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Spring 2007 Prizes and Awards
See insert inside

"Woodstock of Physics," Quantum Computing Among Highlights of 2007 APS March Meeting

More than 7000 physicists will converge on Denver, Colorado this month for the APS March Meeting, usually the largest physics meeting of the year. The meeting will take place at the Convention Center in Denver, at the threshold of the beautiful Rocky Mountains, March 5-9, 2007. The principal topic areas will be condensed matter physics, industrial applications, new materials, chemical and biological physics, fluids, polymers, and computation. A number of sessions will address social issues.

Happy Anniversaries. Two momentous occasions in the 20th century history of physics will be celebrated at the Denver meeting. The first is the 20th anniversary of the so-called "Woodstock of Physics": a mammoth session at the 1987 APS March Meeting devoted to the new class of ceramic superconductor discovered not so many months before. After decades of poring over materials which became superconducting only at liquid helium temperatures, the prospect of critical temperatures above 100 Kelvin electrified scientists and the public alike. Speakers reporting fresh results on so-called high temperature superconductors (HTSC) went on until 3:15 am. Now, 20 years later, another set of talks (a few by the same practitioners from 1987) will review what has been learned and what we can look forward to when it comes to superconductivity (B1).

While the HTSC anniversary might command more attention, the anniversary of the highly successful theory of low-temperature superconductivity is also important. Named for its three originators–John Bardeen, Leon Cooper, and Robert Schrieffer, who shared a Nobel prize for their efforts –the BCS theory explains superconductivity as arising from the pairing of electrons through the mediation of subtle vibrations rippling through the material. Physicist Paul Grant calls the BCS work "the most monumental theoretical achievement of condensed matter physics in the 20th century." A special evening session at the March Meeting will look at the impact of this theory on the study of not only atoms and solids but also nuclei, quarks, and the cosmos itself. (G1)

Latest Quantum Computer Hardware. Physicists are pursuing several hardware options for making truly powerful quantum computers that would fulfill their potential of performing ultra-fast database searches, rapidly cracking secret encrypted codes, and greatly improving molecular-level

MARCH MEETING cont. on page 3

Meet the New Editor-In-Chief: Gene Sprouse

Gene Sprouse is the new APS Editor-in-Chief, replacing Martin Blume, who has retired. Blume had served as Editor-in-Chief since the beginning of 1997.

The APS Editor-in-Chief, one of the Society's three operating officers, has responsibility for all APS research journals–the *Physical Review*, *Physical Review Letters*, and *Reviews of Modern Physics*–and in addition oversees the editorial staff and the journal production staff associated with them. Sprouse took over the position on March 1.

Photo by Ken Cole

Martin Blume (on the left) and Gene Sprouse

After attending MIT as an undergraduate, Sprouse received his PhD from Stanford in 1968, and joined the faculty at Stony Brook University in 1970. He became full professor in 1979, and served as department chair from 1990 to 1996. Last year he was promoted to Distinguished Professor. He served as director of the Nuclear Structure Laboratory at Stony Brook from 1984 to 1987, and again from 1996 to the present. His research interests include nuclear structure, neutral atom trapping, and laser spectroscopy of radioactive atoms. Sprouse was elected an APS Fellow in 1984.

Starting in 1995, Luis Orozco (now at the University of Maryland) and Sprouse led a team at Stony Brook to study the element francium with laser trapping techniques. Francium has no stable isotopes, and is extremely rare; "There's only about an ounce of it on the Earth," says Sprouse. They produced the francium in Stony Brook's superconducting LINAC, and then succeeded in transferring the atoms into a magneto-optical trap for further careful study of the atom's properties. Francium is the heaviest alkali atom, and holds special interest because its atomic properties can be calculated with high precision, says Sprouse. It can be used to study fundamental interactions, in particular the strength of the weak interaction between electrons and quarks in the atom, and the effects of the weak interaction in the nucleus. These effects have already been observed in cesium, but in francium, they are much stronger and should be easier to measure, says Sprouse. The Stony Brook accelerator has recently shut down, so Sprouse's collaborators will carry on the francium work at TRIUMF, in Vancouver, while he turns his primary attention to the APS journals.

When he's not investigating the atomic properties of francium, Sprouse might be found in his kitchen, baking bread–his specialty is baguettes.

Now, he's starting a new endeavor: leading the APS journals. Sprouse says he views his new position as a challenge. "There are very interesting things go-

SPROUSE cont. on page 7

Poll Finds Significant Interest in School Boards Among Physicists

An *APS News* poll conducted in February has found that while not many physicists have served on their state or local school boards, a significant number have been involved with their school boards at some level, and many would consider running for election if they had some organizational support.

Michael Brown, Executive Director of Scientists and Engineers for America (SEA), thinks that school boards are an area where scientists can be valuable, and it's relatively easy to get involved. "Scientists have a lot to offer school boards," said Brown. SEA is an organization formed last September to promote good science in policy making.

Students in the United States continue to do poorly in science. The US is falling behind other countries in science proficiency, and because of that we're losing our ability to compete in the global marketplace, said Brown. Encouraging scientists to get involved with school boards is one step we can take to improve science education, he said.

The *APS News* survey asked participants to answer three simple yes/no questions:

SCHOOL BOARDS cont. on page 6

APS Gathers Postdoc Best Practices; Comments are Invited

In January, APS Executive Officer Judy Franz asked physics department chairs in research universities for information about an important but sometimes overlooked segment of their community: postdocs. In her letter, Franz pointed out that postdocs often face problems both with their present working conditions, and as they plan for their future careers.

"Physicists in their postdoc years are especially vulnerable–their future careers depend critically on the success of their research during this rather brief period," the letter said, "yet we hear of concerns from post-docs about their isolation, poor health benefits and maternity leave policies, lack of travel funds, and being tied too closely to one advisor or one project. APS would like to learn how your department deals with such concerns, as well as any other ideas you have that would help post-docs be more productive."

A variety of responses was received, from which APS extracted quotes describing what the departments do for postdocs, and what issues are considered to be most important. These were posted on the APS website under "Postdoc Best Practices." They are grouped into various subjects, such as "Benefits", "Combating Isolation", and "Career Development", with the hope that they will be useful to other departments in finding ways to help their own postdocs.

Many departments offer full benefits to postdocs. Others offer everything but retirement; one covers everything except maternity leave. To combat postdoc isolation, departments listed such items as a postdoc handbook, an annual social event, and an active seminar program in which postdocs were invited to participate.

Career development is an important issue for postdocs. Many departments stress mentoring, and at one department, the mentor is deliberately chosen to be someone other than the postdoc's research supervisor, to provide an alternative voice should a conflict arise. One chair had a global solution to career development: "Work to increase the number of tenure-track faculty positions! Everything else is just window-dressing."

As reported by the chairs, postdocs are often involved in teaching, which is viewed as a benefit both in combating isolation and in career development. Opinions varied as to whether postdocs should expect travel funds, or whether that should be left to the discretion of the principal investigators.

The full list of best practices can be found at http://www.aps.org/careers/guidance/postdoc-best-practices.cfm. Interested readers, especially postdocs, are invited to provide their own comments in a box at the bottom of the page. The most useful of these will be posted on the site.

Fellows Reign in Southern California

Photo by Darlene Logan

On January 16, a large turnout of APS Fellows assembled in the UCLA Faculty Center to socialize and to hear about some APS programs. The evening was hosted by Barry Barish of Caltech, and was presided over by APS President-elect Arthur Bienenstock of Stanford. In addition to Bienenstock, attendees heard from APS Executive Officer Judy Franz, Director of Education and Diversity Ted Hodapp, and Director of Public Affairs Michael Lubell. In the photo, Bienenstock (center), enjoys the company of Fellows King-Ning Tu (left) and Roberto Peccei, both of UCLA.

Members in the Media

"The spirit of this is that they are trying to get us to pay attention to the issue and get our act together, which is not together."

***Frank von Hippel**, Princeton University, on the Bulletin of the Atomic Scientists "doomsday clock," which was moved closer to midnight due to the threat climate change poses to civilization, Newark Star Ledger, January 18, 2007*

"We only have to turn a knob and it slows."

***John Howell**, University of Rochester, on a new method of slowing light and using the slowed light pulses to store an image, Washington Post, January 19, 2007*

"The conditions here are not easy. It's very cold and dry, and there isn't enough oxygen. In this season of the year, there is daylight round the clock, the rooms are tiny and one can shower only twice a week for two minutes."

***Hagar Landsman**, University of Wisconsin, on the conditions in Antarctica, where she is working with the IceCube project to study neutrinos, Jerusalem Post, January 28, 2007*

"It's going very well. And this is such a delicate operation. You always live on the edge with this project. It's like driving a race car; you never know when you're going to go off the road."

***Francis Halzen**, University of Wisconsin, Madison, on the construction of the IceCube neutrino detector in Antarctica, Wisconsin State Journal, January 18, 2007*

"There may be a period of time when the only thing we have in space is Webb. So we just have to get it right."

***John Mather**, NASA, on the Webb Space Telescope, which is scheduled for launch in 2013, Washington Post, February 5, 2007*

"Even a small change in deceleration, if it goes from 1 millisecond to 3 milliseconds, it's a factor of three. It's the difference between a lethal force and a force that just knocks you unconscious. The awning acted as a de facto airbag."

