physics research can be subtle, and often have no clear answers. These case studies promote conversations that we hope will help people in making good choices."

The activity and discussion guide comes in separate editions for teachers and students, and can be downloaded in pdf format at www.aps.org/programs/education/ethics

Materials Physicists Attracted to Spider Webs

By Eric Betz

Among the many breakthroughs in materials science presented at this year's March Meeting, it was hard not to be drawn in by a physicist claiming to have figured out the physics of spider webs.

If you were a fly, freeing yourself from a spider web would be an insurmountable task, but why the spider's glue is so sticky has been an unsolved mystery. Even in wet weather, the spider's natural net is often the end for a non-observant insect. And according to Vasav Sahni of the University of Akron, studying what makes spider webs sticky could lead to myriad adhesive applications.

Sahni is tight-lipped about what his team is currently developing, but in a press conference at the meeting, he discussed how his team was able to replicate the spider's glue in his lab.

Sahni said that spider webs are made from two different types of silk. The first type is called dragline silk, which makes up the radial lines going from the outer edges of the web toward the center. The second type is called capture silk, and these lines are responsible for absorbing momentum when the prey collides with the web. However, the soft and highly sensitive capture silk must also ensure that they prey is caught and can't get away after impact.

These lines have a silk core with tiny water and polymer nodules dispersed along them. Sahni and his colleagues set out to find exactly how these nodules behaved so that they could mimic the system.

To do that, they met in their lab at night so as to avoid any tiny vibrations that might be created by their coworkers. "If you breathe, you can see it on the force sensor," said Sahni.

They inserted a custom glass probe into the tiny glue droplets and measured the force needed to stretch one individually. They determined that the nodules behave like a viscoelastic solid and then used that information to create their own spider glue. Sahni said the technology could be used for everything from underwater sealants to in-body sutures.

Among the other materials advances at the meeting was a presentation by Tobin Filleter of Northwestern University on a new fabric made by weaving together carbon nanotubes. Filleter said that scaling carbon nanotubes up into larger structures has been difficult so far, but he thinks his team may have found a solution.

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Letters

Readers interested in submitting a letter to APS News ***should email letters@aps.org.***

Don't Be Ridiculous!

Regarding "This Month in Physics History" in the March *APS News*: Great story, but don't be ridiculous. Hanging a counterfeiter has nothing whatsoever to do with the history of physics even if the noose was provided by Isaac Newton.

Michael Nauenberg
Santa Cruz, CA

Strange Memory Demands Confirmation

The March, 2011 Bygone Years item stimulated a memory I have often wanted confirmed. Back in about 1949 I recall that some journal of the APS once a year ran a list of the most distinguished twenty (?) physicists, in numerical order. I was a graduate student at the time at Harvard and remember a young faculty member complaining that after the first ten names he would claim equal distinction with anyone on the list.

It is hard now to imagine that there ever was such a list but the memory remains. Can you confirm its one-time existence, give us the year of its demise, and republish the last list, if it ever existed.

Henry R. Lewis
Cambridge, MA

Ed. Note: *We have been unable to confirm the existence of the list to which the writer alludes. Perhaps one of our readers can shed some light on what the memory refers to.*

Let APS Members Speak for Themselves

In the March issue of *APS News* two letters appear that comment on our letter (APS Should Stick to Scientific Matters; January, 2011.) We would like to respond.

The letter by Viola (APS Should Engage in Climate Change Debate) misrepresents the content of our letter by using in isolation the quote: Wolfram and Werner argue that the APS "should limit its activities to scientific matters and avoid societal and political issues altogether."

We also said "We feel the APS should limit its activities to establishing facts and finding the truth by scientific means. Individuals or groups within the APS membership have every right to express political or policy views...It is their duty to do so." Viola also says the 90% of the APS membership is in "accord" with the APS global climate change statement. Is this number pulled out of some hat? As far as we know the APS survey on this issue has not yet seen the light of day.

The second letter, by Blumenfeld, (Physicists Need to Speak Out) says: "Thomas Wolfram and Sam Werner...believe that climate change is a purely political matter." On the contrary, we believe that climate change is purely a scientific matter. We would like to keep the discussion out of the realm of politics and that is why we wrote our letter. We totally agree with Blumenfeld that "APS members in general, have a special competence and should not hesitate to speak out." Our thesis is that speaking out is an individual's responsibility and that APS should not try to speak for its entire membership on public policy issues.

It is unfortunate that our letter was falsely represented. Perhaps the title our letter (given by the *APS News* editors), APS Should Stick to Scientific Matters, contributed to the misunderstanding apparent in the Viola and Blumenfeld letters.

Thomas Wolfram
San Clemente, CA

Sam Werner
Gaithersburg, MD

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near. Dreams of superconducting power lines, low energy server farms and magnetic levitating trains seemed palpably close. People compared the perceived coming superconducting revolution to the way semiconductors revolutionized the world through computer processing.

As it turned out, the revolution hasn't quite come. "It was fun actually to imagine all that stuff," said Seamus Davis of Brookhaven National Laboratory. But he added, "it's really not like what happened in the world of semiconductors."

It soon became apparent that the cuprate superconductors topped out around 164 K. Then in 2008, the surprise discovery by scientists in Japan that iron-based pnictides can superconduct at temperatures as high as 55 K touched off another flurry of excitement. This opened up a whole new family of high temperature superconductors to explore. Though still far below room temperature, the discovery offered physicists hope that some new unexplored material will ultimately yield a superconductor that can work its magic without the need for cryostats.

"I don't think that there's anyone in the room saying you couldn't get a room temperature superconductor," Crabtree said.

As researchers continue to probe for a general understanding of superconductivity, new uses for the phenomenon continue to be developed. Today, the most frequently encountered use of superconductivity is in MRI machines. As early as the 1970s, it was realized that the strong magnetic fields generated by a superconducting coil would make clearer images and be more reliable than those generated from the fields of conventional magnets. Today, virtually all MRIs are built with superconducting coils generating their powerful magnetic fields.

