APS NEWS

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

November 2006
Volume 15, No. 10
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APS Task Force Recommends Ways to Better Serve Industrial Members

The APS can and should do more to serve the needs of its industrial members, according to a task force on industrial physics that submitted its report to the Executive Board in September.

The task force was formed to assess the situation of APS activities for industrial physicists and make recommendations of how APS can better serve this segment of the membership.

About 20% of regular APS members are industrial physicists. Over the past 20 years, this proportion has been falling, even as the percentage of physics PhDs employed by industry has been increasing. In the 1990s, 56% of physics PhDs worked in industry, up from 36% in the 1950s.

"At a time when the importance of physics to the nation is increasingly felt via its contributions to economic growth and prosperity, the role of the physicists who make these contributions in the APS has declined to the point of being almost invisible in the major APS activities," the report says in its introduction.

Nowadays, many industrial physicists work in small companies, rather than the giant basic research labs of the past, such as Bell Labs, GE, IBM, Dupont, and Xerox. Today's industrial physicists work on projects that are more applied, closer to project development. There are still physicists in large firms, but the nature of their work has changed, said task force chair Charles Duke. "The global economy has changed the game. Industrial physics is a whole lot more important," said Duke. Increasingly, support of physics research and development is motivated primarily by economic impact. "In the era of the global economy, if physics as a profession wants more investment, it has to deliver economic prosperity, and the people who do that are industrial physicists. Industrial physics is very important for the health of physics in general, and physics societies," said Duke.

"It's a very different world," said APS Executive Officer Judy Franz. It is important for APS to

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APS Interviews Apker Finalists

The APS Apker Award is given annually for outstanding research by an undergraduate. Finalists are chosen in two categories: from institutions that award PhD degrees, and from institutions not awarding the PhD. The finalists meet with the selection committee for a day of interviews, which this year took place on September 11 at SLAC. The committee then recommends recipients in each of the two categories to the APS Executive Board.

Photo Credit: Diana Rogers, SLAC

Shown here are six of the seven finalists. They are (l to r): Hugh Churchill (Oberlin), Matthew Pellicione (RPI), Inna Vishik (Stanford), Benjamin Heidenreich (Amherst), Huanqian Loh (MIT), and Timothy Cronin (Swarthmore). The seventh finalist, Stephanie Moyerman of Harvey Mudd, was in Europe on a fellowship, and was prevented from returning to the US by the conditions of the grant. The committee conducted her interview via teleconference from London. The recipients of the 2006 Apker Award will be reported in the next issue of *APS News*.

April Plenary Speakers Set

As *APS News* goes to press, eight of the nine plenary lectures at the APS April meeting in Jacksonville, April 14-17, 2007, have been confirmed.The slate features many distinguished speakers on a broad range of topics. They are:

Steven Chu, LBL, "The Energy Problem: What Can Physicists Do?"

Francis Everitt, Stanford, "First Results from Gravity Probe B"

Gerald Gabrielse, Harvard, "New Measurement of the Electron Magnetic Moment and the Fine Structure Constant"

James E. Hansen, NASA, "The Threat to the Planet: Actions Needed to Avert Dangerous Climate Change"

Jacqueline Hewitt, MIT, "The 21cm Background: A Probe of Reionization and the Dark Ages"

Shamit Kachru, Stanford, "String Theory, Branes, and, if you wish, the Anthropic Principle"

David Spergel, Princeton, "Cosmology After WMAP"

Steven Vigdor, Indiana,"New Results from RHIC on the Spin Structure of the Proton"

Meeting attendees will be able to register online at http://www.aps.org/meet/APR07/ starting in early November.

Fellowship Nominations Go Electronic

Starting this year, any APS member wishing to nominate a colleague for Fellowship will do so using the web. The previous system of downloading, filling out and mailing in a paper form has been discontinued. The web-based form allows the sponsor to enter all the candidate's information, to upload support letters, and to designate a co-sponsor (Fellowship nominations require two APS members as sponsors).