***James Kakalios**, University of Minnesota, on how a man survived a fall from a 17th floor window, Associated Press, January 23, 2007*

Committee on Informing the Public Holds First Meeting

Photo by Ken Cole

On January 29, the new Committee on Informing the Public held its first meeting at APS headquarters. The committee will oversee APS's media relations and public outreach activities (see story in the December 2006 *APS News*, available online). Seated at the table are (l to r) Dan Dahlberg of the University of Minnesota; APS Head of Public Outreach Jessica Clark; and APS Public Outreach Specialist Kendra Rand. Gathered behind them are APS Head of Media Relations James Riordon; APS Associate Executive Officer Alan Chodos; Sean Carroll of Caltech; Committee Chair Philip W. Hammer of the Franklin Institute; Ivan Schuller of the University of California, San Diego; Laura Greene of the University of Illinois; Paul Zitzewitz of the University of Michigan, Dearborn; Gianfranco Vidali of Syracuse University; Larry Gladney of the University of Pennsylvania; and Paul Chaikin of New York University.

This Month in Physics History

March 16, 1938: Katharine Blodgett patents anti-reflective coatings

Many things became much clearer in 1938 after Katharine Blodgett developed anti-reflective coatings for glass. Uncoated glass is far from invisible. It reflects a significant amount of the light that hits it, creating distortion and glare. Blodgett, a physicist at General Electric laboratories, developed a method of coating glass with a soapy film that would eliminate most of those reflections. Her insight led to the practical ant-reflective coatings that now coat picture glass, windshields, eyeglasses, camera lenses and much more. Blodgett received a patent for the process in March 1938, and GE announced the discovery in December of that year.

Katharine Burr Blodgett was born in Schenectady, NY, in 1898. Her father, a patent attorney at General Electric, died shortly before she was born, and the family moved several times during her childhood. She attended Bryn Mawr College, and during her senior year, Blodgett visited GE to tour the labs. Her tour guide was Irving Langmuir, who had known her father. He encouraged her to pursue further studies in chemistry and physics. After receiving a master's degree from the University of Chicago in 1918, Blodgett returned to GE to work as Langmuir's assistant. Langmuir, who went on to win the Nobel Prize in chemistry, was at the time opening up a new field of research by developing a way to produce uniform one-molecule thick oily films on a water surface.

Photo: AIP Emilio Segre Visual Archives, Physics Today Collection

Blodgett (center) demonstrating surface chemistry experiments for visitors at the opening of General Electric's new Research Laboratory building

After Blodgett had worked for a few years as his assistant, Langmuir encouraged her to continue her education still further. In 1924 she went to Cambridge University, where she worked with Ernest Rutherford and wrote a thesis on the topic of gaseous electronics. She was the first woman to receive a PhD in physics from Cambridge. She returned to the United States in 1926 and rejoined the staff of GE as a research scientist. At first, she collaborated with Langmuir on some improvements to light bulbs, and then in 1933 they began working again on surface films. The monolayer films were well understood by this time, so Blodgett and Langmuir began building up thicker films to study. Blodgett developed a way to transfer the soap film from a water surface to a solid surface such as metal or glass, and found that by repeating the process she could build up films of barium stearate layer by layer, up to about 3000 layers. These became known as Langmuir-Blodgett films.

Blodgett then began looking for some applications for the films. She noticed that even the clearest glass reflected as much as 10 percent of incident light, making it difficult to see through. Blodgett realized her soapy films could solve that problem. Since she could precisely control the thickness of the soapy films by building them up one molecular layer at a time, and could easily deposit the films on a glass surface, Blodgett figured out that she could develop a coating of just the right thickness to cancel out most reflections from the glass surface. She built up a film with thickness equal to ¼ the average wavelength of visible light (about 1388 Angstroms). This way, any light that reflected off the glass surface would have traveled half a wavelength farther than light that had reflected off the film surface, so most of the reflections would cancel out. Blodgett also tweaked the chemical composition of the film to adjust its index of refraction to enhance the reflection-canceling, and she was able to eliminate almost all of the reflection, making the glass nearly invisible.

On March 16, 1938, Blodgett received US patent #2,220,660 for the "Film Structure and Method of Preparation." This was one of six patents Blodgett received in her lifetime. She also published a paper titled "Use of Interference to Extinguish Reflection of Light from Glass," in the *Physical Review* in 1939.

General Electric announced the discovery in December 1938, and it immediately caused a lot of excitement. Blodgett and her "invisible glass," as the popular press called it, were featured in *Time*, *Life*, and *The New York Times*. The public's fascination with Blodgett and her work may have been due in part to the fact that she was a woman in science, which was still very unusual at the time.

During WWII, Blodgett contributed to the war research by developing poison gas absorbents, a method for de-icing aircraft wings, and improved smokescreens. She also developed a "color gauge" to measure the thickness of coatings, conducted more research on films, studied electrically conducting glass, and developed a way to use electrical discharges in gases to clean solid surfaces of impurities, a method that is used in semiconductor device fabrication. Blodgett retired in 1963 after a long career at GE. She died in 1979 at age 81, having received numerous awards for her work, though she was conspicuously left out of a 1953 article in Science celebrating 75 years of research at GE laboratories.

Blodgett's original soap coatings were not useful for commercial products because they were too soft and could easily be wiped off the glass surface. Soon after her announcement, however, other groups developed durable coatings and improved methods of production. These coatings have been reducing reflections from eyeglasses, picture glass, camera lenses, microscopes, windshields, televisions and computer screens ever since.

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Built for Speed: NASCAR Physics Featured in Public Lecture

In February, 200,000 people gathered in Florida to watch the Daytona 500, with another 35 million tuning in via TV. But NASCAR is more than just a sport: there's real science involved in piloting a car around the 31-degree banked turns of the Daytona International Speedway at 190 mph.

"Mastery of the laws of physics is a pre-requisite to compete, let alone win," says Diandra Leslie-Pelecky, an associate professor of physics at the University of Nebraska, who will talk about the physics involved in NASCAR in a public lecture at the APS April Meeting in Jacksonville, Florida. This includes why racecars are shaped like kidney beans; why they don't have mufflers; why hitting the car in front of you makes both cars go faster; and why NASCAR vehicles need 110-octane gas when the average SUV gets by on 92 or 93.

A long-time NASCAR fan, Leslie-Pelecky's interest in the science behind the sport was piqued when she watched a car crash, even though the replays showed no obvious cause–no collision, no sideswipe, no flat tires, no engine failures. Her quest to find the answers to this and other questions took her to some unexpected places for a physicist: from behind the scenes at top racing shops, to the asphalt at the Texas Motor Speedway.

Leslie-Pelecky earned her PhD from Michigan State University and joined the faculty at the University of Nebraska in 1994. Her academic research focuses on magnetic nanomaterials with potential applications in improving MRI technology and cancer diagnosis, and she is also very much involved with science education and public outreach.

The car says "DLP," Diandra Leslie-Pelecky's initials.

MARCH MEETING continued from page 1

simulations for designing drugs and other new materials. At the Denver meeting, researchers will describe quantum-computer designs based on a newer approach, the use of superconducting electronic components, which could be made with existing manufacturing methods and are inherently less noisy than classical semiconductor circuits. Developments include the construction of a component called a controlled-not quantum logic gate, the first proposed superconductor-based quantum computing architecture that enables error correction, and a "dial" that can vary how strongly the superconducting quantum bits (qubits) interact. (N2)

Several other researchers will discuss quantum computing designs based on trapped ions, presently the most technically advanced approach. NIST-Boulder's David Wineland (D2.2) will discuss a promising new multiple-electrode, single-plane ion-trap design that potentially prevents ions from overheating, currently the bane of all ion-trap groups. Lucent's Dick Slusher (D2.4) will talk about silicon-based VLSI (very-large-scale integration) processes for scaling up the number of traps so that they would contain enough ions to perform useful quantum simulations of real-world materials. Additional meeting talks feature semiconductor-based (B43.4), exotic-particle-based (D7.4), and optics-based (S33.3) quantum-computing designs.

Natural Glue. Studying adhesives in natural composite materials such as bone and mollusk shells at the nanometer scale, microscopy pioneer Paul Hansma and his colleagues have learned a few lessons which they have concluded can lead to a new class of tough, lightweight, and damage-resistant artificial materials. Natural composites are held together by organic glues that make up just a few percent of the composite by weight. These glues hold together the stronger elements in the composite. They yield just before the strong elements otherwise break. They heal themselves by re-forming chemical bonds. According to calculations by Hansma and colleagues, combining stiff and strong nanostructures such as carbon nanotubes or graphene with just a few percent by weight of biologically-inspired adhesives could lead to a new generation of high-performance materials (A4.3).

