APS NEWS

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

June 2010
Volume 19, No. 6
www.aps.org/publications/apsnews

Scientific Fraud
See Page 8

Presidential Transition

Photo by Bob Kelly

You might think that Cherry Murray (right), President of APS in 2009, was passing the gavel to current President Curtis Callan. That would be wrong. The gavel is actually passing the other way, as Callan takes the opportunity, during a break in a recent Board meeting at APS headquarters, to present Murray with a ceremonial gavel, inscribed with her name, commemorating the five Executive Board and two Council meetings that she chaired during her year as President.

Teacher Education Program Adds Five New Sites

By Gabriel Popkin

The APS-led Physics Teacher Education Coalition (PhysTEC) recently announced it would fund five additional universities to develop their physics teacher education programs into national models. The new awardees are California State University, Long Beach; Chicago State University; Middle Tennessee State University; Towson University; and the University of California, Davis.

The winning institutions were selected during a two-stage review process that began with a pool of 52 applicants, which were evaluated based on their capacity for large increases in the number of physics teachers graduating from their programs, as well as strong departmental and institutional support for teacher preparation efforts. The review panel included representatives of APS and the American Association of Physics Teachers (AAPT), which jointly manage the project, as well as external reviewers.

Funding for the awardees will begin this Fall and will last for three years. The new sites will join the thirteen institutions that have already received money from the project since it began in 2001. According to data collected by the project, many of these institutions have made significant gains in the number of high school physics teachers graduating from their programs. Several have been recognized as exemplary programs by the national Task Force on Teacher Education in Physics, which is in the process of completing its report on the state of physics teacher education in the US.

According to Theodore Hodapp, APS Director of Education and Diversity and PhysTEC project leader, PhysTEC sites have achieved success by increasing teacher recruiting efforts; hiring master teachers to work within physics departments; developing early teaching experiences; revamping content and pedagogy courses; and developing collaborative relationships between physics departments, education schools, and local school districts. Hodapp says, "Through its work with the funded sites, the project has identified a number of key components that we feel drive success in teacher preparation, and we expect our new sites to adopt these pieces as they move forward. We were impressed that so many applicants were clearly aware of these best practices."

The site selection committee

PHYSTEC continued on page 8

It's a Bumpy Ride to Private Management for Los Alamos, Livermore

By Michael Lucibella and Alaina G. Levine

When the management of the historic Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory (LLNL) was transferred from the University of California to two private companies, many officials hailed the move as the turning over of a new leaf for the labs. The goal of the transfer was to introduce private sector accountability into a management system seen by many in Congress and the Department of Energy as broken. However four years on, costs have swelled, red tape endures, and questions persist as to whether the transfer has benefited the labs in the long run.

"When I heard a company was going to run (LANL), I thought they would do it efficiently. I thought it would be good for us," said a long-time member of the technical staff of LANL. "But it used to be that science drove this place and everyone knew it…Now that's gone."

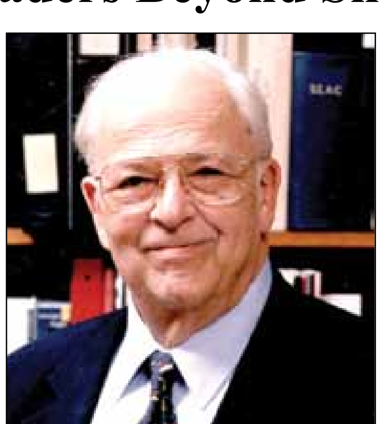
Interviews with current and former employees of both laboratories show shared concerns that since the facilities have become managed by a for-profit entity, science is no longer the top priority; rather, the emphasis is on generating profits through a climate of intense risk aversion. Many of those who still work with the lab have asked to remain anonymous because of concerns of repercussions from their employers.

One of the lab's former directors said that the system of governance at LANL in particular was broken in 1997 and since then has become more so. Siegfried S. Hecker served as the Director of LANL from 1986 to 1997 and is currently a research professor in the Department of Management Science and Engineering, and the co-director of the Center for International Security and Cooperation at Stanford University. He said the excessive security concerns, the creation of an extra level of bureaucracy, the National Nuclear

LOS ALAMOS continued on page 6

Richter Takes Readers Beyond Smoke and Mirrors

Burton Richter shared the Nobel Prize for physics in 1976 for his work on the discovery of the J/ψ meson in 1974. In 1984 he was named the director of the Stanford Linear Accelerator Center. During his time as director, he oversaw the completion of the Stanford Linear Collider and its challenging startup as it came online in the late eighties and early nineties. In 1994 he served as President of APS. Over the last decade and a half Richter has gotten deeply involved in issues of energy and the environment and has been able to devote more time to it since stepping down as head of SLAC in 1999. He recently completed Beyond Smoke and Mirrors; Climate Change and Energy in the 21st Century, *to give readers a concise overview of the facts, the policy issues, and the myths of this controversial topic, available now through Amazon.com, Barnes & Noble and Cambridge Press. He talked to* APS News *recently about the topics he raises. A more complete version of the interview is available at www.aps.org/publications/apsnews/index.*



What is your book about?

The book is an attempt to write for the general public on climate change, energy, what we know, what the uncertainties are, how to do something about it, what our options are both technically and in policy. The general public, the broad public, has a real problem in that they are sandwiched between two groups which I call the deniers and the exaggerators. The media loves conflict, so what the media always likes to do is to set up the extremes and let them battle it out because they think it gets more attention, which it certainly does, but it doesn't do a lot to clarify the issues, if I can put it that way. So

RICHTER continued on page 3

New Process Gives APS Members More Voice in Policy

By Michael Lucibella

The recently adopted addendum to the APS 2007 Climate Change Statement came about as the result of an effort by the Panel on Public Affairs to clarify the existing statement using input from the membership. The process to add to the statement was developed in conjunction with the Constitutional and Bylaws Committee to help serve as a template for the adoption of future policy statements.

The addendum was included in order to add greater detail, provide data, and clarify the language used in sections of the existing statement. The contents of the original statement were not changed, and the addendum can be found following the original statement in the "Policy and Advocacy" section of the APS website.

"The approach we took was to dissect the policy statement and say what is the policy statement, and what is the information that supports that statement," said John Browne, a member of the subcommittee. He

VOICE continued on page 5

President Obama Celebrates Laser's 50th

Editor's Note: *On May 12, President Obama issued a letter in which he joined the celebration of the 50th anniversary of the first working laser. In the print version of* APS News, *this space contained a facsimile of the letter, on White House stationery and with the President's signature attached. However, the terms of use of this letter prevent us from posting it on the web. Consequently, what follows is the text of the President's message, minus the stationery and his signature. A story about this letter appears on page 4.*

I am pleased to join all those celebrating the 50th anniversary of the development of the world's first working laser.

The story of the development of the laser is a quintessentially American one, of intensely creative theoretical work, followed by innovative engineering, and a spectacular diversity of applications that have brought economic benefits unimagined at the start of the process. Only 50 years ago, lasers were labeled "a solution in search of a problem," with no practical application envisioned outside of basic research. Today, lasers have revolutionized the way we live–from watching our favorite movies on DVD players to surfing the web to scanning barcodes at the grocery store.

I commend the many American scientists and engineers whose ingenuity and contributions to laser science and technology have helped make the laser one of the most important and versatile inventions of the 20th century. Such achievements inspire the next generation of students and tinkerers to pursue careers as scientists and engineers, and to keep the pipeline of American innovation flowing well into the future.

On behalf of our Nation, I celebrate with you this important technological milestone. I look forward with real excitement to further advances in this field and new applications as yet undreamed of today.

Members in the Media

"A stronger form of random-number generators are so-called device independent. It doesn't matter what's inside the box."

***Christopher Monroe**, University of Maryland,* National Public Radio, *April 14, 2010.*

"Humans have fought each other for millennia over tiny differences in race, religion or culture…Imagine how most people would react to beings that were *truly* alien?... My personal message to E. T. is to 'Keep well clear and defend yourself,' before stepping into the hornets' nest of our militaristic society."

***Paul Davies**, University of Cambridge, as quoted from his book* "*The Eerie Silence: Renewing Our Search for Alien Intelligence,*" The New York Times*, April 20, 2010.*

"A message from an extrasolar civilization could have an agenda behind it…This agenda might not necessarily be positive. Indeed, it might be malevolent."

***Richard Carrigan**, Fermilab, quoted from his paper "Starry Messages: Searching for Signatures of Interstellar Archaeology,"* Christian Science Monitor*, April 26, 2010.*

"It's highly unusual for an experiment to be redesigned this close to launch. I would question the wisdom of flying something redesigned so close to launch."

***Gregory Tarle**, University of Michigan, on the delay of the Alpha Magnetic Spectrometer, originally slated to be launched into space on board the shuttle Endeavour in late July,* New York Times*, April 23, 2010.*

"Makes me cringe…The terrible stereotyping of the nerd plus the dumb blond are steps backwards for science literacy."

***Bruce Margon**, University of California Santa Cruz, on the NBC show "The Big Bang Theory,"* The New York Times*, April 26, 2010.*

"Far from being a dumb blonde, Penny has demonstrated time and again that she possesses above average intelligence and practical knowledge that often far exceeds that of the guys."

***David Saltzberg**, University of California Los Angeles, on one of the characters in NBC's "The Big Bang Theory,"* The New York Times*,* *April 26, 2010.*

"This is brain-like computing."