Transporting energy is another area that laboratories and companies are actively investigating. The US power grid loses about ten percent of generated electricity in the transmission from generating plant to end user. Superconducting cables should be able to eliminate almost all of that loss. At the same time, as renewable energy becomes a bigger part of the country's supply, the need to transfer large amounts of electricity great distances becomes imperative. With the best sources of wind power in the Midwest and solar in the Southwest, electricity will have to be transmitted hundreds of miles to reach the population centers on the east and west coasts.

Starting in 2008, the Long Island Power Authority, with support from the Department of Energy, has been testing a prototype high-temperature superconducting cable with generally positive performance results at a transmission voltage of 138 kV. The need for cooling the line and high costs of the lengths of cable has been the biggest impediment for widespread integration into the grid. However South Korea has taken the lead in actually integrating superconducting lines into its grid. The South Korean utility company KEPCO announced in 2010 that it was purchasing three million meters of superconducting wire to fabricate ten kilometers of superconducting cable for use in the country's power grid, including three kilometers feeding directly into Seoul.

"We are at the point of an historic transition in the field of the application of high temperature superconductivity into the power grid," said Alexis Malozemoff from the company American Superconductor which also makes superconducting wires. "[Until] US utilities show similar leadership…it looks like the Koreans are going to lead the way."

GRAPHENE continued from page 1

top of whatever surface you're writing on." The challenge for him and Geim in the beginning, he said, was sorting through their sample trying to find those one-nanometer-thick layers.

But nature hates low-dimensionality, he said, and much of the research that was presented at the meeting focused on trying to iron out the many difficulties associated with making something essentially two-dimensional.

Throughout the week, many talks described experimenting with different materials as substrates for synthesizing high quality graphene. Others dealt with trying to achieve the same by removing the substrate altogether.

Tomás Palacios, an associate professor of electrical engineering and computer science at MIT, said one of the major problems with graphene is that putting it in contact with metal will dramatically decrease its performance. Any residues that build up on the surface of a one-layer sample will drastically alter its properties, he said.

Palacios described graphene as "a great material looking for an application," and said he's currently working on realizing that potential by creating a graphene circuit.

He doesn't expect graphene to compete with silicon as a material anytime soon, because silicon has been studied so thoroughly for more than a generation. However, graphene can still be beneficial in the short term because one can use it to create highly flexible and cheap electronics, he said.

"For the last several years graphene has been a material with enormous potential for many applications; now it's time to start making devices," said Palacios. "The next few months are going to be really exciting."

Speaking at a press conference, Walter de Heer, a professor of physics at the Georgia Institute of Technology, pointed out that graphene had been discovered before the work in 2004 by Geim and Novoselov, showing a patent he held for "thin film graphite" in 2003. Though de Heer admitted that the graphene that existed in the early 2000s was "lousy," he said that he had made measurements on graphene before Geim and Novoselov, but didn't know it at the time.

He also challenged the idea that graphene would result in cheap electronics any time soon and instead asserted that it would create better, but far more expensive electronics that would ultimately lead to advances.

"In the 1900s, a shipbuilder would look at a balsa-wood-and bicycle-parts-designed airplane and say 'what are you going to do with that'," said de Heer.

Addressing de Heer's comment, Novoselov later said that he never claimed to have "discovered" graphene, and readily conceded that parts of the discovery he received the Nobel Prize for were in place already. Instead, he says that his 2004 paper with Geim was chosen because of the major breakthroughs they were able to achieve when they used adhesive tape to create graphene.

"Graphene is the most active area in physics and may be the most active area in science" said Sankar Das Sarma, director of the Condensed Matter Theory Center at the University of Maryland. Das Sarma showed a graph that demonstrated the exponential rise in the number of papers published on graphene since 2004 and attributed the material's rapid increase in popularity to Geim and Novoselov's paper.

In his lecture, Novoselov also gave a glimpse at what the future might hold for a substance that is the strongest, stiffest and thinnest known. He said some of the most interesting applications arise, not from graphene itself, but instead from combining it with other materials in what he described as drawing with many different colored pencils.

He said we can now start to think about creating other two-dimensional materials, each with its own unique properties and benefits. "One of the highlights of the last few months is that you can now start with graphene and break it apart and put it back together to get new 3D crystals."

For example, if you combine layers of graphene with layers of boron-nitride, hydrocarbons, or fluorographene–each carbon atom bound to one fluorine–you get entirely different materials.

"The real breakthrough of graphene isn't its optical properties or its electrical properties," said Novoselov, "it's the opportunities for all these new materials."

zero gravity

Willebrord Snellius, also known as Willebrord Snel (or Snell) van Royen

by Nicole Yunger Halpern

North of the Alps
and south of the fjords
lived a man
called Willebrord.

The University
of Leiden
conferred another
appellation:

Professor of
Mathematics,
he described
the erratic

behavior of
refracted light.

Thanks to his
enlightened insight,

optics pupils,
York to Utah,
know his surname
from his Law.

Yet another
moniker
belonged to this
trigonometer:

Like his title
of employment,
from Daddy came
the name van Royen.

Even if young
Snellius's
successes kindle
jealiouses,

who could help
but choke and gag
if forced to own
this teacher's tag?

I wonder if
the man could tell
that history
would favor "Snell."

Nicole Yunger Halpern is a Modified Physics major at Dartmouth College.

Viewpoint...

Another SSC Moment?

A small cohort from the APS March Meeting in Dallas took the opportunity one afternoon to celebrate the centennial of superconductivity by making a pilgrimage to the site of the Superconducting Supercollider in Waxahachie.

Waxahachie was selected as the site in 1988, and large-scale construction began in 1991. But in October of 1993, the project was terminated by Congress, dealing a severe blow to the future of high-energy physics in the United States, and to some extent negatively affecting the whole spectrum of American physics research.