The Cost of Light. Lighting in the US is a $50 billion business and accounts for 22 percent of electricity use. Solid-state lighting, as manifested in light emitting diodes, seeks to get the most light out of available electricity. LED light flourishes in niche markets, such as brake and traffic lights, and future conquests are in sight. Performance of 138 lm/W(lumen per watt) have been achieved in the lab for low power devices and over 90 lm/W for high power devices. According to George Craford (Philips Lumileds Lighting Company), "high power commercial products with performance in excess of 100 lm/W will become available soon, which is substantially more efficient than incandescents (15 lm/W) and compact fluorescents (60 lm/W) and equivalent to high performance fluorescent lighting." Representatives from a variety of labs pursuing solid-state light will provide reports on their progress. (J3)

Knowing Left From Right. Like many other biomolecules, RNA and DNA exist in nature in right-handed but not in left-handed form. This asymmetry, known as chirality, is one of the most mysterious open questions about the origin of life. A previously unknown difference between the two versions of the RNA molecule has now emerged. Raman spectroscopy seems to suggest that the energy levels of certain electrons are slightly different in the two versions. This slight asymmetry could be an effect of the weak nuclear force. Future studies will use a new free-electron laser to probe other electron energy levels in RNA. (V35.7)

Security Scanners Look to the Stars. A new imaging system could surreptitiously identify people carrying concealed weapons with the use of detectors derived from instrumentation that has long been a mainstay in astronomical observations. The system that Panu Helisto (VTT Technical Research Centre of Finland) will describe detects the terahertz radiation that people and warm objects naturally emit all the time. Terahertz imaging provides higher resolution than infrared monitors and works at ranges of 10 to 30 meters. Because they detect temperature variations, they don't reveal anatomical details that show up on some other clothes-piercing scanners. Such a technology would be an ideal security scanner for airports and other public spaces. (Y39.1)

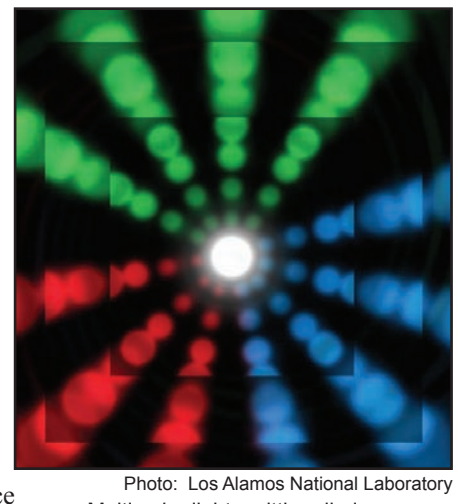

Photo: Los Alamos National Laboratory
Multi-color light emitting diodes

Energy Boosts from Land and Sea. Douglas Schmitt (University of Alberta) will report on new seismic imaging methods to track the flow of heavy oils, such as those in Colorado's shale and Canada's abundant oil sands, when they are extracted via the injection of solvents or steam into the ground. Accurate imaging of reservoirs will be vital if sand or shale oils are ever to become significant energy sources. Later in the same session, Timothy Collett (U.S. Geological Survey) will provide an assessment of the promise of another unconventional energy source–icy combinations of natural gas and water known as hydrates. Collett will summarize the latest estimates of hydrate reserves and survey the various methods for extracting natural gas from them. (A2)

To Mars! Manned missions to Mars and a semi-permanent lunar base are currently high on NASA's priorities. Unfortunately, once we leave the protection of Earth's magnetic field and atmosphere, we are mercilessly exposed to numerous sources of radiation. In order to survive trips to Mars and even extended stays on the moon, we are going to have to come up with light, effective shielding. Ram Tripathi (NASA) will discuss some of the shielding options, including carbon nanofibers, that could offer long term protection to space travelers. (W28.13)

Brainy Amoebae. For the first time, the hunting strategy of an amoeba has been shown to be somewhat better than random. The amoeba called Dictyostelium seems to remember its previous steps–which it performs by pumping itself into protuberances known as pseudopods–and to explore new grounds, increasing its chances of finding food. One hypothesis is that the formation of pseudopods leaves temporary "scars" in the cell's cytoskeleton, making it more likely that the next pseudopod will point in a new direction. A similar mechanism might exist in a variety of other single-cell organisms and even in human cells such as neurons. (U35.4)

Mapping Protein Folding. Understanding how proteins fold is one of the questions at the heart of biophysics. Atomic force microscopes allow one to unfold proteins essentially by hand, and to compare the energy of the folded and unfolded configurations. A new technique uses a microscopic cantilever, attached to the AFM tip, to pull and stretch a protein while measuring the protein's reaction force by how much it bends the cantilever. This way, the protein's energy landscape can be mapped along the entire unfolding process, something that was previously only estimated by theoretical methods or simulations. The new technique can be applied to any protein, as well as to DNA and RNA. (V15.10).

Liar, Liar. A new network theory model could be the closest analogue yet to the classic Washington game of who-knows-whom and how best to leak information (and disinformation) to the press. When individuals try to get in contact with people who can lead them to the information they want, the result is a dynamically evolving web of social connections. The new model shows that if too many of the individuals spread false information, the result is a global breakdown of the network, with true information sent on ever longer paths and essentially lost. (P22.2)

Down to the (Nano)Bone. Bone contains important nanometer-scale structures that endow it with much of its strength. Christine Ortiz (MIT) will describe experiments involving "nano-granular friction," the resistance to motion caused by nanometer-scale mineral particles in bone, which help to increase the strength of bone when compressed. Ortiz and her colleagues are studying the variations in its composition and porosity in different points of its structure, and are proposing that these structural variations lead to a new mechanism of energy dissipation that might enhance certain bone properties such as ductility, the ability of bone to change shape. (Y4.5)

Climate Change. Susan Solomon (National Oceanic & Atmospheric Administration) is a co-chair of the current study by the Intergovernmental Panel on Climate Change (IPCC), the organization jointly established by the World Meteorological Organization and the United Nations Environment Programme (UNEP) in 1988. An expert on the ozone hole, Solomon will discuss the upcoming report of the IPCC Working Group 1. Doug Nychka (National Center for Atmospheric Research) was a member of a recent NAS panel exploring the "hockey stick" shaped curve of temperature versus time. The NAS came up with a reasonable judgement that the statistics used in making the curve were not perfect but that this inaccuracy wouldn't change the net conclusion much, namely that anthropogenic warming was taking place. David Randall (Colorado State) will talk about counting clouds and, more generally, how to address the problem of accommodating such widely different size scales in climate modeling. (V7)

Entrepreneurial Physics. Spinning a promising new technology into a viable commercial business has its pitfalls. Philip Wyatt of Wyatt Technology Corporation will share his experiences starting his own company. His first attempt failed, but he took the lessons learned and successfully started a second venture, commercializing new instrumentation for studying the laser-scattering properties of cola beverages. Other speakers offering their entrepreneurial insights at the session include James Wyant (University of Arizona), founder of the WYKO Corporation; Virgil Elings, co-founder of Digital Instruments; and John Woollam, founder of J.A. Woollam Co. (H6)

Pauli as Mephistopheles. Quantum physicists attending a 1932 meeting at Niels Bohr's Copenhagen Institute amused themselves by staging an updated version of Goethe's Faust. The plot featured Pauli tempting Paul Ehrenfest to accept the idea of a chargeless, massless particle, then called the neutron. George Gamow's second wife, Barbara, translated the anonymous *Faust: Eine Histoire*, which was published in Gamow's *Thirty Years That Shook Physics*. Karen Keck of the Net Advance of Physics will talk about the parallels between Goethe's original and the parody, and how Barbara Gamow's translation compares to both. (U20.2)

Letters

Scientists: Humble, or Arrogant?

In his back page article in the January *APS News* "Sound Science or Sound Bite," Michael Bugeja tries to convince the reader that the public perceives of scientists as arrogant, by providing the results of a simple Internet search experiment. The article quotes, "What's the first thing that comes to mind when you hear the word 'scientist?' Chances are it isn't 'modesty or humility.' A simple experiment underscores this conclusion. Type 'modest scientist' or 'humble scientist' into the Internet search engine Google and you'll be lucky if you get more than a couple of hits. Then do the same thing with 'arrogant scientist' and the number of hits increases by an order of magnitude."

Naturally, favorable and unfavorable public opinion of a social class should almost be equal, unless (at least) some people in a class tip the public's perception one way or another–for example, we have all heard about used car dealers. Although the result of Bugeja's experiment concerns only one aspect of a scientist's persona, the result still points toward an unbalanced public view.

I felt sufficiently troubled by the "order of magnitude" difference suggested by the article that I decided to carry out the experiment myself. Luckily, such an experiment does not need any funding or exceptional facilities and would not demand much time. I searched for the exact phrases "humble scientist(s)", "modest scientist(s)", and "demure scientist(s)", which resulted in 1230(326), 620(232), and 53(0) hits, respectively. On the other hand, I searched for "arrogant scientist(s)", "egotistic scientist(s)", "pompous scientist(s)", and "haughty scientist(s)", which resulted in 609(517), 30(10), 398(1160), and 53(46) hits, respectively.

The "humble scientist" case yields the total of 2461 hits, while the "arrogant scientist" case gives 2823 hits. Amusing, isn't it? The "humble scientist" indisputably scores more than "a couple of hits" and the two cases do not differ by an order of magnitude at all. In fact, they are comparable. That would be also the case if you limit the search to only "humble" and "arrogant" scientist(s). A quick look at a few pages of search results reveals even more. On each page of ten entries, one or two entries are either duplicate or irrelevant. That roughly corresponds to a 10 to 20 percent error in the outcome of Bugeja's experiment, which makes the "humble" and "arrogant" scientist numbers even more comparable.

To be precise, and putting aside the humor, such a simple experiment is not credible enough to base any conclusion upon, but perhaps only good enough to give a ballpark estimate of what people, and in particular those who contribute to the Internet, may think of a scientist when it comes to the subject of humility.