***Ranjit Pati**, Michigan Technological University, describing a new, two-molecule thick organic computer that's based on an organic compound,* MSNBC.com, *April 28, 2010.*

"We can determine the distance from our telescope (in New Mexico) and the moon by measuring the time it takes for the laser light to make a round trip…The distance changes all of the time due to geometry, rotation and orbit. But by having multiple reflectors, we can establish the orientation (or tilt) of the moon,"

***Thomas Murphy**, University of California San Diego, on lunar laser ranging,* San Diego Union-Tribune*, May 1, 2010.*

"In the search for such a rare interaction, what counts is not how big your detector is but how good it is in sorting out the mess of interactions from all other sources,"

***Elena Aprile**, Columbia University, on the search for dark matter,* The New York Times*, May 4, 2010.*

"Particle accelerators have been in the zeitgeist for a couple of years now because of the Large Hadron Collider (LHC) in Switzerland… There are good things and bad things about the portrayals of particle accelerators in media."

***Todd Satogata**, Brookhaven National Labs, on Tony Stark's arc reactor in "Iron Man 2,"* FoxNews.com, *May 7, 2010.*

"It's likely that they're timing their attacks in such a way so as to avoid capture,"

***Suzanne Amador Kane**, Haverford College, on the periodic timing seen when swallows defend themselves against predators,* Minnesota Post*, May 10, 2010.*

"The sensitivity of the light source can tell us so much about the chemical composition of whatever we shine it on that we're really excited about the future of what we can do,"

***Uwe Bergmann**, SLAC, on using high energy X-rays to image a fossilized Archaeopteryx,* San Francisco Chronicle*, May 11, 2010.*

"Very high-energy gamma rays can penetrate several inches of steel."

***Steven Chu**, Department of Energy, on using gamma rays to image the damaged oil well in the Gulf of Mexico,* The Atlantic*, May 13, 2010.*

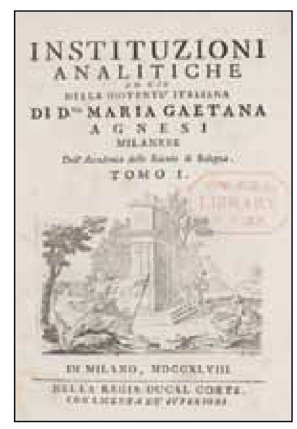
This Month in Physics History

Circa June 1748: Publication of *Analytical Institutions*

Renaissance Europe, for all its splendor, did not offer many scholarly opportunities for women, unless they chose to join nunneries. A notable exception was Italy, which espoused a more enlightened view that allowed a few women to flourish in the arts, medicine, literature, and mathematics. Among the most notable of the mathematically minded women of the era was Maria Gaetana Agnesi.

The eldest of 21 children–her father married three times–Agnesi was born in 1718. She was very much a child prodigy, known in her family as "the Walking Polyglot" because she could speak French, Italian, Greek, Hebrew, Spanish, German, and Latin by the time she was 13. By her late teens, she had also mastered mathematics.

Agnesi had the advantage of a wealthy upbringing; the family fortune came from the silk trade. She also had a highly supportive father, who hired the very best tutors for his talented elder daughter. Unfortunately for the shy, retiring Agnesi, he also insisted she participate in regular intellectual "salons" he hosted for great thinkers hailing from all over Europe. The young Maria delivered an oration in defense of higher education for women in Latin at the age of 9 (she had translated it from the Italian herself and memorized the text).



There is evidence from contemporary accounts that Agnesi loathed being put on display, even though her erudition earned her much admiration. One contemporary, Charles de Brosses, recalled, "she told me that she was very sorry that the visit had taken the form of a thesis defense, and that she did not like to speak publicly of such things, where for every one that was amused, twenty were bored to death." When her mother died, Agnesi took over running the family household, giving herself an excuse to withdraw from participating in these gatherings.

De Brosses admired her intellectual prowess greatly, and expressed his horror upon learning that she wished to become a nun. Agnesi did, eventually, become a nun, but not before spending 10 years writing a seminal mathematics textbook, *Analytical Institutions*, which was published in 1748. She started writing when she was 20, intending it to be a textbook for her younger brothers.

Largely self-educated, Agnesi had the good fortune to find a mathematical mentor in a monk named Ramiro Rampinelli, a frequent visitor to the Agnesi home, who directed her study of calculus. He also encouraged her to write a book on differential calculus, giving rise to *Analytical Institutions*. And through his influence, she was able to gain the input of Jacopo Riccati, one of the leading Italian mathematicians of the day, while writing her seminal manuscript. She revised the draft text to incorporate Riccati's comments.

Thanks to her father's wealth, Agnesi arranged for a private printing of the book, ensuring she could oversee its publication. The two-volume text ran more than 1000 pages. Volume one covered arithmetic, geometry, trigonometry, analytic geometry and calculus. Volume two included discussions of infinite series and differential equations. In the preface, Agnesi paid tribute to her monkish mentor, declaring that without Rampinelli's help, "I should have become altogether entangled in the great labyrinth of insuperable difficulty… to him I owe all advances that my small talent has sufficed to make."

One of the geometric curves featured in *Analytical Institutions* is the Witch of Agnesi. Agnesi dubbed it *la versiera*, a nautical term meaning "a rope that turns a sail"–an allusion to the motion by which the curve is drawn. At some point, a harried English translator misinterpreted the word as *l'avversiera*, "she-devil" or "witch." Agnesi did not invent it; Pierre de Fermat and Guido Grandi also studied this curve in 1703. It was of interest to mathematicians keen on exploring the relationship between plane geometry and algebraic expressions, as well as the relationships between plane geometry and differential calculus.

Among other phenomena, this curve describes a driven oscillator near resonance; the spectral line distribution of optical lines and x-rays; and the amount of power that is dissipated in resonant circuits. Today, Agnesi's curve is used primarily as a modeling and statistical tool. Some computer models for weather and atmospheric conditions, for example, use Agnesi's curve to model topographic peaks of terrain. It can also be used as a distribution model, substituting for the standard bell curve model in statistics. It can be difficult to integrate over a specified range using the bell curve; the Witch of Agnesi's algebraic expression is relatively straightforward in contrast, and thus easier to integrate.

Most biographies, while admiring, feel compelled to note that Agnesi's seminal tome contained "no original mathematics." Her accomplishment was noteworthy in part because Agnesi's gift for languages enabled her to read mathematical papers from around the world and synthesize those works in a single text. Notably, *Analytical Institutions* was the first tome discussing calculus that included the very different methods developed by co-inventors Isaac Newton and Gottfried von Leibniz.

Because it was one of the first and most complete treatises describing finite and infinitesimal analysis, *Analytical Institutions* caused a stir when it first appeared. A committee of the Académie de Paris praised her work: "It took much skill and sagacity to reduce… to almost uniform methods these discoveries scattered among the works of modern mathematicians, and often presented by methods very different from each other. Order clarity and precision reign in all parts of this work. We regard it as the most complete and best made treatise."

The book also won her the admiration of Pope Benedict XIV, who had studied mathematics in his youth. Because of this, Agnesi was the first woman to be appointed as a mathematics professor at a university–the University of Bologna–although there's no record she ever formally accepted the position.

When her father died in 1752, Agnesi abandoned mathematics and focused on charitable work, founding two homes for the poor and sick, in 1759 and 1771, respectively. By 1783 she headed a home for the elderly. She died a pauper in 1799, having given away everything she owned.

APS *NEWS*

Series II, Vol. 19, No. 6
June 2010

Coden: ANWSEN ISSN: 1058-8132

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

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

Subscriptions: APS News is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $15. Nonmembers: Subscription rates are available at http://librarians.aps.org/institutional.html.

Subscription orders, renewals and address changes should be addressed as follows: For APS Members–Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org.
For Nonmembers–Circulation and Fulfillment Division, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication. Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

RICHTER continued from page 1

this is my attempt to do it. What I've done is to try and write for the general public and put in some technical notes at the end of the chapters for that part of the public that I call the "Scientific American crowd," the people who like to read about the scientific details. So that's what it is, and we'll see how it does.

What was your motivation to write the book?

Since I stepped down as the director of SLAC, I was spending more and more of my time on these energy and environmental and policy issues and I found that there wasn't really anything for the public that told the story in an understandable way so that you can convince the public that we've got a problem, but we don't know exactly how big the problem is, but nonetheless it's potentially so big that we better start doing something about it now. Now I stick my neck out in this book because when I talk about either technical solutions or policy solutions, I grade them as "winners," "losers" and "maybes," and I am quite sure that some of the things that I list as losers will excite some criticism and some that I list as winners will excite some criticism, whether it's on the policy side or the technical side.

At the end of the book, you go into some of the solutions that you see as "smart" and some that you say are "dumb." What are some of the solutions you see as smart, and what are some of the ones you see as not so smart?

Here's an example of one that California has done that I think is a loser. They have put in something called a "low carbon fuel standard" for automobile fuels. So what does this mean? By 2020, for the same amount of energy out, fuel has to put out 10 percent less greenhouse gas than it does today. That sounds good, except that if you think about a car, it isn't just the fuel that determines what the greenhouse gas emissions are, it's what comes out of the tailpipe. So if I (as the EPA has done) say "OK auto manufacturers, thirty five miles per gallon by 2016," that reduces emission by 40 percent, and a lot faster too. If I switch to a diesel engine for the same energy, diesel engines are more efficient than gasoline engines. So with today's diesel engines and today's diesel fuel I already do about fifteen percent better than gasoline, so why should you add this complexity to something when what you're trying to do is reduce emissions and why do you think you're so smart as to tell the auto world how they should do it, rather than tell them what they should do. I am perfectly in agreement with the notion that we should tell them what to do. And in fact if you look at the energy efficiency study that the APS put out, for which I chaired the study group, we said that it's perfectly reasonable to demand fifty miles per gallon for single fuel vehicles by 2025 or 2030. So I don't like regulations that specify how, I like regulations that specify what. I don't think we're smart enough to know how technology is going to evolve over a long time.