The buildings, which loom suddenly and incongruously out of the rolling pastureland, are abandoned now. Their corrugated metal sides resound eerily as the wind sweeps past them across the Texas plains. Inside, virtually everything has been stripped bare, although in one building there are some unopened crates full of equipment that had the bad luck to be delivered just as the project was being shut down.

Outside, mounds with deep pits inside them are scattered like miniature calderas. These are the filled-in shafts that once gave access to the tunnel that would house the accelerator. Before cancellation, 17 shafts were dug, and about 15 miles of the projected 54-mile tunnel had been bored. The tunnel is still down there somewhere, probably mostly filled with water.

It's hard to visit the site and avoid comparing it, in one's mind, to the CERN laboratory in Geneva, where the Large Hadron Collider is up and running and where major discoveries are presumably just around the corner. The SSC would have been finished earlier,

Photo by Quantum

Abandoned buildings at the SSC

probably a decade earlier, and would have run at much higher energy (colliding proton beams of 20 TeV each, compared with 7 TeV for the fully operational LHC, although the LHC is now running at half that). But the cost was deemed prohibitive, and leadership in high-energy physics has passed to the Europeans.

President Reagan gave his blessing to the SSC with the exhortation "Throw Deep." The ball was indeed thrown deep, but the pass was never completed. Another Reagan quote, from the 1980 presidential campaign, was the question "Are you better off now than you were four years ago?". Is physics in the US better off today than it was in 1993, when the SSC was canceled? The Tevatron at Fermilab will soon be shut down, after a distinguished career but without the chance for the biggest prize; and the Holifield Research Accelerator at Oak Ridge is also being terminated. With the federal budget process in disarray, further cuts, possibly drastic ones, are on the table. President Obama has referred to a "Sputnik moment" that will re-ignite enthusiasm and support for science and technology. If we're not careful, we may be facing another "SSC moment" instead.

-Alan Chodos

Readers can find some interesting before and after photos of the SSC site at the March 24 blog post of "Physics Buzz," the blog hosted by the APS website for the public, PhysicsCentral.

Spice Ingredient Touted as Explosive Detector

At this year's March Meeting, physicists presented new and unorthodox projects that are designed to help detect concealed threats. One researcher developed a way to use the optical properties of a curry powder ingredient to detect explosives, while another has been working on a way to use lasers to take air samples from kilometers away.

Though it sounds fantastic, Abhishek Kumar from the University of Massachusetts, Lowell found a way that curcumin, an ingredient used in the spice turmeric, can be made to detect the presence of TNT.

"Curry powder can detect explosives," Kumar said. "We can predict in a few seconds the presence of DNT, TNT or other explosive substances."

When curcumin is exposed to intense light, it fluoresces a bright green color, a property that researchers have turned into a bomb detector. Kumar and his collaborators Mukesh Pandey and Jayant Kumar mixed curcumin with the chemical novozym-435 so that the two substances bonded to form one long molecule. When traces of explosives come near it, they bond together with the end of the novozym, causing in turn the fluorescence of the curcumin to quench and dim.

The device Kumar is working on takes this compound and spreads it over a film. The film is waved in an area for a few seconds where an explosive might be present. If there are any stray molecules from the explosive floating in air, they will bond to the compound, quenching the fluorescence. After being exposed to light the sample is observed to see if it darkens.

"Once you expose this film to TNT vapor, you don't see anything. The fluorescence is quenched," Kumar said. "This could be very specific as well as sensitive."

Already Kumar and his team have been conducting some field tests and are talking with two companies about commercializing the technology. So far the curcumin is highly effective in saturated environments, darkening by as much as 90 percent. They're right now working on ways to improve the sensitivity of the detector in environments less saturated with explosive vapor. Kumar said that once the device is finished, it would be well-suited for detecting hidden explosives and buried landmines.

Finding dangerous substances from far away is the focus of the work of Andrew Traverso, a graduate student at Texas A & M. He proposes using the atmosphere to create a "backwards propagating laser in the sky" to look for the spectral signature of WMDs.

"We'd like to detect minute particles in the upper atmosphere kilometers away without sending

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Developing Hands-On Sustainable Energy Solutions

By Michael Lucibella

Pete Schwartz has undergone a transformation. When he started his research as a faculty member at Cal Poly San Luis Obispo in the early 2000s, he built on cutting-edge nanotechnology, growing decane thiol monolayers and studying meniscus force nanografting. Today he is much more likely to use a ball-peen hammer than an electron microscope now that he's devoted himself to creating sustainable technology for the developing world.

"Right now I have students working on a low-cost solar concentrator that could be used to cook in developing countries," Schwartz said.

Schwartz said that his perspective began to change around 2005 when he started doing work on his house. He had always felt strongly that people needed to make better decisions about energy and resources, and saw this as the opportunity to put it into practice for himself. He went about greening his home, pulling out the irrigation systems and instead installing a solar shower in his back yard whose runoff flows into his garden. He made other changes to the house, like installing energy efficient windows and replacing his standard toilets with biodegrading pit toilets.

"In the process I realized I was more excited about these scientific explorations than what was going on in the lab," Schwartz said, "I could see the results…It was simple, it was something I could grab onto, but the scientific process was still complete."

When speaking at the "Physics of Sustainable Energy" conference at the University of California, Berkeley in early March, he illustrated his thought process as he shifted from nanotechnology to sustainable-energy research. He began by showing a series of photos of splashing and flowing water. Films of liquid flowed off an obscured surface, undulating and spraying everywhere. He talked about the fluid dynamics of the forming ripples, complete with overlaid force diagrams and equations. The final slide pulled back and the audience could see that the water had been flowing off a smiling infant, bathing in a sink.

"The human being is the most interesting physical system," Schwartz said.

He took a sabbatical in 2006 and 2007 with Dan Kammen and the Energy and Resources Group at UC Berkeley. There he studied everything he could about sustainable energy. He participated in studies of California's low carbon fuel standards, wind energy potential off the coast of Santa Barbara, and electric car costs.