What is disturbing, nevertheless, is the claim that an almost-effortless experiment would have a certain outcome to support a certain point of view, when it apparently has never been carried out.

Mehrdad Adibzadeh
Charlottesville, VA

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Following the suggestion in the Back Page article by Michael Bugeja, I typed "arrogant scientist," "humble scientist" and "modest scientist" into Google. The results: arrogant-668, modest-615, humble -1210. 668 is not an "order of magnitude" greater than 615 or 1210, and both 615 and 1210 are orders of magnitude larger than "a couple."
Your humble servant,

Ronald Ransome
New Brunswick, NJ

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In his recent Back Page article, Michael Bugeja claims Google will find 10 times as many hits for "arrogant scientist" as "modest scientist." Actually searching on those terms produces about 1 million hits for each. If the terms are quoted, the number of hits is reduced to about 600, again for each.

The results are nearly identical if you substitute "journalist" for "scientist." The exception is for "modest journalist" (with quotes). That produces half the number of hits that "arrogant journalist" produces.

Charles Bloch
Houston, TX

There is no Truth in Science

I quite enjoyed reading Michael Bugeja's Back Page in the January *APS News*. Everything was dandy until I reached his comments on TRUTH. Scientists observe and then attempt to correlate their findings through theoretical constructions. If the constructions are good enough then we can use them to predict further observations. That is all science is, not truth seeking. There are no certitudes in science that can distinguish between truth and falsehood.

All I know about truth is very personal: when persons say or write what they believe they are telling the truth. When they falsify what they say or write they are telling a lie. Couldn't be simpler than that. There are no truths in science but many falsehoods. God help us all if some truth seeking scientist says he has found TRUTH, and is believed. Let's leave truth out of science. It never belonged there.

Moishe Garfinkle
Philadelphia, PA

Michael Bugeja Responds

Ah, the irony of it all!

I have been asked to respond to inquiries, such as the letter published here by Mehrdad Adibzadeh, concerning a quotation that was mistakenly attributed to me in part because *APS News* condensed my essay, cutting out a vital sentence.

To read "Sound Science or Sound Bite?" in its entirety, visit this URL: http://insidehighered.com/views/2006/10/10/bugeja

The quotation in question concerns humility and appears in the journal *In Character* as a subtitle to an essay written by a scientist (not me, the journalist):

What's the first thing that comes to mind when you hear the word "scientist?" Chances are it isn't "modesty or humility." A simple experiment underscores this conclusion. Type "modest scientist" or "humble scientist" into the Internet search engine Google and you'll be lucky if you get more than a couple of hits. They the same thing with "arrogant scientist" and the number of hits increases by an order of magnitude.

As my essay notes, a scientist comes to my town to discuss why intelligent design is not science and seemingly makes an arrogant statement. The scientist is the same one who published the *In Character* essay. How could that happen? The rest of my piece addresses that sublime irony.

Journalists wait decades for irony like that to happen. To assume that I wrote the quotation misses the careful foreboding that propels the essay to conclusion.

And now, I confront another assumption. The editor of *APS News* writes, "Even though the author of the letter failed to notice that you were quoting someone else, it is still of interest (especially to physicists, who practice an experimental science) to test the assertion about the results of the Google search."

Did you think that a journalist also would fail to test the assertion?

Before "Sound Science or Sound Bite?" found its way to *Inside Higher Ed*, it was a speech delivered at a biotechnology conference. I will conclude by quoting verbatim from that speech:

In the spirit of scientific inquiry, I tested this experiment on April 10, 2006. I thought you would enjoy the results:

There were 325 entries for "humble scientist" and close to triple that, 861 entries, for "arrogant scientist." Well, I thought, "scientist" is such a generic term. Why don't we refine that using "botanist," "physicist," "biologist," "mathematician," "chemist" and "geneticist"?

Who, would you say, are the most modest and most arrogant of that sample in the Google test?

Turns out, physicists are the most arrogant with 171 listings under "arrogant physicist." That was followed by "arrogant mathematician" with 117 entries, "arrogant biologist" with 31 entries, "arrogant geneticist" with 22 entries, "arrogant chemist" with 10 entries, and a very respectful three entries for "arrogant botanist."

Okay. Which branch of science was the most modest? There were 37 modest mathematicians, according to Google, 31 modest biologists with an equal number of modest chemists, 7 modest physicists, 1 modest botanist, and, as you might suspect, there were no Google phrases in the 1.5 million Web sites in the search engines directory containing millions, if not billions more pages of text, not one entry, mind you, for one measly "modest geneticist."

Well, you might argue, why don't you try the same experiment using "modest journalist" versus "arrogant journalist." Are you likely to get the same results? Google lists 163 "modest journalists" and 181 arrogant ones. That passes for "fair and balanced," I guess.

Question: Why was this section omitted from my essay? Answer: I fact-checked the piece before publication with a scientist at Iowa State University who felt the Google experiment was cute but detracted from the irony of the piece.

Lesson? *Don't cut vital irony or irony will cut you.*

Ben Franklin Blazes Trail for IBM Inventors

Ben Franklin's experiments with turkeys (*APS News, This Month in Physics History*, December 2006) were not known to IBM colleagues and me when we discovered excimer laser surgery in 1981, using leftover Thanksgiving turkey.

Prior to this discovery, my colleague Rangaswamy "Sri" Srinivasan had co-discovered that short, high fluence pulses of ultraviolet (193 nm) light from an ArF excimer laser could photoetch plastic of the kind used for packaging of semiconductors. Sri and I then had casual discussions on the possibility of using the excimer laser to excise human and animal tissue. Together with our colleague Sam Blum, we irradiated our fingernails and observed clean etch patterns, but we were afraid to irradiate our skin.

The breakthrough occurred when "Sri" decided to bring some turkey leftovers from his Thanksgiving dinner to our lab (IBM's T.J. Watson Research Center), where he used the excimer laser to produce a clean incision in a sample of cartilage attached to a turkey bone. Soon afterwards, he showed the laser-etched sample to Sam and me. I took this sample and tried to make an incision using green (532 nm) pulses of light from a frequency-doubled, Q-switched Nd:YAG laser.

My "eureka" moment came when I compared the two irradiated regions of the cartilage under an optical microscope. The excimer laser-irradiated incision was extremely clean, with no visible evidence of burning, charring, or other collateral damage. In contrast, the green-irradiated region was black, looking like a piece of burnt toast.

A high-resolution electron micrograph of the sample gave us a real appreciation of the cleanliness of the three-dimensional groove that had been produced by the uv excimer laser, in contrast to the irregular, charred region produced by the green Nd-YAG laser. Then, with some trepidation, we shone the laser beam on our skin (my left pinkie finger).To our delight, it did not hurt.

We believed we had discovered a new form of laser surgery, in which living laser-etched tissue would heal without scarring, due to the absence of trauma to the collateral tissue. We wrote up an invention disclosure, "Far Ultraviolet Surgical and Dental Procedures," which was eventually issued as a US patent, and which laid the foundation for today's laser refractive surgery procedures, LASIK and PRK. For our invention, we were inducted into the National Inventors Hall of Fame in 2002. Today, nearly 15 million people been treated with laser refractive surgery to correct myopia, astigmatism, and hyperopia.

Little did we know that we were following in Ben Franklin's footsteps in using a turkey as our first experimental sample.

James J. Wynne
Yorktown Heights, NY

Memo to APS: Practice What You Preach

I enjoyed Bill Hooker's Back Page Article "The Future of Science is Open (Access)" in February's issue of *APS News*. It's a shame that APS isn't part of that future: online access to the current APS News is restricted to APS members.

Geoffrey Crew
Cambridge, MA

Need Survey on Global Warming

Politicians and news reporters claim that scientists overwhelmingly "believe" man-made global warming is a fact and needs to be addressed using draconian measures. Who has done these surveys and where are the results? As an APS member and professor at a college, I've encountered numerous other scientists who are skeptical about man-made global warming. As a scientific society, I believe you have an important role to play in this issue. I suggest you initiate a web-based survey of APS members to determine whether in fact these news reports are correct.

The survey might include a question such as:

Choose the statement with which you agree:

(1) Warming of the Earth is occuring and is primarily caused by man-made sources. Drastic measures need to be initiated to

NEED SURVEY continued on page 5

Letters continued

The Answer, My Friend, is Blowin' in the Wind

Two statements regarding renewable energy contained in the Back Page interview with Steve Chu and Steve Koonin [*APS News*, December 2006] deserve correction. Renewable energy (wind and solar) are dismissed for reasons that do not stand up under principles that should be well understood by your members. The statements are that "[Sequestration and nuclear] are the only technologies we know that we can scale now to the magnitudes needed," and "…because it is a transient source, without efficient and cost effective energy storage, the base line will be nuclear power and coal in the near-term future."

Wind power can in fact be ramped up quickly and on a large scale today, without waiting for future technological breakthroughs. Denmark currently gets 20% of its electricity from wind without "storage" or "back-up" capacity. In the U.S., a country with a vast wind resource, wind power is growing fast, and was the second-largest source of new power generation in the country in 2005 and 2006. Barriers to wind power's growth on a large scale are regulatory, not technical, and a task force including the U.S. Department of Energy, National Renewable Energy Laboratory, American Wind Energy Association and utilities, foundations and other groups, is evaluating the goal of 20% of U.S. electricity from wind.