Another example which I think is really maximally stupid is corn ethanol. Everybody knows that corn ethanol, when you account for land use changes, averaged over the US is worse than gasoline for emissions. Why are we mandating corn ethanol? You know perfectly well why we're mandating it; both parties are looking for votes in the corn belt. As soon as one party made a slight step in that direction the other party had to go along with it, so we're spending huge amounts of money for nothing. Those are two quick examples; there's a lot more.

What's one you see as a good potential solution?

In technology I think the best things for now are substituting natural gas for coal where you could make a huge impact very fast and at rather low cost. You don't get any credit for doing that in the present system. You get credit for putting in solar cells, but solar cells produce electricity for a huge amount of expense. Electricity from solar cells is 25 cents per kilowatt hour compared to five or six cents for a gas-fired power plant; so why are we doing that? Eventually solar cells will be terrific and we'll have the energy storage that goes with them to make them practical. I'm all for solar cells but I'm also for doing things that can have a big impact at minimum cost. Energy efficiency is another such thing. My pets are energy efficiency, substitute natural gas for coal, nuclear power which will certainly be controversial, and getting renewables like wind up to a reasonable level while we figure out how to take care of the variability of wind. Right now you can't really handle that well.

What is the hardest thing about convincing the public and policy makers about how important an issue this is?

The problem is that the consequences are far in the future but you're asking for action now. I'm not going to see any effect, I'm an old guy, I'm retired, but my little granddaughters, aged five and a half and three, they're going to see a big effect. So the effects are downstream and you're asking people to spend money now and if you look at the science, there are considerable uncertainties in it, and it's going to take time to reduce those uncertainties. If you look at the IPCC fourth report, their scenario is called A1FI, but it's pretty close to what people would call business as usual. That is, we continue on the present track with the same mix of fuels, and they get a temperature rise of between, if I remember this right, something between two and six or seven degrees Celsius. Since I talk to audiences here I'll put in Fahrenheit, four degrees to twelve degrees Fahrenheit. That's a big range. And if you look at how long it's going to be to narrow that range up, I believe it's going be twenty to thirty years (I say why in one of the chapters, why it's going to take us that long to know whether we're heading for the low end or the high end). So it's very easy to say, "well, it's uncertain, it's not going to happen for a hundred years, let's wait." And unfortunately the longer you wait, the more expensive and the harder the problem is to solve.

Would you say you're pessimistic or optimistic about the future?

No, I'm optimistic about the future. If I were pessimistic I wouldn't have bothered writing the book. I would have just pulled the covers over my head and enjoyed myself. For example I think that this so-called Kerry-Graham-Lieberman bill in the Senate that's working its way through is a much better starting point than the Waxman-Markey bill that passed the House. It's more modest in its start, and it takes lessons from other people's experience, and if it ever gets out of the Senate, I think there's actually a reasonable chance that it would get enacted.

Any other thoughts?

I would just like to end with one conclusion which I may have already said: Politics is harder than physics, and getting all of this together and into a coherent shape and getting something done is not going to be easy. We shouldn't expect it to be easy, but we have to keep on going and above all, we've got to get the real story out to the general public in a way they can understand and that's what I'm trying to do.

Education Corner

A column on educational programs and publications

Gender Equity Conversation Visits

APS invites physics departments to schedule Conversations on Gender Equity. These conversations foster dialogue between visiting discussion leaders and members of physics departments or laboratories. Discussion leaders meet with students, faculty, staff, the department chair or lab director, and other interested parties to examine the institution's culture and how that culture affects its climate for gender equity and expansion of diversity, with a goal of finding customized solutions. The visiting team is selected from members of the APS 2007 Gender Equity workshop steering committee, the APS Committee on the Status of Women in Physics, and other physicists who are engaged in diversity issues.

All travel expenses for the discussion leaders are borne by APS (with funding from the National Science Foundation). To date, teams have visited University of Notre Dame, Brown University, University of Houston, Northeastern University, Cornell University, SUNY Stony Brook, and the University of California Berkeley. For more information and to schedule a visit, see www.aps.org/programs/women/workshops/gender-equity/sitevisits

M. Hildred Blewett Scholarship

Applications are due June 4, 2010 for the M. Hildred Blewett Scholarship for Women in Physics. The annual scholarship consists of an award of up to $45,000 to enable women to return to physics research careers after having had to interrupt those careers for family reasons. Details on the scholarship and how to apply can be found at www.aps.org/programs/women/scholarships/blewett

American Association of Physics Teachers Summer Meeting

This year's AAPT Summer Meeting will take place in Portland, Oregon from July 17-21, with a theme of "50 Years of Lasers." The AAPT meeting features two days of workshops followed by three days of sessions, plenary talks, and other events. For more information, see www.aapt.org/Conferences/sm2010

Embed Teacher Recruiting Video in your Website

As reported last month, the APS/AAPT-led PhysTEC project recently produced a fast-paced five-minute video designed to inspire physics majors to pursue a career in teaching. The PhysTEC website now includes html code that you can use to embed the video in your department's website. See www.phystec.org/video/video-teachphysics for the code.

ESEA Reauthorization

The Department of Education recently issued a blueprint for reauthorization of the Elementary and Secondary Education Act (ESEA), which was renamed "No Child Left Behind" under the previous administration. The blueprint instructs states to continue developing and implementing science assessments, but does not include science testing in the important measure of Adequate Yearly Progress. APS along with the American Institute of Physics and four of its member societies endorsed a letter to the House Committee on Education and Labor with the following recommendations:

1. Include science in any accountability measure while recognizing the importance of laboratory and inquiry-based learning.
2. Include language in Title IIA directing school districts to set aside a portion of the Teacher Quality funds for science professional development programs and reauthorize the Math and Science Partnership program (Title IIB) at $450 million.
3. Create an office at the Department of Education to oversee the Department's science, technology, engineering, and mathematics (STEM) education programs.

INSIDE THE BELTWAY

Risk(y) Management

by Michael S. Lubell, APS Director of Public Affairs

Michael Steele, the oft-criticized chairman of the Republican National Committee, has spent much of his tenure both fending off accusations of fiscal impropriety and tending to his chronic case of foot-in-mouth disease. But his detractors among the Republican rank and file will have to cut him some slack if his party takes control of either the House or Senate in November, as some tracking polls suggest it could.

All the bad publicity he received in April from stories describing an RNC-funded outing to a lesbian-bondage nightclub for a bunch of over-sexed California contributors will long be forgotten if Steele and the GOP pull off a congressional coup five months from now. Less than a year ago any such suggestion would have provoked a collective snort from TV's pack of supercilious Sunday soothsayers.

For now, it's the Democrats who are in desperate need of a rejuvenating elixir. Why their political health deteriorated so rapidly has everything to do with health: medical and economic. And it has everything to do with risky behavior, although not in a California sex club, but where it really counts, in Washington's corridors of power.

There is little doubt that President Obama inherited an economy in virtual freefall and a financial system in virtual lockdown. Both had their genesis in shockingly bad risk management–inside Wall Street's wood-paneled boardrooms and within Washington's watchdog officialdom.

The President and his advisors understood it. Congressional leaders understood it. And yet in trying to administer the cures, they failed to manage their own political risks. They failed in framing their policies in ways the public could grasp, and they failed in pursuing the remedies in ways the political enterprise could manage.

What the media labeled a Wall Street bailout they could have stamped a Main Street savings

RISKY continued on page 5

Letters

A Series of Comments on Fourier

As always, the March "This Month in Physics History" column in *APS News* was well documented and very interesting. I would just like to add some information on the biography of Joseph Fourier, for your readers. You write that he "was selected for a new teacher–training school to help rebuild France, where he studied under three of the most prominent French mathematicians, Joseph Louis Lagrange, Pierre-Simon Laplace, and Gaspard Monge".

May I add several points :

- This school was the first Ecole normale founded in 1794 which is still active as the Ecole normale supérieure (Paris). The magnificent lectures of the three mathematicians have recently been edited as the "leçons de mathématiques" under the direction of Jean Dhombres (Dunod) .
- Joseph Fourier also had classes in natural sciences by the crystallographer René Just Haüy, the chemist Claude Louis Berthollet, and the biologist Louis Daubenton. I recently produced a critical edition of the *leçons de Physique , de chimie et d'histoire naturelle*. (éditions Rue d'Ulm-Paris).
- All the high-level courses, after a revolutionary troubled period, were given to a large number of students. They indeed intended to provide all of France with school teachers. They still offer one of the most remarkable pictures of science a few years after the *Encyclopedie* was published. The lectures were reproduced to be distributed to all the students two weeks after the classes had been given, together with debates. We have recordings of clever questions asked during the debates by Joseph Fourier.
- Fourier was appointed professor at Ecole Polytechnique just after this initial training. The two "Grandes Ecoles" had been created that same year by the revolutionary Convention.

Etienne Guyon
Paris, France

Early Work on Graphitic Epitaxial Growth

In the January issue of *APS News,* Andre Geim stated in a letter that "the earliest paper on graphitic epitaxial growth which I am aware of dates back to 1975 [1]", and that "I am certain that even earlier papers will eventually be found, and I would most welcome further historical insights."

I would like to draw your attention to a paper that Walt Haas and I published in 1970 where we found a monolayer of graphite formed on Ru(0001) surfaces during experiments aimed at determining how to obtain atomically clean surfaces of Ru(0001). The paper was entitled "A Study of Ru(0001) and Rh(111) Surfaces using LEED and Auger Electron Spectroscopy", submitted 24 November 1969, and it was published in *Surface Science*, Vol. 21, pages 76-85 in 1970.

When I visited Prof. Gao's group at the Institute of Physics in Beijing on 24 October 2008, I was shown some recent LEED and Auger work of theirs regarding the growth of graphene on Ru(0001). They were surprised when I showed them my results from over 35 years earlier where the LEED patterns and Auger spectra were almost identical. They apologized that their literature search did not go back that far and that they were completely unaware of my earlier work. Their work was published in *Advanced Materials*, Vol. 21, pages 2777-2780 in 2009, and includes STM and XPS data as well.