Because Fellowship nominations are active for two years, the 2007 process will be a hybrid one, in which the nominations submitted before the 2006 deadlines will still be in paper, while the nominations that arrive after the 2006 deadline will do so electronically. By the time of the 2008 deadlines, however, all the paper should have been flushed out of the system.

As the system has worked up to now, sponsors had to mail in their nominations, which were then logged into the system manually. Multiple copies of each nomination had to be made, and then packages of nominations had to be sent to the relevant units' Fellowship committees. With about 400 nominations received each year, a large expenditure of time and money has been involved.

The web-based nomination system is available at URL http://fellowship.aps.org. Since only APS members can sponsor Fellowship nominations, access to the form requires an APS userID and password, to which every member is entitled. Those who have already set up their userID and password but may have forgotten them, can call or email Shelly Johnston at 301-209-3268, johnston@aps.org . Sponsors without passwords can obtain them from a link located on the Fellowship log-in page.

"We have tried to eliminate all the bugs," says Alan Chodos, APS Associate Executive Officer, "but undoubtedly some will remain. We hope our members will be understanding as we work to fix any residual problems." Sponsors who have trouble in submitting their nominations should contact Shelly Johnston as above.

New Website Targets a Broader Audience

The address will be the same, but the look and feel will be very different. This month APS unveils its new and improved website at www.aps.org.

While most of the current content will still be available on the new site, it is intended to be better organized, more attractive, easier to navigate, and more useful to a wider audience.

This is the first major redesign since the APS site was launched in 1995. In 2005, the APS Executive Board decided to update the site, in order to better highlight APS programs and services, especially those for groups other than APS members, including policy makers, students and educators, librarians, and the public ("physics enthusiasts").

The new website will emphasize the programs and resources APS offers for these groups, while still catering to the needs of the primary audience, APS members. The new site will also highlight other APS websites, including the APS journals, PhysicsCentral, and *Physical Review Focus*. "This will raise awareness of the whole family of APS websites," said webmaster Sara Conners.

Content is organized to make things easier to find. The site has been designed with "user-centered principles," said Conners.

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Photo credit: Sara Conners

APS web content coordinator Kelly Osborn contemplates all the hard work by many people that made possible the transition from the old APS web site (left screen) to the new (right screen). After the launch of the new site, she will work with APS IT staff to keep it running, to update the content, and to implement improvements as needed.

Mather, Smoot Share 2006 Nobel Prize in Physics

APS fellow John C. Mather (NASA Goddard Space Flight Center) shared the 2006 Nobel Prize in physics with George Smoot (Lawrence Berkeley National Laboratory) for "their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation." Mather and Smoot will split a 10M Swedish Kroner (~$1.4M) prize.

The Nobel Prize Committee cited the physicists for their work on the Cosmic Background Explorer (COBE) project. This orbiting spacecraft was the first to detect faint temperature variations in the cosmic microwave background (CMB) radiation–the faint microwave signals from space that are remnants of the Big Bang. The CMB was first observed experimentally in the 1960s by Arno Penzias and Robert Wilson at Bell Labs, for which they later received the Nobel Prize.

Prior to the COBE map of the universe, it was unclear why the universe contained stars and galaxies rather than an evenly distributed dust cloud. Theorists had predicted that a sensitive measurement of microwaves from the sky would reveal minute temperature fluctuations, which represent variations in the density of matter in the early universe. It was

John C. Mather

George Smoot

MATHER, SMOOT continued on page 5

Members in the Media

"The only way for someone to kill string theory will be to come up with a better one."

***Sean Carroll**, Caltech, USA Today, September 18, 2006*

"An object at rest tends to remain at rest–that does apply to the Redskins."

***James Trefil**, George Mason University, on the Washington Redskins' losing record. The Washington Times, September 19, 2006*

"Photonics has been a low-volume cottage industry. Everything will change and laser communications will be everywhere, including fiber to the home."

***John E. Bowers**, UCSB, on an announcement of silicon-based chips that can produce laser beams, The New York Times, September 17, 2006*

"In proteins, the three-dimensional structure is very important to the function, and this is just one example."