One of the keys to successful large-scale integration of wind are large regional electric power markets where variability of both load and generation are smoothed out and where system operators can more reliably balance electricity demand and supply. Another key is diversity in the mix of fuels used for electricity generation. Flexible generators such as natural gas-fired units and hydropower are generally much more economical than storage devices for system balancing. Third, construction of new transmission lines will be needed under any type of electricity growth scenario. A key to large-scale development of wind in the US is transmission investment to tap the vast resources of the US heartland–an investment that is quite affordable compared to that of carbon sequestration on a large scale or new networks of Liquified Natural Gas (LNG) terminals and pipelines. In fact, the authors described sequestration in their reply to the previous question as "not yet demonstrated" and of "unknown cost."

The annual rate of growth of wind generation over the past 10 years has been 28%. Globally, there is now over 70,000 MW of wind generation in operation. There have been 10,000 MW of wind capacity installed in the US to date, and not a single megawatt of backup capacity or storage for the wind generation has been required by the power system operators. This growth in wind is supported by a young, dynamic workforce, and major manufacturing companies (GE, Siemens, Mitsubishi, Caterpillar), major financial institutions (Goldman Sachs, Morgan Stanley, Berkshire Hathaway), as well as energy companies FPL, Iberdola, EDF, Shell and even Steve Koonin's BP.

With this demonstrated ability to scale wind generation, we can look to actual experience as well as numerous peer-reviewed studies of large-scale use of wind for answers to the authors' concern. (See for example GE Power Systems Energy Consulting for New York State, 2005, EnerNex for Minnesota 2006.) Chu suggests that wind and other renewables require storage because they are "transient." This misunderstanding stems from a narrow definition of the energy supply. An energy technology does not have to be "baseline" (baseload) in order to make a large contribution to electricity supply. An example is natural gas, which now accounts for close to 19% of U.S. electricity supply, about the same share as nuclear. Natural gas is mostly valued because of its flexibility in responding to peaking demand.

Wind and other technologies can make a large energy contribution to the nation's supply even while their contribution to baseload may be modest. In wind's case, its value is in the large amounts of energy it can deliver, and in the fact that it is clean (zero-emissions, light footprint), cost-effective (cost of electricity produced does not vary over time since there is no use of fuel), energy-efficient (wind has one of the highest energy payback ratios of any energy technology), and that it strengthens energy security (wind is domestic and inexhaustible). Moreover, wind observed and captured at a single location is variable, but within patterns that can be anticipated on a seasonal and even daily basis and are modeled with increasing accuracy. What's more, the circulation of air around the earth is constant, driven by the constant energy of the sun. To make practical use of this simple phenomenon requires some scale, which the wind industry is capable of delivering, despite the authors' comment to the contrary.

Wind generation is added to power grids which can span portions of continents. Energy production is more concentrated than energy consumption, and transmission is key to keeping the supply and demand of electricity in balance at all times. Chu is correct in advocating greater attention to new, high voltage transmission. The point he misses is that the distribution of wind generation across a wide region allows a much greater reliance on wind, because the variation in wind production at any one location is offset by the production at other locations. Just as the wind is necessarily always blowing somewhere, windfarms spread across the Eastern or Western Interconnection of North America can, and already do, provide large amounts of clean, economical energy and even a measurable amount of reliability, what Chu called "baseline."

Mike Jacobs
Concord, Massachusetts

Ed. Note: The author is Deputy Policy Director, American Wind Energy Association

Getting High on Physics

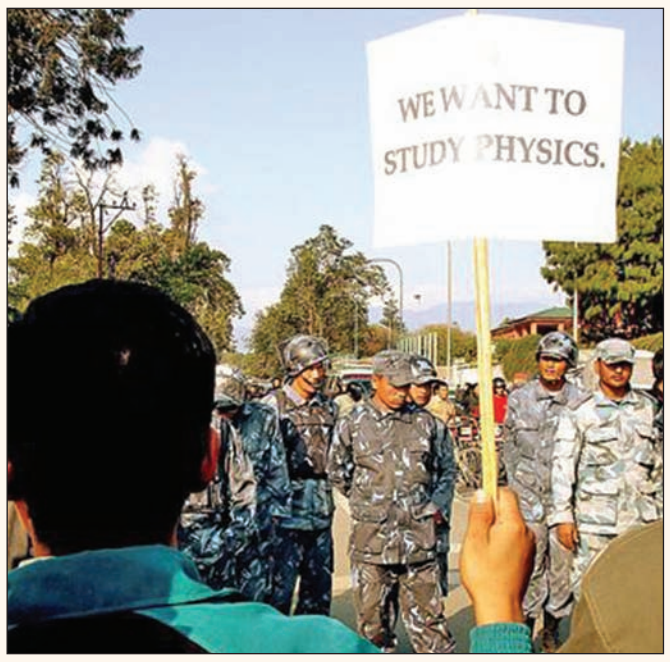


Photo: Nepalnews.com, 2006 © Mercantile Communications Pvt. Ltd.

You're probably thinking this picture must be faked, because who in the world would carry a protest sign saying "We Want to Study Physics?" Students in the mountain kingdom of Nepal, that's who. Last December, a group of students demonstrated in front of Nepal's Ministry of Education and Sport, demanding greater access to physics classes, which apparently is severely limited. *APS News* has not been able to find out whether the protest resulted in satisfaction of the students' demands. For those who doubt the authenticity of this picture, a video version is available at http://www.nepalnews.com/nepalnewsvideo/dec_12_06_student_strike_physics.wmv .

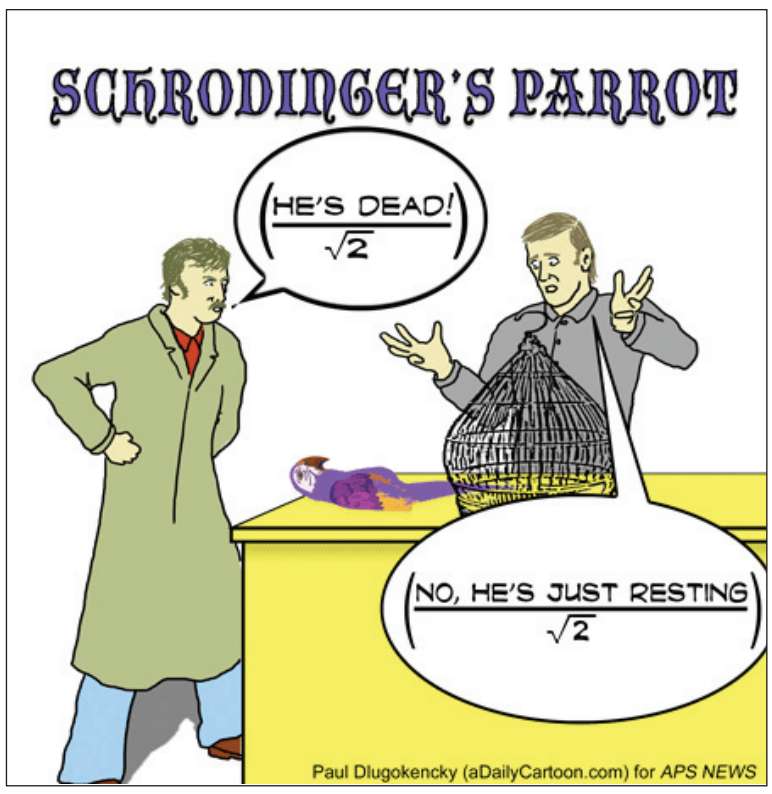
NEED SURVEY cont. from page 4

reduce global warming.

(2) Warming of the Earth is occuring but is probably due to cyclical temperature changes which have occured over millennia. Man is probably a minor effect on atmospheric climate, and major measures are not needed in an attempt to minimize global climate change.

This would be a good way to determine your members' opinions and contribute to the global climate change discussion.

Mark Campbell
Annapolis, MD



Cartoon by Paul Dlugokencky, concept by Zachary H. Levine

INSIDE THE BELTWAY:
WASHINGTON ANALYSIS AND OPINION

Bipartisanship? Fuggedaboutit!

By Michael S. Lubell, APS Director of Public Affairs

A few months ago, several Beltway advocates met in Intel's Washington offices for an off-the-record discussion with a senior White House official. We were out to gather some intel on the President's FY 2008 budget request, which was still several weeks away. The Administration, our source assured us, was going to follow through on the next installment of the American Competitiveness Initiative (ACI), which promises to double the aggregate budgets of the DOE Office of Science, the NIST laboratories and the National Science Foundation over ten years.

That was comforting news, but our anxiety and depression about the FY 2007 budget badly needed a dose of Prozac. First, before the November election, the Republican controlled Senate had held all spending bills hostage, other than Defense and Homeland Security. Then, after the election, a group of 60 House Republican budget hawks blocked all further action. And finally, David Obey (D-WI) and Robert C. Byrd (D-WV), the new chairmen of the House and Senate Appropriations Committees, out of frustration with the impossible task of crafting spending bills for all of the federal government in a matter of a few weeks after the 110th Congress convened, pledged that they would put all departments and agencies on a year-long Continuing Resolution (CR).

"If Obey and Byrd followed through," I told the White House official, "all the wind would be taken out of science's sail, generally, and the ACI, specifically." With Democrats and Republicans both having endorsed an agenda for discovery and innovation, I suggested that the White House might want to issue a statement of "bipartisan" criticism of the budget process to date.