John T. Grant
Dayton OH

Senator Reid Will Fix It

I thought Michael Lubell's article, "If it's broken, fix it," [Inside the Beltway, *APS News*, April 2010] was so good that I sent an e-mail to Senator Harry Reid to draw his attention to the article's suggestions of non-partisan redistricting, free TV-ad time, and making filibustering, if called, a burdensome activity.

Nick Carrera
Falls Church, VA

Back Page Nails It

Please accept my belated commendations on the Back Page by Virginia Corless ("Theater Deepens the Vision of Physics") in the February *APS News.* As a theater professional and instructor for over twenty years, it is always surprising that most individuals "outside the box" have very little comprehension of how so many systems have to mold together for a successful process. This is what it takes to make a satisfying production and experiment. Ms. Corless hit the nail on the head.

One rarely sees any attention given to the performing arts in such a notable setting. Many thanks for broadening our horizons!

James Gandolfo
Newport News, VA

New Technique Raises Fears of Nuclear Proliferation

In February APS's Panel on Public Affairs released a report that outlined steps for reducing the spread of nuclear weapons around the world. At the same time, an emerging uranium enrichment technology shows the difficulties ahead for future nonproliferation efforts.

The separation of isotopes by laser excitation (SILEX) uses lasers to refine uranium into a usable form. This new technique, developed over the better part of two decades, could make nuclear power slightly cheaper, but could also be used to covertly manufacture nuclear weapons.

In the SILEX process, precisely tuned lasers are shot at raw uranium. Because of the beams' frequency, they preferentially ionize atoms of uranium-235, which a charged metal plate is then able to attract and collect. Research into the process has been going on at various times in more than twenty countries for over two decades, but the technical difficulties involved led most teams to abandon the research. Recently physicists in Australia successfully developed a workable technique and the process is now being commercialized by a US company. The Global Laser Enrichment subsidiary of GE Hitachi Nuclear Energy has applied for a license from the Nuclear Regulatory Commission to set up an enrichment plant in North Carolina.

The total amount of energy needed to operate a laser enrichment facility would be a fraction of what current centrifuges use. The concern is that countries looking to surreptitiously enrich uranium and develop nuclear weapons would be able to easily hide these facilities.

Francis Slakey, professor at Georgetown University and APS's Associate Director of Public Affairs, writing with co-author Linda Cohen of the University of California, said in a recent opinion piece in Nature that, "The world is heading towards the development of nuclear-enrichment technologies so cheap and so small that they would be virtually undetectable by satellites." In addition they called for the NRC to carry out a nonproliferation assessment of the technology because of its potential to do more harm than good.

APS has not taken a stand on the issue, and does not mention SILEX specifically in its recent Nuclear Downsizing report. More broadly, it does call for the Nuclear Regulatory Commission to take into account the possible spread of dangerous technology when issuing licenses.

Robert Rosner, a professor at the University of Chicago and former director of Argonne National Laboratory, said that uranium enrichment with SILEX technology would be easy to conceal.

"The other two techniques tend to be energy intensive …and are therefore easily detectable," Rosner said, adding that this would not the case with laser facilities, which could be hidden because of their smaller sizes and energy needs.

Slakey said that if the technology is developed further, which seems likely, there are steps that can be taken to minimize likelihood of the technology falling into the wrong hands. He said that one of the important criteria for the NRC to take into account when issuing licenses for SILEX is how well its technical information is guarded.

"The primary issue is that we want to make sure the design and discoveries are adequately protected against theft," he said, adding that historically, nearly all enrichment technologies have been stolen at some point.

President, Congress Take Note of Laser Anniversary

The United States government affirmed the importance of the laser to the modern world in two separate announcements issued days before the 50th anniversary of its invention. Both the White House and the House of Representatives issued statements commemorating the milestone.

On May 12, President Obama issued an official presidential statement praising the invention of the laser. A copy of the letter containing the statement appears on page 1 of this issue. The statement commended the ingenuity of the laser's creators and highlighted how numerous commercial and engineering applications have come out of it even though originally it was thought to have limited use outside of basic scientific research.

The presidential message was issued a week after the House of Representatives passed a resolution expressing similar sentiments. Introduced by Rep. Vernon Ehlers (R-Mich.), H.Res-1310, Recognizing the 50th Anniversary of the Laser, passed the House on May 4th. The preamble highlighted the work of the many people associated with its invention and the huge economic impact it's had over the last half-century.

The text of the resolution reads, "Resolved that the House of Representatives (1) recognizes the 50th anniversary of the laser; and (2) recognizes the need for continued support of scientific research to maintain America's future competitiveness."

House resolutions do not carry the weight of the law, and rarely are accompanied by corresponding motions in the Senate. They are used to express the sense of Congress about a specific topic, usually recognizing a major milestone or achievement.

The bill had six cosponsors including Reps. John Garamendi (D-Calif.), Ralph Hall (R-Texas), Gabrielle Giffords (D-Ariz.), Bob Inglis (R-S.C.), Suzanne Kosmas (D-Fla.) and David Wu (D-Ore.).

APS, together with the Optical Society, SPIE, and IEEE-Photonics, is spearheading LaserFest, the yearlong celebration of the 50th anniversary of the first working laser, that was constructed by Theodore Maiman and co-workers at Hughes Research Laboratories in Malibu, California on May 16, 1960. On May 16, 2010, as part of its Historic Sites Initiative, APS presented a plaque to HRL commemorating Maiman's achievement. APS President-elect Barry Barish read President Obama's message as part of the presentation ceremony.

Cell is Mechanical Device

By Calla Cofield

A pioneering network of physicists, engineers and biologists are beginning to develop a picture of the cell as a mechanical device, not just a chemical one. As a result, scientists are gaining new insight into the structure, behavior and functions of the cell, as well as its malfunctions and failures. This new map of the tiny, yet complex structures will change the treatment of diseases that originate in or affect them. But within this scientific community (so new that it hasn't settled on a name for itself) there has arisen some debate about how soon this research will result in disease treatment.

"Cells don't just speak through chemistry, they speak through forces," said Alex Levine at a press conference on cell mechanics at the APS 2010 March Meeting in Portland. Levine, Associate Professor of Chemistry and Biochemistry at UCLA, is suggesting that understanding the chemical nature of cells is only half the story.

For hundreds of years, biologists have found hints about the mechanical nature of cells, but a lack of sufficient tools always halted further investigations. In the last two decades, technological advances have opened the door for researchers, particularly physicists and engineers, to study the nanoscale forces exerted by cells and the atomic structure of the materials that make them up. Almost overnight, scientists have become aware that cells may change their shape based on directional blood flow, or migrate from one area to another in order to find the environment with the right rigidity for development. Cells may communicate internally by changing the tension in connecting fibers. Chemical cues may cause a cell to change the equilibrium point of a mechanical system in order to generate motion, such as tensing muscles.

Trained as a physicist, Levine entered the field of biological physics

CELL continued on page 5

VOICE continued from page 1

said also that in the addendum they added additional information in areas they thought needed further detail. "Physicists like to see data. They don't like hand-waving arguments. They want to know what has been measured and they want to know the uncertainty"

The statement was called into question when at the spring 2009 meeting of the APS Council, councilor Robert Austin brought forward a motion calling for the original statement to be replaced with a new statement. The request was tabled, and Cherry Murray appointed a committee headed by Daniel Kleppner to review both statements and suggest potential options for responding to the motion.

Acting on the Kleppner committee recommendation, Council passed a motion in November calling for POPA to review the 2007 statement and address "issues of tone and clarity". POPA formed a subcommittee headed by Duncan Moore to draft an addendum to the statement. In addition to Browne and Moore, James Drake and Frances Houle served on the subcommittee. The members were chosen because none had worked on originally drafting the climate change statement, and none had taken a public stance on the controversy of climate change.

In early January, the subcommittee members held lengthy teleconferences with five prominent voices in climate change research. The experts they interviewed included both proponents of anthropogenic climate change as well as those critical of it.

After consulting the climate experts, the subcommittee began writing the addendum. On February 5th POPA unanimously adopted the addendum in its preliminary form.

On February 23rd, APS President Curtis Callan sent an email to all APS members that linked to a website with the proposed addendum. It invited all members to read the statement and critique the draft. This was the first time the entire membership had been asked to weigh in on an APS National Policy Statement.

As reported in last month's *APS News,* a total of 1,767 people, or about 4 percent of the membership, responded to the email and submitted responses through the website. Each comment was read by at least one person on the subcommittee. Comments were ranked from 1 to 5 based on how strongly they supported or opposed the proposed addendum. Those comments that the committee member thought had constructive suggestions for edits were set aside and circulated for all subcommittee members to read.

After each subcommittee member read all of the set-aside comments, they went back and re-edited the statement based on the responses. The committee made over 50 changes to the seven-hundred-plus word addendum. Many of the changes clarified the language used; however, several of the changes were more substantial.

"The membership had a huge impact on the whole thing," said subcommittee chair Duncan Moore, "We made significant changes… [including] a couple of factual errors that were corrected because of that."

POPA submitted the final version of the addendum to the Council on April 18th, and it was adopted 31 to 2 with one abstention.

This won't be the last time the membership is asked to comment on such matters. The Constitution and Bylaws Committee is currently working on a system to similarly solicit member input on any future public statements.

"It seems like a good process," said councilor Gay Stewart, "Everybody got a chance to voice their opinion."

Not all of the councilors were completely satisfied with the process for members to weigh in.

"It should have been quantitative not qualitative. It was a very flawed poll," said Austin, who ultimately voted against the adoption of the addendum. He said also that having members submit written responses was an unscientific way of gauging the opinions of the membership, "I think they should have had a professional pollster come in."