Pete Schwartz poses with his daughter Tekuru on his shoulders and several children from San Pablo Guatemala.

"It forced me to deeply investigate every different kind of renewable and conventional energy being used," Schwartz said.

One area that he looked at was how energy consumption affects quality of life around the world. The United Nation's Human Development Index weighs the personal wealth, education and health of a population to quantify how "well off" a nation is. The higher the HDI number, the better off a nation is. In his talk, Schwartz highlighted a graph of the world's HDI numbers against energy usage per capita. The results are dramatic: the more energy a nation uses, the "better off" its population is. Most of the world's population is poor and uses a small fraction of the energy used by the developed industrialized nations. As poorer nations develop, they'll likely start using exponentially more energy, and generating correspondingly more greenhouse gases.

"This is just a hopeless situation," Schwartz said. "Can we help them develop carbon-free?"

This question drove him toward finding ways to develop renewable energy solutions cheaply and easily. He began teaching a course at Cal Poly, Appropriate Technology for the World's People, which had students create technologies for developing nations that are easy to build, cheap and environmentally friendly.

Part of the curriculum is to learn from past projects that have either failed or caused unforeseen consequences. On one trip to Nicaragua in the summer of 2009, while conferencing with nonprofits and other nongovernmental organizations, Pete met a researcher named Luz Marina Delgado who had been teaching a similar course at Caltech. The two became friends and Schwartz and Delgado set out on a three week tour of Delgado's native Guatemala in 2010.

Schwartz said that much of Guatemala he visited was "chaotic," and the towns often had streets filled with trash and feral dogs. During his travels, however, he came across one village that was different. Called San Pablo, it lay close to the Mexican border. Schwartz described it as a "bastion of progressive, very enlightened

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March Meeting Prize and Award Recipients

Photo by EventWork Photography

APS President Barry Barish presented prizes and awards to these individuals at the March Meeting ceremonial session in Dallas. Further information can be found in the prize and award insert that was published with the March APS News (available online), and also on the APS website under the "Programs" tab. Seated (l to r): Xiaowei Zhuang, Peter D. Johnson, Zhi-Xun Shen, Erez Lieberman-Aiden, Nicholas P. Economou, Billy W. Ward, Christopher Chudzicki, Dmitry Fedosov, and Herbert Spohn. Standing (l to r): Stephen Leone, Ian Walmsley, Bernard S. Meyerson, Arthur P. Ramirez, Juan Carlos Campuzano, Shaul Mukamel, Gary Grest, Kurt Kremer, Raffaele Mezzenga, and Chia Wei Hsu.

Physics Sheds Light on Cancer and Bacteria Evolution

By Gabriel Popkin

Cancer and bacteria have a lot more in common, it turns out, than the fact they can kill us. Both types of cell live in highly regulated communities, communicate with their neighbors using signaling molecules, and undergo rapid evolution when exposed to environmental stresses. Physicists who presented their research at this year's APS March Meeting hope to use experimental techniques and models from physics to unlock the secrets of such deadly phenomena as tumor metastasis and drug resistance.

In a session on the physics of evolution, Robert Austin, professor of physics at Princeton, laid out the challenges for physicists taking on cancer: mortality rates for the disease have mostly been flat in the past three decades, and in some cases are rising; moreover, what treatments we currently have tend to moderately extend life, but rarely save it. Austin heads the Princeton Physical Sciences Oncology Center, one of twelve centers around the country that are applying techniques and insights from the physical sciences to the battle against cancer. He says, "We welcome crazy ideas."

One of those "crazy ideas" is the possibility that cancer represents a sort of atavism—a regression to the evolutionary past, in which ancestral, normally noncoding regions of human DNA start being expressed again. Despite the fact that tumor cells are mutated versions of our own cells, they are very poorly differentiated, resembling embryonic stem cells rather than the more specialized cells that make up our tissues. "Cancer is evolution running backwards," said Austin. To understand this, "We need to build biological time machines. Can we invent a time machine that runs cells backwards?"

Robert Riehn, a professor at North Carolina State University, described research aimed at better understanding this backward evolution of cancer. Riehn studies changes that occur in cancer cells at the epigenetic level, where DNA transcription and gene expression are controlled. He and his colleagues use microfluidics devices called nanochannels to stretch out small sections of tumor cell DNA, and fluorescent markers to observe important signatures of epigenetic changes that occur in cancerous cells. These changes can lead to the expression of normally silent genetic programs which Riehn and others believe lead to the evolution of the dangerous metastatic behavior that makes cancer such a big killer.

Others presented studies of drug resistance and metastatic behavior related to changes in cells' environments. Guillaume Lambert, a graduate student at Princeton, described research using microfluidics techniques to expose tumor cells to chemical gradients of drugs, nutrients, or other chemicals, and measure their evolutionary response. Along similar lines, Qiucen Zhang, also a Princeton graduate student, described a method of rapidly "fixing" drug resistance in a population of bacteria in as little as ten hours, by growing the bacteria in a micro-environment containing a gradient of the antibiotic ciprofloxacin (Cipro). Meanwhile, Liyu Liu, a postdoc at Princeton, presented research on the metastatic behavior of cancer cells he grew on microchips, in environments called "tepuis," whose name was inspired by a form of isolated mesa found in the Guiana Highlands of South America. By placing different types of cancer cells in the "lowlands" and allowing them to invade the tepuis, Liu is hoping to determine some of variables that influence metastatic behavior. Lambert, Zhang, and Liu all work in Austin's group.

Theorists also got in on the game, presenting several models for understanding cancer development. Simone Bianco, a postdoc in bioengineering and therapeutic science at the University of California, San Francisco, studies the changes that occur in internal architecture when a cell becomes cancerous. Bianco presented a way to model these changes in a "multidimensional morphology state space," which he hopes will lead to insights into the mechanism of tumorigenesis. Ping Ao, a professor of physics and engineering at Shanghai Jiaotong University in China, described an approach using network theory to map cancer onto a fitness landscape, similar to an energy landscape that might be used to model protein folding. Ao said, "As physicists, we want to know if there is a simple perspective behind all the complexity" of cancer.