"No chance of that. It's up to the Democrats to fix the problem," he said. "They won the election. It's their predicament."

That was the first evidence I had –although it came as no surprise –that bipartisanship was going to remain little more than rhetoric. As the newly elected members of the 110th Congress filed in to take their oaths of office, more evidence rolled in. First a little background.

Several years ago the Union of Concerned Scientists (UCS) issued a report slamming the Bush Administration for scientific malfeasance. The essence of the charge was that the White House cherry picked scientific facts to suit its political agenda, imposed partisan and ideological litmus tests for appointees to federal advisory committees and generally relegated science policy to the Potomac River swamps.

The UCS report was just a trifle hyperbolic and tinged with partisanship. With Republicans firmly in control of both houses of Congress, it was guaranteed to land with a dull thud on Capitol Hill, which it did.

BELTWAY continued on page 7

zero gravity

The Lighter Side of Science

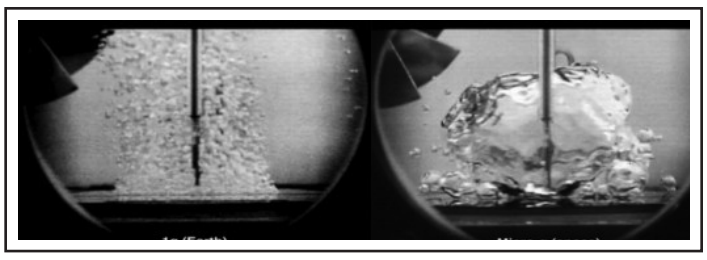
Water in Zero Gravity

By Sabine Hossenfelder

In my apartment the heating is in the ceiling. This is not a joke. I've wondered where the guy grew up who had this ingenious idea. Had he never heard that hot air rises? But NASA has provided me with a hint regarding this question.

This morning, I was staring at the tea water, waiting for it to boil. Did it ever occur to you that the rising heated water is necessary to get the temperature homogeneously distributed? But what if the hotter water with smaller density does not rise because there's no gravity? Well, it stays where it is.

Here's how boiling looks in zero gravity: The heated water stays close to the heater. Regions further away from the heater stay cooler, so the actual heated part boils earlier. Once it begins to boil, the vapor bubbles don't rise, but join each other due to surface tension. Eventually, one large bubble forms that clings to the heater. Cool, eh? I mean, hot. It looks like this.



Boiling in space–small bubbles merge into one large bubble.

Boiling on Earth

Photos by NASA/Glenn Research Center

(NASA has the full video available at http://science.nasa.gov/headlines/images/boiling/bubble0g.mpg. You can also watch a water balloon burst in outer space here: http://www.space-video.info/misc/ balloon.html.)

Now I'm convinced the guy who constructed my heating came somewhere from outer space. That's just how things are up there, why bother. All I have to do is sleep on the ceiling.

Sabine Hossenfelder is a theoretical physicist at the Perimeter Institute. She writes the Backreaction blog (http://backreaction.blogspot.com) with her husband, Stefen Scherer. A full article on boiling water in zero gravity can be found at http://science.nasa.gov/headlines/y2001/ast07sep_2.htm.

SCHOOL BOARDS continued from page 1

• Have you ever attended a meeting of your local or state school board, or worked with your school board?

• Have you ever served on a school board or run for election to a school board?

• Given the need for better K-12 science education, would you consider running for school board if you could count on some organizational help?

In addition, room was provided for an optional comment.

The survey was sent to 1500 APS members, of whom 380 had responded by press time. About 26% of respondents said they have attended a school board meeting or worked with a member of their school board, and 12 respondents (3.2%) have actually run for and/or served on their school board. The poll also indicated that 94 more would consider running if they could count on some organizational support. Some survey respondents commented that they wanted to improve education but did not have time to run for or serve on a school board. Others said they were not interested in doing so because they do not have school age children, and several wrote that they thought serving on a school board was unnecessary because their local schools are already good. A few said they were involved in education in their communities in other ways.

In some cases, scientist input is needed on school boards to counter threats to science teaching, such as efforts to insert intelligent design into the science curriculum. "We need people involved in the education process to stand up and say this is not a scientific theory," said Brown. But the need for scientist involvement goes beyond intelligent design, said Brown. "It's much larger than a specific issue."

One physicist who successfully ran for school board is Marshall Berman, who served on the State Board of Education in New Mexico. He decided to run for election after the State Board of Education, influenced by a creationist board member, removed all references to evolution from the state science standards in 1996. Berman formed an organization of scientists and other interested citizens in New Mexico called the Coalition for Excellence in Science and Math Education (www.cesame-nm.org), dedicated to improving science education. After he and the organization tried lobbying and letter-writing with no success, Berman decided to run for election to the State Board of Education. Though he had no prior experience in politics, he and a group of volunteers learned about the political process, and he was able to win election, defeating a 20-year incumbent. He took office in 1999.

Eventually the other members of the board began to trust him on scientific issues, and they adopted a set of high-quality science standards that included the teaching of evolution.

Berman achieved that, he said, by becoming an insider. "You have to build trust, in any kind of organization. It doesn't matter what your credentials are," said Berman. He believes he could not have accomplished what he did without actually serving on the State Board of Education.

Berman said he would absolutely encourage other scientists to serve on school boards. He did so while employed full time at Sandia National Laboratories. Serving on the state school board did take a significant amount of time, he said, and he did deal with many issues other than science curriculum. He says it's important for those who want to run for office to be familiar with all the issues that are important to the community, and not to try to run a single-issue campaign on science education.

Most school boards don't have to deal with intelligent design or other serious threats to science education, but scientists can still be useful, say some physicists who have served on their local school boards.

Bob Welsh, a physicist at the College of William and Mary, served on a school board in Williamsburg, Virginia, from 1995-1998. Williamsburg is a college town with an educated population that is supportive of science and education, and the public schools there are good, said Welsh. During his term, the school board did not have to deal with intelligent design or any other issue related to science education, but he thinks that it would have been useful to have a scientific perspective on the school board if such an issue had come up. He suggested that in rural areas scientists could be even more valuable on school boards. "A scientist in a small town might find serving on a school board to be far more significant," he said.

Scientists can also help school districts by volunteering to review textbooks, suggests Welsh. He volunteered to do so before he served on the school board, and he believes his scientific expertise was valuable and appreciated. Overall, Welsh said he found serving on the school board worthwhile, though it turned out to be a bigger time commitment than he had expected.

Another physicist who has served on a school board is Philip W. "Bo" Hammer, vice president of the Franklin Center of the Franklin Institute in Philadelphia. He is now in his second term on the school board in Haddon Heights, NJ, a small school district in a suburb of Philadelphia, with roughly 1380 students in the district. Hammer is currently the board vice president, and serves on the curriculum committee.

Hammer decided to run for school board because he has a son in the school system and he wanted to be involved in ensuring a good education for students in the district. He said the schools in Haddon Heights, and the science teachers there, are very good. He believes it's important to have a scientist on the school board to keep an eye on how science is taught, and being on the board puts him in a good position to deal with any problems that might come up, said Hammer. Advising the school board in a public forum can have an impact, but since a lot of the board's work is done in committees, actually serving on the board gives an individual much more influence, Hammer said.

Hammer had no difficulty running for and being elected to the school board–in fact, he ran unopposed both times. Serving on the board required attending the monthly meetings as well as some committee meetings, a time commitment he did not find too burdensome.

Hammer said he would encourage others scientists to get involved with their local school boards. "I think there's a lot of hesitation among scientist to get involved in the political process, but in actuality it's a very rewarding experience. I think of all the elected offices, being on a school board is one where an individual can make a lot of difference."

New Report Reviews Primary Economic Driving Factors in US

The Council on Competitiveness has released a report, *Competitiveness Index: Where America Stands*, reviewing the primary factors driving America's economic success during the last two decades, and and looking ahead to the nation's competitiveness prospects in the next twenty years. "The context for US competitiveness has changed dramatically over the past two decades," the report states, providing both opportunities and risk for the US in the future.

The Council, now twenty years old, focuses its attention on technological innovation, workforce development, and the comparison of the US economy to that of other nations. Members include corporate chief executives, university presidents, and labor leaders. The Council is affiliated with nonprofit research organizations, professional societies and trade associations.

A significant portion of the 108-page report is devoted to a series of one-page exhibits that highlight US dominance in many drivers of the American economy, but which also identify areas of concern. Of particular note is a section entitled "Foundations of U.S. Competitiveness and Sources of Future Prosperity." Among the notable findings were the following:

• The US leads in the 2002-2003 shares of global output in domestic R&D investment, new US patents, scientific publications, scientific researchers, bachelor's degrees in sciences and engineering, and new doctorates in science and engineering. But each of these shares has declined, in some cases quite dramatically, when compared to the mid-1980 figures.

• Total US industrial and government R&D spending of $286.4 billion was the highest of all nations. But other nations had a higher percentage growth rate in their R&D investment. China increased its R&D investment at an annualized rate of 19.3% in the last decade.

• US companies perform most overseas R&D in developed countries, but are increasingly turning to emerging economies. Brazil, China, Hong Kong, India, Korea, Malaysia and Singapore account for a combined share of 9.7 percent of all foreign R&D spending by US foreign affiliates in 2003.

• Sixteen of the world's top 25 most innovative companies are American companies. Seventeen of the top 20 universities ranked by research performance are US institutions.