All of the councilors interviewed said that an important issue to them was that any statement adopted had to be based on sound science.

"It's a good idea with the caveat that in the end POPA has to write the statement based on their work and not just on a poll of the membership," noted councilor Steven Rolston.

CELL continued from page 4

via the study of polymers. Cell cytoskeletons are made of a polymer unlike anything artificially created in a lab, and they represent one of the many arenas where the study of cells offers the promise of new physics. Now Levine has taken a particular interest in what he calls "cell quakes" or tremors in the cell wall that help the cell move around.

"We're in sort of a Lewis and Clark phase in the field," said Levine, "a time when you can discover mountain ranges and rivers. There's a lot of low hanging fruit."

Much higher up the tree, dangling above the heads of researchers, is the promise of utilizing this new understanding of the cell to treat and cure disease. And Denis Wirtz has wasted no time going after that highly coveted and direly needed prize.

Wirtz was trained as a physicist and chemical engineer, but upon entering an appointment in Chemical Engineering at Johns Hopkins University, he dove head first into biology. In 2008 and 2009 he and his research group published work showing that cells from mice suffering from accelerated aging (progeria) and muscular dystrophy, two diseases that originate from different locations on the genome, display the same kind of physical deformation to critical structures in the cell. Whether the deformation is the cause of the disease or a clue to its source is uncertain, but Wirtz is encouraged that he's on the right track.

Without so much as a pause, Wirtz is now ready to tackle one of the most deadly and dreaded diseases in America: cancer. In November 2009 the National Cancer Institute officially opened the Engineering in Oncology Center (EOC) at Johns Hopkins, where Wirtz will serve as director. The NCI invested 14.8 million dollars over five years in the EOC, one of twelve in the country. A press release from Hopkins says the Center will give the participating cancer researchers a "fresh pair of eyes" by teaming them up with physicists and engineers who have not specialized in cancer research, or in some cases even biology.

"Little is known about the effect of mechanical forces on the regulation of cancer cell growth," said Wirtz in the Johns Hopkins press release. "That is what the Engineering in Oncology Center and the National Cancer Institute want to find out. The results should point us to therapies and diagnostic tools that complement existing genetic or molecular treatments."

Wirtz talks passionately about his interest in understanding the science of cancer, and his hopes for treating it. At the APS Meeting in Portland he emphasized the important role that physicists and engineers will play in reaching that goal.

On the other hand, some of Wirtz's colleagues, including Levine, have cautioned against being overly optimistic.

"Medicine is the engineering application of physics and biophysics," Levine said. "As you know, there was a long time between the beginning of quantum mechanics and the production of transistor radios. Personally I think this is an even more complicated subject. I suspect there will be a long timeline between treatments and the biophysics we are doing."

However, neither Levine nor other members of the field think that Wirtz's work will yield no positive results. Paul Janmey, a professor of physiology at the Institute for Medicine and Engineering at the University of Pennsylvania, adds that research institutes like the EOC may make new breakthroughs in cancer diagnostics.

"It's plausible that we'll be able to identify tissue more prone to full blown tumors," Janmey said. "Chemical signs that tissue will become cancerous haven't been particularly successful. If there is a relatively non-invasive, micromechanical way to identify local stiffness and boundaries between soft and hard tissues that look similar, then that could be a strong indicator of where tumors will develop."

With the potential for great disappointment and frustration, there is an argument for keeping one's hopes restrained. At the same time, the high stakes also call for the immediate pursuit of solutions. "If [Wirtz] is right," adds Levine, "All the better."

Together at the APS Meeting, Levine and Wirtz have the rapport of old friends, and they jointly discussed topics with reporters. More important than their individual pursuits is advertising this new field to physicists, who, they can both agree, will play a crucial role in its progress.

Food, Drink, and Lasers on the Hill

Photo by Michael Lucibella

On April 28, the foyer of the Rayburn Office Building on Capitol Hill was crowded as members of Congress, congressional staffers, and representatives of the scientific community celebrated the 50th anniversary of the laser. Eleven different organizations mounted demonstrations and displays around the perimeter, which the crowd enjoyed along with the refreshments. Especially popular were the LED "throwies" that were distributed by the LaserFest booth and that can be seen glowing on several attendees' lapels in the photo. The crowd was also treated to a brief address by Tom Baer of Stanford University, who emphasized the considerable economic impact achieved by the laser since its beginnings in a research lab in 1960.

RISKY continued from page 3

plan. And they could have foreseen the outrage about seven-figure Wall Street bonuses and restricted compensation at firms receiving federal help either by legal means, where possible, or by jawboning, where legal remedies were unavailable.

Instead, the Troubled Asset Relief Program, enacted during the waning days of the Bush Administration, has become a political liability for Obama and members of Congress on both sides of the aisle who voted for it. Not long ago, three-term conservative Republican Senator Bob Bennett of Utah learned how risky his pro-TARP vote was when, led by Tea Party activists, Utah Republicans denied him an opportunity to run for re-election in November.

Not pausing to manage political risk in the midst of the meltdown of America's financial system might be understandable. But it's hard to excuse the White House for ignoring the political need to focus the 2009 Recovery Act money on near-term job creation when its own PR shop was hyping the legislation as a job stimulus bill. The policy driver for a three-year economic recovery and reinvestment plan may well be correct, but Democrats should have been prepared to handle the political risk of passing a $787 billion federal program that probably would not generate highly visible public benefits prior to the 2010 elections.

Still, the political dangers inherent in the TARP legislation and the Recovery Act pale by comparison with the risks Democrats ran in pursuing the climate change and health bills without advancing a convincing argument for the inherent economic benefits of either. To the average voter, who has lost a job or is still in fear of losing a job, those bills smacked of Washington hubris and elitism, the very perceptions that have elevated the Tea Party from a marginal movement to mainstream.

In addition to knocking Bennett out of the political arena in Utah last month, Tea Partisans can justifiably claim substantial credit for defying oddsmakers this past January by sending Republican Scott Brown of Massachusetts to the Senate and then in April virtually forcing Florida's incumbent Republican Governor Charlie Crist to withdraw from his party's upcoming Senate primary.

Democrats who assert that the White House was asleep at the political switch for much of last year can point with ample evidence to the fallout of the Administration's siesta: a slew of declared retirements by prominent congressional Democrats, many of whom would be facing unusually difficult re-election races if they chose to run in November.

For science, the consequences could be substantial. Among key players who have already announced their departure are Senator Byron Dorgan of North Dakota and Representatives David Obey of Wisconsin, Bart Gordon of Tennessee and Brian Baird of Washington. The exodus list grew when Representative Alan Mollohan lost a West Virginia primary in May. Science boosters all, they will be vacating the chairmanships of committees vital to the support of research and education. As Congress focuses on deficit reduction, these key players will no longer be there defending science's turf.

For the National Institutes of Health, especially, the warning signs could hardly be more ominous. In the House from his perch atop both the full Appropriations Committee and the Labor-HHS-Education Subcommittee, Obey was defender exemplar of the NIH budget. And in the Senate, Arlen Specter was his reliable counterpart. But on May 18, Specter, who had switched parties last year, was upended in a Pennsylvania Democratic primary. Next January, both Obey and Specter will be gone.

Biomedical research, already under financial stress, could find itself in a budgetary straitjacket by the start of the 2012 fiscal year. And if scientists remain politically complacent as fiscal hawks ascend to power, the rest of the research enterprise could be shackled, as well.

Photo by Michael Lucibella

How DO Lasers Take the Twinkle Out of Starlight?

In late April, the APS LaserFest outreach team participated in the Cambridge Science Festival in Cambridge, Massachusetts. Over 3000 students had the opportunity to sample a variety of giveaways and demonstrations illustrating some of the unique features of the laser. In the picture, APS Outreach Specialist Chris Discenza (right) is busy keeping up with traffic at the LaserFest table, while a passerby ponders the astrophysical uses of lasers. The poster she's looking at is one of three with teaser questions that APS created for LaserFest. Those interested can request copies of the posters, as well as find the answers to the questions, by visiting either PhysicsCentral (www.physicscentral.com) or the LaserFest website (www.laserfest.org).

Model Predicts the Progress of Disease Detection

By Calla Cofield

Many groups at the APS March Meeting presented their work on new devices for disease detection. Three groups presented work on more robust TB detectors. Another company revealed proof of concept for a handheld device that could do everything from monitoring white blood cells to identifying bacteria in drinking water.

John X. J. Zhang and researchers from the University of Texas at Austin want to improve on current technologies to identify tumor cells that appear in the bloodstream long before tumors become visible through imaging techniques. They are engineering sensors that go out and look for the cancer cells in the sample, in contrast to current technology in which the sensors remain stationary and wait for the cells to pass by.

In this way Zhang and his group have changed the relationship between the number of disease indicators in a volume and the time it takes for them to reach the sensor. According to Ashram Alam, a professor of electrical and computer engineering at Purdue University, this is the underlying challenge for all biosensor technologies.

"On the surface, these technologies, protocols and approaches look very different," said Alam. "But they all use different manifestations of the same principles. They all rely on how the molecules diffuse to the sensors. [Our work] along with others from Naval Research Lab (led by P.E. Sheehan) and MIT (led by T.M. Squires) speaks mostly to the physics of sensitivity and how far you can go based on the physical principles of how molecules are detected."

Alam spoke at a press conference at the meeting in Portland and related the task of disease detec-

MODEL continued on page 7

LOS ALAMOS continued from page 1

Safety Administration (NNSA), and the fact that the contract to run the lab was given to a for-profit entity, all led to the greater emphasis on risk avoidance.

"It was difficult to get work done in 1997, and now it's simply so difficult to get work done that it gets difficult to attract the best and brightest" to the facility, he said, "It's gone downhill for some time and we failed to fix it with the creation of the NNSA and the new management structure." He added that people are now more afraid to make mistakes, contributing to the difficulty of conducting scientific work.