Another theme that emerged from talks on both cancer and bacteria is the use of game theory, a concept borrowed from math and economics. Austin argued that current cell-death treatments tend to leave behind only the most aggressive cancer cells, which are the ones that have evolved the most radically. "We need a game theory approach to dealing with cancer," he said. "How can we design a selection pressure that rewards slow growth, decreased mutations, and belonging to a community?"

A number of researchers in Jeff Gore's lab at MIT applied game theory to the evolution of drug resistance in bacteria. Tatiana Artemova, a graduate student in Gore's lab, investigated how cooperation between different strains of bacteria helped them develop resistance to a new antibiotic. In a related talk, Hui Chao, an undergraduate in the lab, explored how "cheating" non-resistant bacteria may take advantage of drug-resistant bacteria to survive in an environment that contains an antibiotic. Both speakers used quantitative models of cooperation and cheating to describe the evolution and behavior they observed.

While too early to tell if any of this work will lead to the long-sought cures for cancer and drug-resistant bacteria, it is clear that physicists are bringing new tools to the table. "Through our naivete, physicists are not bound to the paradigms of biology," Riehn said. "We ask other questions."

Or as Liu put it, "We go in with our intuition. I am not afraid of failure."

INSIDE THE BELTWAY

The Path Forward May Get Considerably Harder

by Michael S. Lubell, APS Director of Public Affairs

The deal President Barack Obama, House Speaker John Boehner and Senate Majority Leader Harry Reid struck in early April to fund the government for the rest of fiscal year 2011 will probably make it more difficult for Republicans and Democrats to come together on two remaining issues: raising the debt ceiling to keep the United States from defaulting on its financial obligations and passing a fiscal year 2012 budget to keep the government operating beyond September 30.

Contention is the essence of democracy, and in Washington genuine civility is sometimes hard to find. But Republican freshmen in the House of Representatives have shaken the foundations of congressional decorum in ways probably unseen since the early days of the republic.

It has been an unwritten rule for as long as any of the old bulls in the House or Senate can recall that new members of Congress put in their time as silent onlookers before they gain the privilege of using the microphone. They are supposed to be seen, not heard, and they are supposed to toe the line, not charge across it.

Not so for the gang of 87 newcomers to the House who have displayed more defiance than deference, more spine than silence. They swelled the ranks of the House Republicans and gave the GOP one of its largest congressional majorities in history. And in every debate, they have confirmed their populist roots and their libertarian leanings.

They have been as effective in pushing the conservative budgetary envelope as they have been in garnering the attention of the media with their rhetorical flourishes. And having helped elect John Boehner speaker, they have made his life miserable whenever they have perceived him straying too far into the realm of compromise. Even when they have cut him some slack, they have remained an effective anchor of the conservative agenda, jerking him back to the right should he haw ever so slightly.

And so it was on the morning of April 14, as the House was preparing to vote on the budget bargain Boehner, Reid and Obama had struck five days earlier, that nearly a third of the Republican freshmen made it clear that they would oppose the speaker's deal. Their conviction and zeal caught fire, and by noon 32 more GOP House members had joined them, making it impossible for the speaker to pass the budget bill without significant help from Democrats–humble pie under any circumstances, but especially in the hyper-partisan atmosphere of the post-2010 elections.

Whether their action signals that John Boehner is in danger of losing his base and whether his leadership position is in any jeopardy, only time will tell. But without question, the budgetary contentiousness of recent weeks has been sufficiently unsettling for the speaker that he is less likely to bend during negotiations with the White House over raising the debt ceiling and adopting a budget for fiscal year 2012.

A mile and a half away down Pennsylvania Avenue, President Obama is having problems of his own with his Democratic base. Having given the House Republicans $38.5 billion of the $61 billion in cuts to non-security discretionary spending they had demanded, Obama suddenly found his left flank on the verge of revolt. They thought the president was about to concede even further ground: on environmental regulations, funding for Planned Parenthood, support for National Public Radio and use of local taxes in the

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an airplane up there, and we'd like to do it using lasers," Traverso said.

Using high-powered lasers and precision timing, Traverso says that his team could turn a distant point of the atmosphere into a lasing medium. He proposes firing two laser pulses into the sky along the same path. The second pulse would have a longer wavelength than the first, meaning that it travels slightly faster in the atmosphere and gradually overtakes the first pulse. The nitrogen or oxygen atoms in the atmosphere get excited where the two pulses meet, sending a laser-like pulse back down the path of the first two pulses.

To take the spectrographic data, a third pulse would be fired from the ground, intersecting the backwards beam. The region where these two beams meet would excite the atoms in the atmosphere, allowing for stimulated Raman spectroscopy of that point. With precision timing the third beam from the ground and the backward-traveling beam can be made to intersect at any altitude.

"We've shown the viability of using the atmosphere as a remote laser," Traverso said. "We're working to perfect the spectroscopy at the moment."

The team is still developing their techniques. So far they have built a tabletop version of the system, which has demonstrated the proof of concept. Running field tests likely poses logistical problems, because the Air Force is restrictive about giving out permission to fire high-powered lasers into the air.

ANNOUNCEMENTS

Distinguished Traveling Lecturer Program in LASER SCIENCE

The Division of Laser Sciences (DLS) of the American Physical Society announces its lecture program in Laser Science, and invites applications from schools to host a lecturer in 2011/2012. Lecturers will visit selected academic institutions for two days, during which time they will give a public lecture open to the entire academic community and meet informally with students and faculty. They may also give guest lectures in classes related to Laser Science. The purpose of the program is to bring distinguished scientists to colleges and universities in order to convey the excitement of Laser Science to undergraduate students.