• While the US now leads the world in PhD production with 1.3 million researchers, the European Union could produce twice as many science and engineering doctorates as the US by 2010. Also, China could also produce more doctorates than the United States by 2010.

• "Fewer engineers from emerging market countries are ready to work because of language, mobility, educational quality, and cultural issues.

• Corporate R&D investment in basic research declined or remained constant as a percentage of GDP, shifting to an emphasis on new product development.

• Nearly all the recent increases in the federal budget are in the life sciences. The compound annual growth rate for life sciences is 5.9% in the period 1986 to 2005, while that of the physical sciences is 0.6%.

• Foreign students account for most of the growth in Ph.D.s in science and engineering.

• The US invests significantly more in education, yet test scores are low compared to other nations.

• Intellectual Property–arguably the foundation of all innovation–is at risk in the US. American businesses lose billions of dollars annually due to intellectual property violations.

A full copy of the report can be found at the Council on Competitiveness website at: http://www.compete.org/

Courtesy of FYI, the American Institute of Physics Bulletin of Science Policy News (http://aip.org/fyi).

PRL Launches New Feature to Improve Accessibility

In January *Physical Review Letters* launched a new feature designed to enhance accessibility and encourage readers to look at papers outside their own specialty. Each week, the PRL editors are selecting several papers to designate as "Editors' Suggestions." These "Suggestions" are intended to be papers that are well-written and of interest to a wide range of physicists.

"The main goal is to enhance the unity of physics by getting people to read beyond their main areas of research," said Robert Garisto, a PRL editor and Chair of the committee selecting the Suggestions.

PRL has been growing for a long time, and because of the large number of papers published and the increasing specialization of those papers, it has become harder and harder for people to venture beyond their own fields. The journal editors have been considering ways to make the journal more accessible, and they recently hit upon the idea of the Suggestions.

Editors' Suggestions are based on potential interest in the results presented and on the success of the paper in communicating its message, especially to readers from other fields. They are not intended to be taken as the most important papers in a particular issue. "Many papers that are equally or more important are not designated as Suggestions," said Garisto.

Arriving at the Suggestions each week is a two step process. Each PRL editor can nominate potential Suggestions, taking into account the paper itself and referees' comments. Then a group of PRL editors from different areas of physics looks at all the nominations and decides which papers to designate as Editor's Suggestions for the week. Roughly five Letters per week are selected. These papers are marked with a version of a printer's mark that appeared on the covers of all sections of the *Physical Review* until about a decade ago.

PRL Editors' Suggestions was launched in the first week January. Several weeks after its launch, Garisto said the program seemed to be working well. "The preliminary data seem to indicate that suggestions are downloaded several times more than the average," he said. So far, the editors have received "some positive feedback and no really negative feedback" about the Suggestions, he added.

In addition to encouraging people to read outside their field, the editors also hope that the Suggestions will encourage people to write better papers, said Garisto.

The journal *Physical Review Letters* started in 1958 as an experiment by *Physical Review* Editor Sam Goudsmit. It took the short articles that would have been published as "letters to the editor" in *Physical Review*, and collected them in a separate journal. The goal of the new journal was to cover all areas of research and make important results available quickly.

Over time, the journal grew substantially, and the number of subfields represented increased. This led to a shift in acceptance criteria from "general interest" to "broad interest." Today papers published in PRL are still expected to be important in their own and related subfields, but they have become more specialized and less accessible to readers outside the subfield.

The editors hope the Suggestions will make a small step towards restoring the ability of PRL to give readers a broad view of current research. The announcement of this new feature can be found at http://prl.aps.org.

Now Appearing in RMP: Recently Posted Reviews and Colloquia

You will find the following in the online edition of *Reviews of Modern Physics* at http://rmp.aps.org

Critical phenomena in microgravity: Past, present, and future
M. Barmatz, I. Hahn, J. A. Lipa, and R. V. Duncan

Microgravity experiments aim to precisely determine the detailed behavior of fluids near second order phase transitions where the asymptotic region is sensitive to the effect of gravity. This review provides a summary of space experiments that have been conducted to date, ground preparations for future measurements, and the theoretical context for their interpretation.

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To be fair, Congress did not single out science in its callous disregard of its Constitutional oversight responsibilities. Foreign affairs, defense policy, intelligence, environmental regulation, Katrina and homeland security all fell victim to a withering of congressional will in the face of expanding executive privilege and public fear of radical Islamic terrorism.

The landscape changed dramatically last November when Democrats regained control of both houses. Since then they predictably have been flexing their investigative muscles. That has come as no surprise to the White House, which, apart from a political blind spot on Iraq, has proved itself extraordinarily adept at reading the Potomac currents.

The last ballots were barely counted when President Bush invited the new leaders of Congress to the White House and publicly pledged that he wanted to work with them to tackle the weighty issues facing the nation. House Speaker Nancy Pelosi (D-CA) and Senate Majority Leader Harry Reid (D-NV) may have harbored a few skeptical thoughts, but they kept them to themselves and proclaimed their support for bipartisanship.

For science, the hugs and kisses didn't last long. The House Science and Technology Committee, under the chairmanship of Bart Gordon, a moderate Democrat from Tennessee, signaled that it took seriously the UCS allegations of the Bush Administration's misuse of science when it formed a new Oversight Subcommittee under the leadership of Brad Miller (D-NC).

At the other end of Pennsylvania Avenue, love fell victim to politics, as well. Intense lobbying by science advocates and key science partisans in both the House and Senate in January and February had successfully pushed DOE, NIST and NSF up on the priority list, enabling them, along with vets and highways, to qualify for special treatment in the CR. As a result, they received much of the money contained in the FY 07 presidential request for ACI–an extraordinarily heavy lift, given Obey and Byrd's opening gambit. But in its FY 08 budget briefing, the White House lambasted the Democrats for short changing science in the FY 07 CR. No mention of the failings of the 109th Congress, which the Republicans controlled.

Bart Gordon quickly fired back with his assessment of the President proposed FY 08 budget. The headline of his February 5 press release screamed, "Gordon on President's FY 08 Budget: Lacks Priorities, Consistency to Ensure U.S. Competitiveness." Oh, incidentally, the White House and Congress didn't send each other Valentine's Day chocolates either.

Photo by Ken Cole

In January, volunteers gathered at APS headquarters to sort the almost 1000 abstracts submitted to the April Meeting, which will take place in Jacksonville, April 14-17. Nick Hadley of the University of Maryland decided that he needed some extra room to spread things around, so he ended up on the floor. By the end of the day, however, all the abstracts had been sorted, and not long thereafter the meeting program was posted on the web at http://www.aps.org/meetings/april/index.cfm .

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ing on in the publication business. I've been teaching at Stony Brook for 36 years, and I'm ready to try something new," he says. He began attending meetings and visiting with staff last fall and then worked full time with outgoing EIC Blume for several weeks before officially taking over the position.

Overall, Sprouse believes the APS journals are in good shape right now. "I think they are really the top physics journals in the world. They're generally very healthy right now, and we have to protect that," he says.

Nonetheless, there are major challenges facing the journals, says Sprouse. The primary one is dealing with more open access to the journal content. "The APS has been a leader in the move to electronic access and now all of the journals back to 1893 are available electronically. In addition, the APS copyright agreement is exemplary in that authors can post the published version of their article on their own web site." However, many proponents of open access insist that all of the journal content should be freely available to anyone who wants to read it without paying for a subscription. This presents a problem of how to fund the important peer review process and cover the other costs of making a journal available.

"We have a start on open access with the 'Free to Read' initiative," Sprouse notes. "Free to Read," which has been available since September, allows anyone to pay a fee to designate any APS journal article "Free to Read." Those articles are then freely available online, without a subscription. So far, nearly 100 articles have been designated "Free to Read," says Sprouse. "It's there for anyone who wants to use it." APS also has two online journals that are entirely open access: *Physical Review Special Topics–Accelerators and Beams,* and *Physical Review Special Topics–Physics Education Research*.

Another challenge Sprouse will have to deal with is the growing number of submissions and ever-increasing size of the journals. "People want to submit papers to us, and that's great," says Sprouse, "But it will require more editors and more staff to maintain the journals."

Sprouse says plans are underway for a number of enhancements to the journals, some of which have already begun. "Another experiment that has recently been started is the Editors' Suggestions in PRL.

Editors are picking papers of more general interest, and highlighting those that we think are especially helpful and encouraging for readers venturing outside of their main areas of study. This seems to be going well," he says.

"We also have a project called the journal innovations initiative. We're looking at different ways to enhance the web version of the journal," says Sprouse. The potential improvements include an advanced search function and various ways to present information about which articles are being downloaded heavily and which papers are referring to which other papers. "We've also had some discussions about enhancements to content, such as podcasts," says Sprouse.

Sprouse also believes APS should do more to recognize referees, whose work is essential to the success of the journals. "The APS recognizes outstanding contributions to physics by elevating a percentage of its members to fellowship. I think there's an analogous contribution made by referees. I'd like to initiate a way that we could recognize referees. They are crucial to the journals," he says. The details of any such recognition program would still have to be worked out, says Sprouse.

The Back Page

The Embargo Should Go

By Vincent Kiernan

When they're not praising the embargo system–under which science journals provide journalists with advance copies of newsworthy articles, but set strict timelines on when that information can be shared–science and medical journalists often bitterly complain that they are its prisoners. For example, Natalie Angier of *The New York Times* claims that the embargo system gives journal editors "a stranglehold on journalistic initiative."