How things got to be where they are

The University of California managed the operations of Los Alamos and Lawrence Livermore since their inception in 1942 and 1952 respectively. During the late nineties and early 2000s dissatisfaction with UC over the management and security of the labs had been increasing among the scientists and in Congress. In 1999, the Department of Energy accused and jailed Los Alamos physicist Wen Ho Lee, based on 59 counts of improperly handling nuclear secrets, charges that were eventually dropped. In 2003, then secretary of energy Spencer Abraham said that there were what he called "systematic management failures," the management contracts with UC would not be renewed, and the DOE would soon accept bids for new contracts to run the labs.

Only private companies were allowed to bid, and UC joined with the engineering firms Bechtel, Babcock & Wilcox, and URS to form Los Alamos National Security LLC (LANS). In addition, they aligned with research firm Battelle to form Lawrence Livermore National Security (LLNS). Though separate companies, the two organizations share many of the people on the two boards of governors. LANS took over operations from the University of California in June of 2006, and LLNS took over in October of the following year.

Until 2008, the LLCs issued publicly available reports that described the performance of each of the labs. These performance evaluation reports detail how well the labs did on a list of goals and metrics that determine how much of their possible fee they earned. However starting in 2009, citing concerns about proprietary information, the LLCs ceased to make these fifty-plus page reports available to the public, and instead began issuing single page summaries.

Critics said that the contract unfairly penalizes employees for mistakes, and encourages employees to avoid projects with uncertain potential outcomes and even underreport accidents in order to keep performance evaluations looking good. This has hurt morale at the lab and has hampered scientific research into areas where a successful result is in doubt.

"Support people used to believe they had an important job – they were helping the scientists do their job for the country," said a Los Alamos technical staff member. But a general feeling of not being able to get work done, combined with fewer advancement opportunities, due to a change in how non-scientists can advance in the LLCs, has contributed to employee malaise.

Terry Wallace, Principal Associate Director for Science, Technology & Engineering at LANL, who grew up in Los Alamos, agrees that there is a morale issue at the facility. The management change "is a difficult transition to make," he stated. "When you have a workforce that believes 'this is ours' [meaning Los Alamos], and a new management team that appears to be dropped from outer space because it's corporate…and they don't know (them). You put those two things together and that spells large change and it's difficult for the workforce to accept that kind of change. And we have a new set of requirements and a new set of people, and that new set of people don't have an immediate reservoir of trust with our large science workforce."

But he added that the contract itself, which is based on government standards, is guiding the management decisions. And "the federal government's expectations were extraordinarily different from May 31 to June 1, 2006," when the changeover occurred, he stated. When the contract was bid, the federal government indicated they want "good stewards of science," he said. "However, once you go to the implementation phase, it's an annual contract and that annual contract incentivises a number of things. Everything they want to incentivise has to do with getting the laboratory in compliance with federal and DOE regulations. There are no DOE regulations about science but there are lots of DOE regulations about how you run a conference, what's an allowable charge, how you can use overhead to buy bottled water, etc. Suddenly you have all these lists of requirements instead of when you're a [Federally Funded Research and Development Center], where they say you go and figure out how to do this. Now they say we want you to do this. That's a pretty big change and we're still getting used to that."

Costs of Science

Since the turnover, the management costs for each lab ballooned to many times what UC was originally paid. In 2008 LANS received $63 million in unadjusted dollars for their work running the lab, and $72 million in 2009. When the University of California was the sole administrator of the lab, the highest it received was $7.65 million in 1998.

Administrative costs at Lawrence Livermore have similarly swelled. In 2009 LLNS received $47 million and $30.9 million in 2008. The most the University of California received for running Lawrence Livermore was $6.75 million in 2005. These increases were included as part of the original request for proposals issued by the NNSA in order to get qualified contractors to bid to run the lab.

In addition to increased management costs, the LLCs are subject to taxes from which the University of California was previously exempted. As a privately-held company LLNS paid $87 thousand to the state of California in 2009 for various fees. However LANS, being located in New Mexico, has faced a much steeper tax burden, and since the transfer paid the state between $74 and $91 million per year in gross receipt taxes. New Mexico does not have a sales tax, and instead levies a gross receipt tax directly on businesses that sell goods and services. LANS, a private company, is subject to these taxes, while the University of California, as a public institution, was not.

"We've been experiencing the same sort of belt tightening that just about everyone else is going through, given the state of the economy. It can be a challenge, but we are making every effort to trim our operating expenses, not sacrifice our science and technology programs," Lynda Seaver, spokesperson for Lawrence Livermore said in an emailed message.

Between 2006 and 2008, about 440 workers, including about 150 scientists and engineers, were laid off at Livermore. In addition, almost 1,500 workers accepted buyouts and left voluntarily, reducing the lab's total workforce from about 9,000 to 7,000. The majority of the scientists who were let go had been with the lab for twenty years or more. Thus far Los Alamos has escaped any significant layoffs.

"These costs, coupled with a lower budget, inflation, struggling economy, rising medical costs, etc. all played a part in our workforce reduction. This was the last thing this Lab wanted to do–we had offered incentives for voluntary separation in hopes of avoiding layoffs–but we did not get the number of employees we had hoped for in order to avoid any layoff," Seaver said, "Just about every other DOE/NNSA lab went through a workforce reduction, for many of the same reasons as us."

Scientists at Livermore have likewise said that the changes in management and workforce reductions have resulted in greater workloads, more bureaucracy and low morale.

"They're not qualified to run a national lab," one researcher at the lab said who wished to stay anonymous, "They just don't have the know-how."

Tomás Díaz de la Rubia, the chief research officer and a member of the board of governors, defended the lab. He said that science is still the top priority at the lab, pointing to the recently completed National Ignition Facility. He also said that Lawrence Livermore recently won more of the prestigious R&D 100 awards in 2009 than at any point in the lab's history, and that Livermore physicist Berni Alder was awarded the National Medal of Science in 2009.

"When you go through a change like this which was actually pretty significant… There's a disruption in the system. There are clearly still things that we have to deal with as we go forward," he said, "There were disruptions and difficulties… but I think we are well on our way."

The former director of Los Alamos thinks that one of the biggest problems is a lack of direction at the lab. Los Alamos and Lawrence Livermore are the nation's two top nuclear weapons research labs, but since the end of the cold war, their purpose has become less clearly defined.

"It's critical for the labs to have their mission redefined and change the operational environment to make it easier for jobs to get done," Hecker said.

Wallace said that while the primary goal of Los Alamos remains "to be the premier national security science laboratory," its mission is evolving. Emphasis remains on ensuring the reliability of the nuclear deterrent, protecting the nation against global threats, and providing scientific solutions to emerging national security challenges. New areas of research, including addressing the nation's energy needs, are receiving more attention. "[In 2006] basic and energy science was around $160 million each year. Today it is $250 million a year. It is a reflection of what the nation wants us to do," Wallace said

Like many current and former employees of both labs, Hecker is quick to point out that his ultimate desire is to improve the lab. Another science employee echoes this sentiment: "I just want to make the lab better. I love this place…I just want it to stop deteriorating."

MODEL continued from page 6

tion to a game of cops and robbers. New technologies hope to increase their ability to find the elusive robbers (disease indicators in large sample volumes) and create better cops (more effective means of capturing and identifying those indicators).

Alam and his group, including postdoctoral researcher Pradeep Nair, studied the zoo of biosensors and disease detection techniques and put the parameters that govern the "cops and the robbers" into a basic model. Those parameters include how well a team's engineered nanoparticles bind to the disease indicators, the device's signal to noise ratio, or a detector's ability to handle a cell gently enough that it doesn't destroy it in the capture process.

The Purdue researchers are calling their model a "periodic table" because it provides a kind of map of all the current biosensors based on their unique values for each of the individual parameters. The map then reveals gaps in the current technology, and provides developers with the opportunity to fill in those gaps with new devices. The team first developed their model based on technology available in the 1970's, and found that they could successfully predict technologies available today. Alam says they have already begun to see some of their current model predictions fulfilled.

"All these parameters can now be understood in a global context, so you don't just start changing one without understanding the others," said Alam.

The model also predicts that current biosensor technology will reach a wall of sensitivity, limited by the density of disease indicators in a volume, and the amount of time the researchers are willing to wait for the results. The wall can be overcome by new techniques such as amplifying the signal from the disease indicator.

"There really are a huge number of things depending on this kind of understanding," he said. "And in the end we hope something significant and wonderful will come out of it."

Physicists Study Quantum Chemistry Near Absolute Zero

Physicists at the March Meeting announced the first observation of chemical reactions at temperatures near absolute zero. It is the first time that the quantum state of the molecules significantly affected a chemical reaction.

Researchers at the University of Colorado cooled a gas of potassium-rubidium molecules in an optical lattice to a few nanoKelvins above absolute zero and observed the atoms break and reform molecular bonds.

"What's going on here is chemistry," said Deborah Jin from JILA at the University of Colorado and one of the team that conducted the experiments, "This is the first time in a chemical reaction the quantum state plays a role."

The cooled molecules reacted with each other over distances much greater than they normally would at room temperatures. At these ultra-low energy levels, the quantum wavelength of each molecule expands out to over 100 nanometers, much greater than the 1 nanometer distances over which chemical reactions typically occur.

When the wavelengths of two potassium-rubidium molecules overlapped under the right conditions, they broke their molecular bonds and reformed as one molecule of two rubidium atoms and one of two potassium atoms.

"The two molecules are highly reactive when they are close together, with nearly 100 percent probability of reaction when they are within a nanometer of one another," said Paul Julienne, a theorist at NIST who was also on the team. "The very long quantum wavelengths of the molecules, more than 100 nm, means that they can only get within 1 nm of each other by specifically quantum ways that depend strongly on temperature and whether the two fermions are in the same or different spin states."