The DLS will cover the travel expenses and honorarium of the lecturer. The host institution will be responsible only for the local expenses of the lecturer and for advertising the public lecture. Awards to host institutions will be made by the selection committee after consulting with the lecturers. Priority will be given to those predominantly undergraduate institutions that do not have extensive resources for similar programs.

Applications should be sent to the DTL committee Chair Rainer Grobe (grobe@ilstu.edu) and to the DLS Secretary-Treasurer Anne Myers Kelley (amkelley@ucmerced.edu). The deadline for application for visits in Fall 2011 is May 30.

Detailed information about the program and the application procedure is available on the DLS-DTL home page: http://physics.sdsu.edu/~anderson/DTL/

Lecturers for 2011/2012:

- **Laurie Butler, University of Chicago.**
- **Hui Cao, Yale University.**
- **Eric Cornell, University of Colorado.**
- **Jim Kafka, Spectra Physics.**
- **Fleming Krim, University of Wisconsin.**
- **Christopher Monroe, University of Maryland.**
- **Luis A. Orozco, University of Maryland.**
- **Carlos Stroud, University of Rochester.**
- **Ron Walsworth, Harvard University.**
- **Linda Young, Argonne National Lab.**

Reviews of Modern Physics

Recently Posted Reviews and Colloquia

Electronic transport in two-dimensional graphene

S. Das Sarma, Shaffique Adam, E. H. Hwang, and Enrico Rossi

Graphene, a single layer of carbon atoms forming a hexagonal lattice, has many remarkable properties, including an electron spectrum that is a realization of nonrelativistic Dirac fermions. This review focuses on the transport properties of this extraordinary material, which are contrasted with those of two-dimensional semiconductor systems. A thorough understanding of these issues will be essential for any future use of graphene in electronic devices.

http://rmp.aps.org

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thinking." There were no feral dogs or trash. Though it was primarily a subsistence agricultural town, students went to school six days a week because people there put such a premium on education.

The town was poor, so residents had improvised a number of solutions in place of technology they couldn't afford. One local had run PVC pipes across his roof to heat his water, while others use natural adobe for insulation. Schwartz saw a golden opportunity to have his students from Cal Poly come to Guatemala and learn about green solutions by helping the local community develop their natural and renewable resources.

To lay the groundwork for his "Guateca" program, in December of 2010 Schwartz led a team of twelve Cal Poly students to San Pablo to start building a relationship between the town and the university. The group took a survey of the town, asking people questions about year-round living conditions, energy usage, diets and education. Already students at Cal Poly had been developing inexpensive technologies using recycled and renewable materials, investigating everything from harnessing streams for "micro hydro" electricity production, house insulation from recycled bottles and prototype electricity-less refrigerators.

In the coming summer, students will travel to San Pablo and put the technologies to use. Schwartz sees it as a teaching opportunity for his students to learn by doing while at the same time benefiting the local community.

"If you want to help people, you've got to go be with people," Schwartz said.

The program is more involved than just installing these renewable technologies in the village. Students will work with the local residents to set up a local enterprise with the technology they develop that will continue after the students leave.

The heart of Schwartz's plan is a summer school he intends to establish in San Pablo for both US and Guatemalan students. There, residents and students would work together and combine what they've learned about business and technology so that the enterprises they've started will last. Schwartz hopes that San Pablo residents will integrate the green technologies into their lives and work.

"We're not going to fix anything," Schwartz said. "It's not something you can just fix. We can benefit from learning from them and in the process understanding their situation better."

Schwartz knows that his plan is ambitious. He said that so far the administration at Cal Poly has been supportive, but there are still many unknowns about the project he's taking on. However he's staying optimistic about the program. Already one of his teaching assistants has headed down to Guatemala to start an English language program for the residents.

"We have confidence in our intent to work through what happens," Schwartz said. "If you apply things with a benevolent curiosity and hard work, technical achievements follow."

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By irradiating fibers of carbon nanotubes with an electron beam, Filleter was able to induce cross-linking between the fibers and cause them to bundle into a much tougher carbon nanotube twine. His next step is to try to produce a macroscopic yarn, and if his methods hold up, Filleter said it could lead to some of the toughest textiles ever made.

Ming Xu, a researcher from the National Institute of Advanced Industrial Science and Technology in Japan, also demonstrated a new rubber-like material that she and her colleagues were developing, which is capable of withstanding a record range of temperatures. Xu said the viscoelastic material is made entirely of carbon nanotubes and that a sample withstood her team shooting metal spheres at it while they exposed it to temperatures ranging from -196 C to 1000 C.

Xu said the ultimate applications were unknown, but that it could be used in anything from spacecraft to earthquake retrofitting.

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District of Columbia to provide abortions, all of which Boehner & Co. opposed. And they started screaming, "Hell no!"

Where was the first African American president they had helped elect who had promised hope for the middle class and the poor? Where was the man, they wondered, who had spoken glowingly of single payer health care and the pressing need to address global warming? Where was the president who had said science, education and energy technology were his signature issues?

If the Democrat base becomes too disillusioned, the 2012 election could be a nonstarter, and Obama could well join Jimmy Carter and George H.W. Bush as a one-term White House resident. Polls showing Obama's approval ratings in the 30s among white voters have not been lost on the Ivy-League-educated president. Less than a week after he had agreed to the fiscal year 2011 deal, he pivoted and began to pepper his rhetoric with populist polemics. He chided Republicans for boosting the fortunes of the rich at the expense of the middle class, and he aggressively promoted his own debt reduction plan as a middle-class counterpoint to the Republican budget resolution that had just passed the House on a party-line vote. He was drawing a metaphorical line in the sand.

I could write an entire column about who occupies the moral high ground on this issue, but that is not my purpose, at least for now. Rather, I am hoisting a warning flag about the budgetary horizon. Science dodged a nasty bullet in the fiscal year 2011 skirmish when Boehner, Reid and Obama finally struck their deal, wiping out the draconian cuts to NSF, DOE and NIST that the original House budget bill, H.R. 1, had promised. It may not be so lucky the next time around if deal making becomes an unattainable goal.