Embargoes do exert great influence over what gets covered and how, but the embargo system is hardly a tyranny of journals over journalists. Journalists are enthusiastic participants in the embargo system and act to keep it functioning. In short, if journalists are in a stranglehold, it is a self-inflicted stranglehold–and one that does not serve the public interest. It need not be this way. "Any decent journalist knows what's in *Nature* next week," says David Whitehouse, science editor for the BBC's Web site.

From the beginnings of modern science and medical reporting in the 1930s and 1940s, journalists were eager to prove their bona fides to scientists and medical researchers so that those researchers would cooperate with the journalists. Journalists emphasized that they sought to be accurate (as the researchers defined accuracy), and asked the researchers to provide advance copies of their papers to facilitate these efforts. Eventually researchers and officials saw the advantages of controlling the flow of news about science and medicine; together, journalists and the research establishment forged the social construction that is now known as the embargo system.

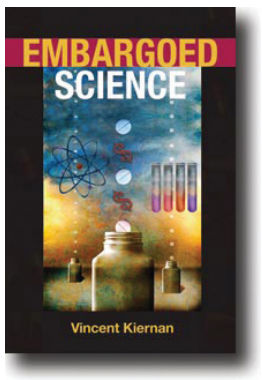
Undoubtedly, the scientific establishment benefits handsomely from the unending torrent of news coverage about research being published in scientific and medical journals. The pattern of news coverage signals to readers and viewers–not to mention lawmakers, business leaders, and others–that science and medicine are important. Whether the research being reported is "good news" (for example, drug X is an effective treatment for disease Y) or "bad news" (Z causes cancer), the scientific and medical establishments are always cast in a positive light, as the font of the new finding.

But media coverage of research journals often amounts to little more than highbrow infotainment: What's the latest theory about the extinction of the dinosaurs? What's the newest thing found to cause cancer? Look at the cool photographs from the Hubble Space Telescope! These are the types of subjects that dominate embargo-controlled news reporting about science and medicine.

Journalists and their media organizations also benefit from the embargo. The embargo supplies news on a dependable schedule keyed to the production constraints of news organizations: if it's Thursday, it's time for a newspaper article about some paper published in *The New England Journal of Medicine.* The news peg provided by the embargo ("In a paper published today in *Science*...") also makes it easier for journalists to convince their editors to run certain research stories. The embargo system capitalizes on the fact that journalists and their editors rely heavily on timeliness as a criterion in defining what is news and what is not.

This is a long-standing problem. "To write a story saying that 'X' was discovered today is a fiction," Howard Simons, then a science writer for *The Washington Post*, said almost 40 years ago. "The today lead is something most of us do because we are still trapped in traditional ideas of newspapering. At a scientific meeting there may be hundreds of papers delivered, all of them important. There is no reason why we shouldn't pick up one of those papers three weeks later and do a story about it. But the traditional light bulb flashes on in our minds and says it's old if it's not hung up like a coat on a news peg." The embargo perpetuates the problem by giving journalists and their media organizations an unending stream of such pegs, so many that a lazy journalist could write only about journal articles if he or she chose.

The embargo works against the public interest in many ways. One is in how the embargo steers journalists away from covering science and medicine as institutions with messy problems, such as fraud, mistreatment of human subjects, failed research, and misplaced priorities. Journalists who are chasing after the latest embargoed journal article do not have time to investigate the workings of science and medicine in this way. "To survive, reporters become dependent on the daily cascade of embargoed research papers, e-mailed press releases, university tip sheets, and conference



abstracts," says Robert Lee Hotz, a science reporter at the *Los Angeles Times*.

"The goal of all of us ought to be to try to get around embargoes and packaged science journalism by finding new ways to get our collective noses under the tent," according to Cristine Russell, former science and medical reporter for *The Washington Star* and *The Washington Post*. "I think that we should not have such herd journalism. People should get out and cover science."

The embargo system also creates a torrent of news that draws excessive public attention to most research. Put simply, journalists should ignore most of the journal articles that they now cover so energetically. Most journal articles are but single dots in the pointillist enterprise that is the scientific method–but the breathless coverage catalyzed by the embargo system often gives the impression that each week's paper is a major breakthrough. Journalists pay much less attention to later studies that play down the findings.

The trump card for embargo supporters is accuracy: News about science and medicine is so difficult to research and write, goes this argument, that journalists need time to do the job correctly–or the public could be harmed by inaccurate reporting. Susan Turner-Lowe, former director of public affairs at the National Academy of Sciences, describes it this way: "Journalists have traded accuracy for scoops." Being critical of embargoes therefore is tantamount to supporting erroneous reporting.

But the fact is that many other journalists work effectively without embargoes. Consider the complexity and implications of other stories covered by journalists who do not specialize in science and medicine: the latest Supreme Court decision, a tax bill passed by Congress, a massive airplane accident, and others. Each of these stories rivals many science and medical stories in technical complexity, the difficulty that journalists may have in reaching expert sources for comment, and the impact on readers or listeners if inaccurate information is reported. Yet reporters uncomplainingly cover these and a myriad of other stories without the helping hand of an embargo.

Even *Nature's* Peter Wrobel concedes that the embargo is not essential for good coverage of science and medicine. "It doesn't require five or six days, or even three, to write most stories," he says. Alexandra Witze, a former science reporter for *The Dallas Morning News* and *Nature's* chief US correspondent, says that the accuracy rationale for journal embargoes is "insulting" to science journalists. "It assumes that we are incapable of doing our job, as journalists in any other field are."

However, the majority of science and medical journalists tend to agree with journal publishers that embargoed advance access to scholarly journals promotes accurate, orderly journalism about science and medicine. This is not necessarily the case. Journalists who operate by a learned set of professional norms and practices are likely to make the same mistakes in a story whether they have a day or a week to prepare it. Moreover, an individual reporter may not use all the additional time that the embargo provides. With an embargo of several days, the reporter may work on the embargoed story in bits and pieces, fitting that story around other stories that the reporter is covering.

Journalists do have an ethical obligation to society to be accurate, but accuracy is more than the technical accuracy of figures and scientific terms. Taken as a whole, science reporting should provide an accurate picture of scientific and medical research, particularly in areas of personal importance to members of the public, such as health issues. The embargo arrangement encourages pack reporting of research from a few selected journals regardless of whether the research is truly important or definitive.

In the short run, the Internet has probably bolstered the embargo system, particularly because the World Wide Web and electronic mail have provided new tools for distributing embargoed articles to journalists. EurekAlert! in particular has been a resounding success story for embargo proponents, so much so that it has spawned imitators such as *Nature's* press Web site and AlphaGalileo.

But in the long run, online communications will probably undermine embargoes on news about science and medicine. One reason is the ease with which the Internet can connect journal publishers with a worldwide cadre of journalists. More and more science and medical journalists, around the globe, are participating in embargoes sponsored by journals in the United States and Britain. Many of these journalists may not be as heavily invested in the embargo system and therefore are more likely to jump the gun when an important paper comes along.

The Internet will also weaken the embargo because it is transforming the process of scientific communication itself. Most traditional journals now offer online access to their articles, with the articles often posted long before the printed journal arrives in a scholar's mailbox. Some journals have gone a step further, by publishing some or all of their articles online before they are published in print. *Science* and *Nature* have begun to post selected journal articles online, after they have completed peer review and editing but before they appear in print.

Scientists are also using the Web to archive and distribute preprints of their papers. With the advent of the Web, scholarly societies and even individual scholars have created databases on which authors can deposit electronic copies of their papers. Few journalists use the Web sites to plumb for news.

One who does is Tom Siegfried, former science editor of *The Dallas Morning News*. "There's plenty of stuff to report out there before they appear in journals," he says. Every night, he says, he checks physics preprint servers, because the latest research is usually reported there first. "In physics nowadays the journals have become increasingly irrelevant," he contends, with their role largely limited to serving as the archival copies of important papers and for proving records for tenure.

The embargo system should be replaced with full and open disclosure of research results as soon as they are ready for public consumption, which generally would mean as soon as peer review is complete. Once a scholarly paper has been accepted by a journal, scientists and their institutions should be free to tell the world about it, and journalists should be free to report on it if they deem it newsworthy. The journal in question could make the accepted paper available to its subscribers online, so that the subscribers could consult the full text of the paper for themselves. Journalists would be freed of the perceived tyranny of the embargo, and they would have new-found time to visit scientists in laboratories and troll for investigative stories rather than leafing through press releases and password-protected Web sites in search of what the competition is probably going to report.

This is emphatically not to suggest that science and medical journalists should break embargoes. To the contrary, journalists have both an ethical and a legal duty to abide by agreements with their sources, including embargo agreements. But journalists are not ethically required to continue to agree to embargoes.

It is time for science and medical journalists to break out of their dependence on journals as a source of science news, and it is time for scholarly societies to stop trying to shape the flow of news in a way that suits their own political ends. The embargo should go.

Vincent Kiernan is an instructor of journalism at Clarion University of Pennsylvania. This essay is adapted from his book, Embargoed Science*, Copyright 2006 by Vincent Kiernan. Used by permission of the author and the University of Illinois Press (see http://www.press.uillinois.edu/.)*

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