The research team found also that the reactions were highly influenced by the nuclear spins of the atoms in the molecules. According to the Pauli Exclusion Principle, two identical fermions cannot occupy the same state at the same time. As a result, molecules that have the same spins are less likely to be near each other than those that have different spins, slowing down the reaction rate by up to factor of 100.

Physicists began using lasers to cool atoms to near-zero temperatures more than 20 years ago; however cooling entire molecules is a much more recent development. Factors including combined nuclear spins and rotational and vibrational states add a huge extra level of complexity to the techniques needed to trap and cool atoms, the first cooling of entire molecules was only achieved in 2008. The simple but reactive potassium-rubidium molecules were ideal for the experiment. In addition each molecule is polar, positively charged on the rubidium side and negatively charged on the potassium side, allowing the physicists to easily manipulate the molecules with an electric field.

"There has been work on ultracold molecules made from ultracold atom gases before, but those are molecules in very high vibrationally excited states, so the molecules are barely bound," said Jun Ye, the other team leader at JILA. "In our experiment, we have ground-state molecules–in their lowest energy states–at nanokelvin temperatures."

The researchers who conducted the experiment say that this technique could yield new insight into intermolecular forces and could have applications in quantum computing and high resolution spectroscopy.

ANNOUNCEMENTS

M. Hildred Blewett Scholarship

for Women Physicists

This scholarship has been established to enable women to return to physics research careers after having had to interrupt those careers for family reasons. The scholarship consists of an award of up to $45,000. The applicant must currently be a legal resident of the US or Canada. She must be currently in Canada or the US and must have an affiliation with a research-active educational institution or national lab. She must have completed work toward a PhD.

Applications are due June 4, 2010. Announcement of the award i expected to be made by August 2, 2010.

Details and online application can be found at http://www.aps.org/programs/women/scholarships/blewett/index.cfm

Contact: blewett@aps.org

Reviews of Modern Physics

Recently Posted Reviews and Colloquia

Baryon spectroscopy

Eberhard Klempt and Jean-Marc Richard

Understanding the fundamental structure of matter requires knowledge of how quarks and gluons are assembled to form baryons: the family of strongly interacting particles containing three valence quarks. While about 120 baryons and baryon resonances are known and their spectroscopy has provided essential clues that led to the development of a theory of the strong interaction, quantum chromodynamics, it has also left many puzzles. This article surveys the field of baryon spectroscopy, with an emphasis on issues, open questions, and prospects in this field.

http://rmp.aps.org

Proposed Constitutional Amendment

INTERNATIONAL COUNCILLORS CONSTITUTIONAL AMENDMENT

At its November 6, 2009 meeting, the Executive Board, acting on the recommendations of a report from the APS Committee on International Scientific Affairs (CISA), asked the Constitution & Bylaws Committee to draft modifications to the Constitution and Bylaws, as appropriate, to ensure that international perspectives are effectively represented in the Council. One manifestation of the increasing internationalization of physics is the fact that nearly 25% of APS members (excluding students) live outside the U.S. However, the membership of the APS Council, the governing body of the society, is overwhelmingly domestic.

Currently, the Council is comprised of the Presidential line (the President, President Elect, Vice President, and the most recent Past President), the Chairperson of the Nominating Committee, the Chairperson of the Panel on Public Affairs, the Operating Officers (Executive Officer, Treasurer/Publisher, Editor-in-Chief), Councillors representing the Divisions, Forums and Sections, eight General Councillors, and one International Councillor, whose primary residence is outside the United States. The total membership is 41. With the exception of the current International Councillor, Councillors are elected to 4 year terms. The International Councillor serves a 2 year term, and thus is not eligible to serve on the Executive Board (composed of the Presidential line, the Operating officers, and 8 Councillors elected to serve during the third and fourth year of their 4 year terms.)

The proposed changes to the Constitution will replace 4 of the 8 General Councillors with International Councillors, who will serve 4 year terms. The current position for an International Councillor serving a 2 year term will be eliminated. Thus each year the society will elect one general councillor and one international councillor, following the procedures described in the Constitution. The Nominating Committee will have the responsibility for recruiting candidates for the International Councillor position, and for ensuring that those Councillors represent a diversity of international regions and perspectives. These proposed changes to the Constitution will ensure that there will be international members of the Council who will be eligible for election to the Executive Board with the composition of the Executive Board left up to the Council.

The Constitutional Amendment was recommended by the APS Constitution and Bylaws Committee and unanimously approved as presented by the APS Council at its April 18, 2010 meeting for a membership vote.

AFFECTED SECTIONS OF THE CONSTITUTION OF THE AMERICAN PHYSICAL SOCIETY

ARTICLE IV–COUNCIL

Composition. The Council shall consist of the President, the President Elect, the Vice President, the most recent Past President, the Chairperson of the Nominating Committee, the Chairperson of the Panel on Public Affairs, who is elected by Council according to procedures specified in the Bylaws, the Operating Officers (Executive Officer, Treasurer/Publisher, Editor-in-Chief), and Councillors: **four** General Councillors, **four** International Councillors, whose primary residence is outside the United States, and Councillors representing the Divisions, Forums and Sections. The value of the percentage X which appears in other Articles and affects the composition of Council, shall be determined by Council and specified in the Bylaws. There may sit with the Council as advisors such persons as Council deems desirable.

ARTICLE VI–EXECUTIVE BOARD AND COMMITTEES

Nominating Committee. The membership of the Nominating Committee shall consist of a Chairperson, a Chairperson Elect, the most recent Past Chairperson, the most recent Past President, and an additional six members elected by Council to staggered three-year terms, not more than two of whom may be Councillors. The Chairperson Elect shall be elected annually by ballots cast electronically or by mail as described in Article VII.5. The Chairperson Elect shall serve a one year term, a second one year term as Chairperson, and a third one year term as most recent past Chairperson. The Chairperson shall serve concomitantly as a voting member of the Council. The Committee shall prepare a slate of at least two candidates for each of the positions of Vice President, Chairperson Elect of the Nominating Committee, and for the vacant positions of General Councillor and **International Councillor** for election by the membership. It shall also prepare a slate of at least two candidates for each of those positions for election to constitutional and standing committees for which this is required by the Constitution and Bylaws. The Committee shall meet at least once a year to determine the slates for election.

ARTICLE VII–ELECTION AND TENURE OF COUNCILLORS, OFFICERS, AND ELECTED COMMITTEE MEMBERS

Request for Nominations. No later than the first of February each year, the Executive Officer shall request nominations for the offices of Vice President, Chairperson Elect of the Nominating Committee, General Councillor, and **International Councillor**.

Nominating Procedures. Each year the Nominating Committee shall prepare a slate of nominations for the positions of Vice President, Chairperson Elect of the Nominating Committee, General Councillor, International Councillor, and other positions as required by the Constitution or the Bylaws no later than the 31st of May. The Nominating Committee shall submit to the Executive Officer the names of at least two candidates for each of the posts to be filled. The election ballot shall contain these names and those of other candidates nominated by petition of the Society numbering at least one percent of the total number of members given in the latest membership list and submitted to the Executive Officer no later than the 30th of April. Nominations by this latter procedure shall not preclude nominations of the same candidates by the Nominating Committee.

The Divisions and Forums will nominate and elect their respective Councillors according to the Bylaws.

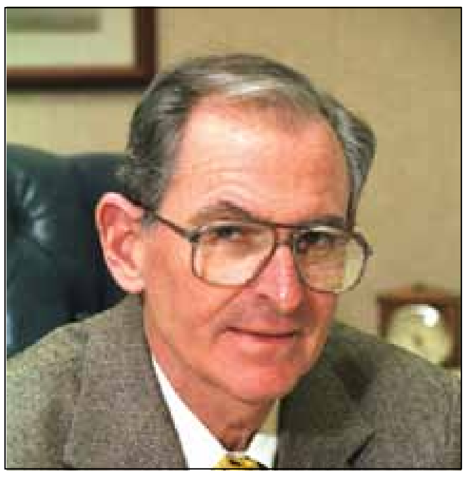
Election Ballot. The election ballot shall contain the names of at least two candidates for each vacancy to be filled, clearly separated according to category: Vice President, Chairperson Elect of the Nominating Committee, General Councillor, International Councillor, and other positions as required by the Constitution or Bylaws. Copies of the election ballot shall be provided to all members of the Society by mail or electronically at least five weeks prior to the Elections Meeting of Council. No ballot shall be counted unless unambiguously filled out by a qualified voter, cast electronically or sent in a sealed envelope bearing the voter's name, and received at a specified location not later than the specified deadline date. The positions in each category shall be filled in order of rank, starting with the candidate receiving the highest number of votes in each category. In the event of a tie, the Council shall decide the election, with the President voting only in the case of a tie among the other Council members. The counting of the ballots shall be entrusted to Tellers appointed by the President. They shall report the election results at the next meeting of Council. As soon as possible thereafter, the names of winning candidates shall be announced in a publication of the Society.

Term of Councillors. General Councillors, **International Councillors** and Councillors representing the Divisions, Forums, and Sections shall serve for a term of four years and may not serve more than two consecutive terms. The Council shall fix the terms of the first Councillors to be elected from a Division, Forum, or the sections so that approximately equal numbers of Councillors shall have terms ending each year. When a Councillor resigns or is incapacitated sixteen months or more before the normal expiration of his or her term, a new Councillor shall be chosen to fill the vacant post at the next election, and the Council shall fix the term of this new Councillor so that approximately equal numbers of Councillors shall have terms ending each year. The tenure of a Councillor shall terminate in the event of his or her assumption of a post as officer of the Society and the unexpired portion of the term shall be filled as above for a vacancy in elected office.