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exploded. The spent fuel rods are thought to have been stored in the upper levels of that building, he said.

The power company then pumped the building full of sea water to try to stop the meltdown. Orbach classified that as a standard move and not a "Hail Mary", as he said much of the press had categorized it. However, he questioned the power company's motive in waiting so long to reach the conclusion that it was necessary and suggested they might not have wanted to admit that everything else had failed.

Each of the speakers took time to reiterate their belief that nuclear power was imperative to America's future.

Victor Reis, a senior adviser in the Department of Energy's Office of the Under Secretary for Science, had originally planned to echo remarks made in the President's State of the Union speech that America was at a Sputnik moment with regard to energy.

Instead, he spoke at length about a five-postulate argument that he had presented to the Blue Ribbon Commission on America's Nuclear Future, which is currently working on policy recommendations.

"If nuclear is going to participate, it's got to grow and it's got to grow fast," he said.

The five postulates were: that the availability of electricity is essential to prosperity; climate change is real and time-critical; nuclear energy is a prime replacement for coal; electricity will remain private; and the US government is interested in the environment, safety, national security and economic well-being, all of which are affected by nuclear energy.

Reis, who was not speaking on behalf of the Department of Energy, categorized much of the problem with energy as getting out of the coal business. He said that currently the US produces 800 Terawatt hours (TWhr) from nuclear power plants, but that in order to meet the President's stated goals, that number would have to grow to 2500 TWhr.

Achieving that amount of electricity from nuclear plants would require a $10 billion investment over the next five years, Reis said.

He also seized on an idea that each of the speakers repeatedly emphasized–that small, modular designs could solve many of our nuclear woes.

According to Reis, America's nuclear future was dependent on the fate of having long-term nuclear waste storage at the Yucca Mountain site in Nevada after interim storage options were taken away for political reasons. Politicians also canceled funding for small, modular designs because many didn't see a need if waste was to be taken straight to Yucca Mountain. When the site was taken off the table, it placed all of US nuclear energy at risk.

He said the Blue Ribbon Commission is expected to help change some of these decisions.

Robert Rosner, of the Harris Energy Policy Institute at the University of Chicago, said that we needed to think carefully about spent fuel storage in light of what happened at Fukushima, but he said that America had responded exactly the wrong way after our own country had problems at Three Mile Island.

Rosner described wings falling off of airplanes and fuselages disintegrating in mid-air during the early days of flight, and said that government action at the time wasn't to stop making new airplanes. He said the federal government invested heavily in determining what went wrong and then invested again in fixing the problems. That decision is why we now have the safe airplanes that we do.

"Is this the way to run–not the airline industry–but the fission industry?," asked Rosner. "I think the answer is no. Engineering fields learn from mistakes; it's time to start putting those lessons to use."

The Back Page

The Gulf Oil Spill Commission: An Inside Look

Ed. Note: *Established in May, 2010, by President Obama, the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling issued its report on January 11, 2011 after 6 months of intensive effort. Cherry Murray, Dean of the Harvard School of Engineering and Applied Sciences, and APS President in 2009, served on the commission, and shortly after it ceased operations on March 11, she talked with* APS News *staff writer Michael Lucibella about her experiences. The following is an edited transcript.*

Q: In a nutshell, how would you describe what the commission found?

A: Let me explain what our charter was first, because it was quite broad. What we needed to do was look at the whole picture, figure out what the root cause of the Deepwater Horizon blowout was, and then develop some options for guarding against and mitigating oil spills associated with offshore drilling, learn from this disaster and figure out what government, industry and whoever else needed to do in order to prevent this from ever happening again.

There were seven commissioners: two co-chairs, Bob Graham and Bill Reilly, and five others. There were 60 staff and the staff did a huge amount of work. The executive director was Richard Lazarus. We had six months. This was the fastest any presidential commission has ever been asked to do a report. We had a huge amount of work to do in a very short amount of time, and how that got accomplished with seven commissioners is by having this incredibly able staff of sixty people. The investigation of what actually happened is still ongoing and there are at least 13 different groups studying this.

Our job was to look at the root cause and leverage but not interfere with any other investigations that were going on. We had several subcommittees who were working on various aspects of this.

We ended up making recommendations on nine distinct areas. The first area was improving the safety, because it became very obvious that this was a serious issue in that eleven people died. We asked what should the government do to improve the safety, and what should the industry do to improve safety, then looked at safeguarding the environment, which is not the same as human safety, but obviously linked. Other issues included strengthening oil spill response planning and capacity, advancing well containment, and then what to do about restoring the Gulf. We also looked at ensuring financial responsibility of the parties at fault.

The major conclusion is that this incident was a failure of management. Offshore oil drilling can be done safely. It will always have risks, and we need to better mitigate those risks. So it was a failure of management, both of the industry and of the government oversight.

Q: What was your personal role?

A: I was on three subcommittees; the subcommittee on what actually happened at the well, the subcommittee on industry safety and the subcommittee on containment. They're slightly more engineering-oriented committees.

Q: How did you go about investigating for these committees?

A: The first thing we did as a commission was fan out. There are five states involved so we fanned out to the five states to look at the impacts on the local governments, people, industry and other entities down in the Gulf. We did a quick tour and then held a hearing in New Orleans for several days. We talked to companies. We had experts from the oil industry–for example, Rich Sears, who was the senior advisor for science and engineering, who retired a year ago from being head of the deepwater Shell exploration in the Gulf. The investigative lawyer team and I went down to the sister ship, the Deepwater Nautilus, which is leased by Shell and owned by Transocean, to look at what it would be like being on the rig and see exactly what's where, because we were trying to figure out who knew what when.

Q: What stuck with you when you were working on the project? What will you remember most about working on this?

A: The team was just absolutely first rate. The staff were outstanding people and it was incredible to get to know them, as well as the commissioners. We had decided as a commission that we would have a consensus report. It was bipartisan. One of the two co-chairs is a Republican and one's a Democrat.