***Peter Virnau** , MIT, on discovering the most complicated knot ever seen in a protein, United Press International, September 20, 2006*

"Generally, inflation would predict a spherical universe."

***Gary Hinshaw**, NASA, on some research suggesting the universe is an ellipsoid, Los Angeles Times, September 30, 2006.*

"Everyone knows what an icicle is and what it looks like, so this research is very accessible. I think it is amazing that science and math can explain something like this so well. It really highlights the beauty of nature."

***Martin B. Short**, University of Arizona, on the shape of icicles, UPI, September 21, 2006*

"You're more likely to study snow when you don't have a shovel in your hand."

***Kenneth Libbrecht**, Caltech, on the physics of snowflakes, Associated Press, October 2, 2006*

"Musicians say a violin is a'little opened up.' That is so vague."

***George Bissinger**, East Carolina University, on trying to develop a vocabulary for violins that researchers, violin makers and musicians can share. The Charlotte Observer, October 2, 2006*

"The public assumes, 'Well, maybe it's not true.' In fact, the spread is between bad and very, very bad."

***Steven Chu**, Lawrence Berkeley National Lab, on the public perception of climate change, San Jose Mercury News, September 19, 2006*

"These are the equations of our lives."

***Wendy Zhang**, University of Chicago, on the equations that govern the physics of fluids, UPI, October 9, 2006*

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NRC Releases AMO Physics Report

The National Research Council (NRC) has released a new report that charts the important contributions which atomic, molecular, and optical (AMO) science research has made, the promise that future research offers, and how the federal government can most effectively support these advances. While the report–entitled *Controlling the Quantum World*–focuses on these fields, it provides recommendations and cautions that can be applied to many other types of basic research.

This 224-page document is one of a series of reports in a decadal survey that NRC committees will issue on various fields in physics. A report on elementary particle physics was released this spring. (See *APS News*, June 2006.) The 17-member Committee that prepared the AMO report was co-chaired by Philip H. Bucksbaum and Robert A. Eisenstein.

The National Science Foundation and the Department of Energy sponsored the study. A pre-publication draft of this report, available at http://www.nap.edu/catalog/11705.html reviews how fundamental physics research in these fields has contributed to improvements in the quality of life, national security, homeland defense, economic competitiveness, health, environment, and education, among others.

The committee gives generally high marks to the support of the federal government for research

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This Month in Physics History

November, 1783: Intrepid physicist first to fly

On November 21, 1783, physicist Jean Francois Pilatre de Rozier, along with the Marquis d'Arlandes, became the first humans to fly. Their flight, in a hot air balloon designed by brothers Joseph and Etienne Montgolfier, was witnessed by thousands in Paris, including the royal family and Benjamin Franklin, and soon inspired a ballooning craze.

Pilatre de Rozier was born in Metz, France, in 1754. He later became a physics and chemistry professor in Reims and a member of the French Academy of Sciences.

The brothers Montgolfier came from a large family in Annonay, France that been successful in the paper making business for generations. Working in the paper mill, the brothers noticed that smoke tended to rise, and that it could lift pieces of paper. The brothers made several unsuccessful balloon experiments indoors first. They filled a paper bag with steam, which just made the bag soggy. The brothers had heard of Henry Cavendish's work showing that hydrogen was much lighter than air, and were eager to put that knowledge to use to lift objects into the air, but they couldn't devise a way to contain the hydrogen.

Their first successful balloon was a bag made of paper and linen, open at the bottom. A fire held at the bottom heated the air in the bag. The heated air inside the bag expanded, making it less dense than the surrounding air, causing the bag to rise.

The Montgolfier brothers didn't quite understand the physics involved– they believed thick smoke was the key to keeping the bag aloft, so they burned things like straw, wool, and even old shoes to produce the densest possible smoke. Not recognizing that the heat had made the bag rise, the brothers also seem to have believed at the time that they had produced a new, previously undiscovered gas that was lighter than air.