The Back Page

Scientific Fraud (or scientific misconduct if you dislike using the term fraud).

by David Goodstein



Being accused of committing fraud is just about the worst thing that can happen to a working scientist. But what, exactly, does fraud consist of? Fabrication, falsification and plagiarism are the three pillars of the edifice of scientific fraud. There are various other forms of questionable behavior possible in science, such as sloppy data handling, guest authorship on a paper and so on, but those are much less serious than ffp (frequent flier plan is the mnemonic for the cognoscenti).

Making positive statements about ethics in science is very tricky. There are many plausible-sounding ethical principles that would wreak havoc if anyone tried to enforce them. One such principle is "A scientist should never be motivated to do science for personal gain, advancement or other rewards." In a parallel case in economic life, well intentioned attempts to eliminate the role of greed or speculation can have disastrous results. In a well regulated system, a scientist's pursuit of personal gain or advancement can lead to important new discoveries. Another such principle is "When an experiment or an observation gives a result contrary to the predictions of a given theory, all ethical scientists must abandon that theory". Suppose a scientist who has devoted a great deal of time and energy developing a theory is faced with the decision of whether to give it up as the result of some contrary evidence. The ethical principle says to give it up, but there is another possibility. Suppose our scientist has a rival who has invested time and energy developing an alternative theory. Then we can expect the rival to act as a severe critic of the theory and our scientist need not take on the psychologically daunting task of being his own devil's advocate. In fact there are many examples in history of scientists who have succeeded by hanging on to an idea in the face of apparently contradictory evidence. One example is Bednorz and Muller, who discovered high temperature superconductivity in the face of a widely accepted theory that said it should not exist. There are numerous such phony principles. But if it's difficult to come up with positive ethical principles for science, what about negative ones? What, exactly, constitutes misconduct in science?

In the 1980's the federal government, in the form of the NIH (the National Institutes of Health) and the NSF (the National Science Foundation) came up with a definition of Scientific misconduct (the feds didn't like to use the word fraud because to prove fraud you have to jump through certain hoops which the government didn't want to do). The definition they came up with was ffp, "…or other practices that seriously deviate from those that are commonly accepted within the scientific community." No one objected to the ffp part but the "other practices" phrase caused a storm of protest because it could be applied to almost anything a scientist did. A number of blue ribbon commissions tried to rectify that situation and failed, but eventually one did come up with a definition everyone could live with. Scientific misconduct is defined as ffp, but it also requires that it be a significant departure from accepted practices, that it be done with reckless disregard for the truth, and that it be proved by a preponderance of the evidence. Thus the "other practices" phrase became an additional burden to be proved instead of an independent means of showing misconduct.

Viewed in this light a number of high profile cases either qualify as instances of fraud or do not. For example, Robert Millikan has been accused of committing fraud in his paper on the celebrated oil drop experiment that ultimately led to his Nobel Prize in physics. His paper includes the phrase "This is not a select group of drops, but all 58 drops experimented upon during 60 consecutive days." However, his laboratory notebooks, conserved in the Caltech Archives, indicate that he actually looked at about 100 drops over a period of 63 days. Many of the drops though were discarded early and can't be counted. Of the 75 or so drops left, Millikan had rigorous standards for when a drop could be counted: if it was too large it fell too fast for its speed to be measured accurately and if it was too small it was subject to Brownian motion (being kicked around by collisions with molecules of air). The 58 drops that remained represented his attempt to get the most accurate value possible for the charge on the electron. And finally, his bald statement that his sample included "all 58 drops" referred not to the charge on the electron, but to a clever technique he had devised for correcting his results for the fact that the air is not a continuous medium, as required by Stokes' law for a spherical drop falling through a viscous medium. Plotted in a certain way, the data were all supposed to fall on a straight line, and all 58 drops did. All things considered, Robert Millikan did not commit fraud.

Two more recent highly publicized cases are those of David Baltimore and Robert Gallo. Neither of them were accused of committing fraud, but two of their more junior partners were: Tereza Imanishi-Kari in the Baltimore case and Miklaus Popovic in the Gallo case. Imanishi-Kari was accused of fraud by her postdoc, Margot O'Toole, who was unable to reproduce her results. Miklaus Popovich was accused of stealing the HIV virus from a sample provided by the Pasteur Institute in Paris. Both were found guilty by the Office of Scientific Integrity (OSI), a government agency that was ultimately renamed the Office of Research Integrity (ORI), and both decisions were overturned on appeal, finding that Imanishi-Kari and Popovic, had done nothing wrong. That was a cause of considerable embarrassment to OSI/ORI and celebration on the parts of Drs. Imanishi-Kari and Popovic, both of whom have continued to pursue rewarding careers in science. Nevertheless, when Luc Montagnier of the Pasteur won the Nobel Prize in 2008 for his work on the HIV virus, neither Gallo nor Popovic were included.

On the other hand, there were two cases at Caltech, Vipin Kumar and James Urban, both of whom were postdocs in the laboratory of celebrated biologist Lee Hood. Kumar doctored a figure in a publication, and Urban submitted a paper for publication with phony data, planning to substitute real data before the paper was published. Both were found to have committed fraud and sanctions were applied.

In my experience three factors are nearly always present whenever fraud occurs in science. They are:

- The scientist involved is under career pressure,
- He or she thinks they know how the experiment would come out if it were performed properly, and
- The research is being conducted in a field where precise reproducibility is not expected.

It is by no means true that fraud occurs whenever these three factors are present. The factors are quite common and fraud is thought to be rare in science. Nevertheless, when fraud does occur those three factors are most often present.

A study done by Patricia Woolf in the 1980's showed that the vast majority of scientific fraud cases that arose happened in biology. This is likely due to the lack of reproducibility (our third factor) found in biology. Its absence may give biologists a bit more scope to cheat. However that picture has been challenged recently by two cases that came up in the field of physics.

In the first, Jan Hendrick Schön of AT&T Bell Labs (now Alcatel Lucent) had achieved considerable renown for a series of near-miraculous discoveries in the field of organic semiconductors. He appeared to be well on his way to a Nobel Prize, when some anomalies were noticed in his data. An investigation concluded that he had committed fraud in at least 16 of his many papers. However in Schön's case my three factors fit like a glove. In particular his was a field in which little reproducibility exists. If a given phenomenon doesn't occur in a given sample, it just means it was a poor sample, not that the phenomenon won't occur in a better sample. This seems to have made it easy for Schön to carry on with his deception nearly three years.

The other physics case was quite different. Experimental physicist Victor Ninov faked the discovery of element 118 at the Lawrence Berkeley National Lab. Here Ninov was in effect betting his luck on a theory that said the reaction he was overseeing should produce element 118. It turns out that for such a discovery to be accepted it must be reproduced elsewhere. When laboratories in France, Germany and Japan tried and failed to get Ninov's result, an investigation ensued that ultimately found Ninov guilty of misconduct. Ninov had turned my third criterion, the reproducibility factor, on its head. He expected his discovery to be reproduced, and he came to grief when it wasn't.

When I give talks on the subject of scientific fraud I'm always asked whether Cold Fusion was an example. Cold Fusion was the "discovery" in the 1980's by three Utah scientists that nuclear reactions could be induced to take place by electrolyzing heavy water using electrodes of platinum and palladium. Many things went wrong in the course of that episode, but fraud was not one of them. Both sides were guilty of ignoring fundamental canons of good science, the pro-side ignoring contrary experiments and the con side being convinced by theoretical arguments. Most of the scientific community has concluded that cold fusion isn't possible, but in my view, the final verdict is not yet in.

Scientific fraud does sometimes occur, and when it does it threatens to tarnish the reputations of all scientists. For that reason we must be vigilant to stamp it out, but we also must not overreact. As the cases of Millikan, Baltimore and Gallo show, fraud is not always present when its existence is suspected. Scientific fraud is thought to be rare, and we must do everything we can to keep it that way.

David Goodstein is the Frank J. Gilloon Distinguished Teaching and Service Professor Emeritus at Caltech. His new book, On Fact and Fraud: Cautionary tales from the front lines of science *is now available.*

PHYSTEC continued from page 1

also considered applicants' ability to address recognized demographic and geographic shortages of qualified physics teachers. "We are excited that two of our new sites—Chicago State and Cal State-Long Beach—serve large minority populations that traditionally have not had access to a high-quality physics education," says Hodapp. "Very few under-represented minorities become physics teachers, and this lack of role models in physics is a significant contributing factor to the low number of physics degrees awarded to under-represented minorities in the US."

Mel Sabella, project leader at Chicago State University (CSU) echoes this sentiment. "Chicago State is a minority-serving institution, and PhysTEC will allow us to support Chicago Public Schools in increasing the diversity of its physics teacher workforce. Students at CSU have a strong desire to positively impact the community from which they come, and we believe pursuing a teaching career in a high needs area is one of the best ways to do so."

The new PhysTEC sites will also benefit from existing large-scale efforts to prepare more science and math teachers, according to project leaders. The chancellor of the University System of Maryland, of which Towson is a part, has called for the system to triple the number of science and math teachers it graduates; UC Davis is part of the state-wide CalTeach effort to prepare more science and math teachers; and Middle Tennessee State University (MTSU) recently became a replication site of the UTeach program that began at the University of Texas at Austin.

"The state of Tennessee graduates fewer than 5 teachers with physics degrees each year, and our university, with the help of PhysTEC, is well positioned to significantly increase the number of qualified physics teachers," says Ron Henderson, project leader at MTSU. "The Physics Department shares our president's ambition of becoming the institution graduating the most secondary science, technology, engineering, and mathematics (STEM) teachers in the state."

PhysTEC is now funded by a five-year, $6.5-million grant awarded by the National Science Foundation in Fall 2009, as well as APS's 21st Century Campaign.