One thing that's quite different from the normal committees that I'm used to serving on is that this was highly politically charged, and obviously there are many lawsuits that are going to come from this. In the middle of this in-

credible political and legal situation, we had to do our work as clearly as possible. So we were not to interfere with the criminal investigation, which we didn't. We were not to comment on the political situation of 'Should we have a moratorium at this time?' Instead we stepped back and listened politely to everyone's comments in the hearings, and letters and other input, and asked the question, 'In the future, would it be a good idea if we have another incident like this, is the moratorium a good way of dealing with it?' not 'Should we or should we have not called the moratorium right now?'

The other thing that we did was look at how well the oversight was being carried out. It was very clear that needed a complete revamping. It was clear to secretary Salazar as well, and he called in a new chief of the Minerals Management Service (MMS), Michael Bromwich from the Justice Department. There was a lot of back and forth on 'Here's what we think, here's how we think your agency should be reorganized,' and he took that as helpful advice, and is doing it. There were a huge number of conversations with him, not just hearings, and therefore I think we had a lot more impact.

Q: What was it like traveling down to the Gulf Coast at this time?

The Gulf region, in those five states, has a particular, very family-centered culture, and each family does one of three things: tourism, fishing and oil exploration in some way–it's either services to oil rigs, working on the rigs or some other aspect of the oil and gas industry. The moratorium was called so that all halted, the tourism went down by a factor of two, and fishing was halted because there was a zone of no fishing. It was a terrible time of depression and anxiety.

The local governments were extremely upset because the national response plan, which was being carried out as a result of the oil pollution act, written in 1990, did not include local governments. It took a month for [the federal government] to realize that this was not working well. The Coast Guard was actually doing an incredibly fantastic job, but there was a communication problem. The locals felt completely left out so they were ad-hoc added into the teams. So I guess the nation learned the lesson that we need better local involvement in the response.

The other thing that we learned is that the problem of perception is way worse than the actual circumstances, which is why tourism went down by a factor of two. That was billions of dollars for the tourism industry and contributes a large part of the tax base and they were just wondering how they were going to make ends meet.

Q: What kind of perceptions do you mean?

A: The perceptions that you couldn't possibly eat Gulf seafood. It was and still is much safer than public perception. And also that you couldn't go to the beaches. There were very few oiled beaches. Yes there was some oil on the beaches, but the major decrease in tourism was completely unnecessary.

Q: What is the future looking like for the Gulf region?

A: The Mississippi Delta has been shrinking under seawater for forty years, and that is due to the dredging for shipping canals, which is done by the Army Corps of Engineers. There has been considerable damage done to the area, basically due to industrial use for the last forty years, and you can't just restore it to what it was on April 20th a year ago–it needs considerable restoration. A glass-half-full look at this situation is that there will be money, and one of our recommendations to the president is that 80 percent of the damages that get paid because of this spill go into the restoration of the Gulf, which should bring this into a sustainable condition. Over the last 40 years the Gulf has lost land area equivalent to something like the state of New Jersey.

Q: What do you hope the country, the government and the public take away from your report?

A: The biggest lesson to be learned is that we need a very different safety culture in the Gulf of Mexico. The industry is perfectly capable of doing this. Since the Exxon Valdez incident, there has been no improvement in the technology of oil spills at all. We were doing exactly the same things that we were doing for the Exxon Valdez. We need to do better than that.

We also need to understand how to contain a well blowout like this. The technology that the oil and gas industry uses to drill these wells in very deep water is comparable in sophistication to the technology to go into space. What they have not done is put as much energy and resources into the technology for safety and for containment and spill response, and that has to change.

There are now two containment companies, one called Helix Producer and another one called Marine Well Containment Corporation, which was about a two billion dollar investment by a number of oil industry people who realized that the moratorium would not stop until we could actually do containment. The only way that oil wells can be killed for good is to drill a relief well, and that takes 90 days, which is why we had 90 days of oil spilling into the Gulf. We need something better than that, and that's already happening in the industry.

We need an industry self-policing unit and much better oversight. The safety and environmental oversight needs to be removed from the leasing and revenue generation. Michael Bromwich has already started this process.

Q: Are you optimistic about your recommendations being adopted?

Yes, many of the most important recommendations don't cost a lot of money. It doesn't cost a lot of money to reorganize the MMS, but we said it needs to be better funded. One way of better funding it, which has already been proposed in Congress, is to take a percentage of the lease money. Right now the lease money goes right into the federal treasury. So instead of having a Congressional line item, make sure that the industry is paying for its regulation.

Any energy industry is risky, but you can mitigate the risks and you need to have very good industry safety culture, but you also need to have good federal regulation. That is probably the most critical of our recommendations. We also believe there needs to be way better science being used in all of the environmental impact statements the industry generates. Serious laws that are already on the books need to be better enforced.

Q: How did actually being on a rig change how you thought about it?

A: I think seeing the enormity of just how big these rigs are and how huge the blowout preventer is, which is about four stories tall. You see pictures of these things, but it doesn't really strike you how much energy you need to shear the drill pipe for example. I got a much better feel for the risks associated with this industry.

We also cautioned against very quick production of oil in the Arctic, a frontier area where we don't know enough about what's there to know what we could possibly be damaging. More science needs to be done just to figure out what resources are there. We know for sure that it will be much harder to clean up. There's a Coast Guard station, and it's a thousand miles away. It took three and a half hours to get out to the Deepwater Horizon rig; how long is it going to take to go a thousand miles? The bacteria and other marine organisms that eat gas, if not oil, are not there in the Arctic and all chemical reactions are going to be slower, so the degradation of the oil would be incredibly slow. The damage would be much worse in the Arctic. We don't know how to do spill cleanup among sea ice. We didn't say 'Don't drill in the Arctic', we said 'Look, we need to understand the risks, perhaps one should look at this a little more carefully before doing a huge amount of development in the Arctic.'

APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org