But even with their poor understanding, through trial and error they were able to produce a working balloon. After making several small-scale tests, they were ready for the first public demonstration. The ten-meter diameter balloon was exhibited on June 4, 1783. Tethered to the ground, and carrying no passengers, the balloon rose high above the marketplace at Annonay.

Sparked by their success, but too cautious to fly themselves, the Montgolfier brothers planned another demonstration, this time with a sheep, a duck, and a rooster as passengers. The flight, on September 19, 1783 in Versailles, was watched by king Louis XVI and Marie Antoinette, as well as a large crowd of fascinated Parisians. The farm animals flew about 2 miles, and returned to the ground unharmed after about 8 minutes. Though the king didn't care for the stench of all the smoke, the flight was a success.

On November 21, 1783, the balloon was ready for the first human passengers. Although King Louis XVI said he wanted to send prisoners on this potentially dangerous experiment, physicist Pilatre de Rozier volunteered for the honor of being the first to fly in an untethered hot air balloon.

He and the Marquis d'Arlandes, who bravely agreed to accompany him, lifted off from the center of Paris, rose to a height of about 3000 feet, and drifted for about 25 minutes before landing in the outskirts of the city, about five miles from where they began.

These early balloon flights were witnessed by Benjamin Franklin, who was in Paris at the time as ambassador to France. Franklin, intrigued by the idea of flight, predicted that hot air balloons would soon be used in the military for spying. Franklin died before being able to take a balloon ride himself.

In order to keep a hot air balloon from falling out of the sky, the air had to stay hot, but that required a fire lit beneath the balloon, which meant a heavy supply of fuel had to be carried along, and had the further disadvantage that the fire tended to send up sparks that could set the balloon on fire.

Another physicist, Jacques Alexandre Cesar Charles, solved that problem by making the first hydrogen balloon. Unlike the Montgolfier brothers, Charles was able to contain the hydrogen, using rubber-coated silk. Not long after the Montgolfier's first public demonstration, Charles successfully launched his unmanned hydrogen balloon from Paris. It flew about 15 miles, and landed in a village outside Paris, where it was attacked by frightened peasants.

Jean Francois Pilatre de Rozier also designed his own balloons, which used a combination of hot air and hydrogen. On June 15, 1785, he became the first to die in an air crash when his balloon exploded as he was trying to cross the English Channel.

Despite early accidents such as this one, ballooning became a popular recreation, and these early flights inspired aviators to design more practical types of flying vessels, eventually leading to modern airplanes. Though not very useful for travel since they are slow and difficult to steer, balloons are still often used in atmospheric, meteorological, and astrophysical research.

APS NEWS

Series II, Vol. 15, No.10
November 2006

Coden: ANWSEN ISSN: 1058-8132

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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.

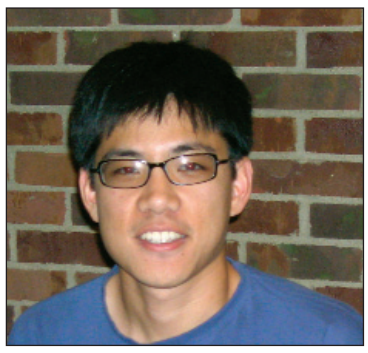
For Nonmembers–Circulation and Fulfillment Division, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent 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.

Mass Media Fellows Reflect on Summer Science Writing Experience

Ed. Note: *Each year APS sponsors two mass media fellows as part of a program run by the AAAS. Typically graduate students in physics or a related field, they spend eight weeks working for a mass media outlet, learning how to communicate science to the public. APS mass media fellow Marcus Woo spent his summer at WOSU-AM in Columbus Ohio, while Rachel Courtland spent the summer at US News and World Report in Washington D.C.* APS News *asked them to tell our readers a bit about their experiences.*

Bitten by the Science Bug

By Marcus Woo



Marcus Woo

It was a humble set-up, just off the side of the road, amidst brush and trees at the edge of a forested area. I swatted at mosquitoes flying in the hot and humid air. Plastic yellow trays filled with clear liquid littered the ground, and a small mesh tent sat unassumingly beside a tall bush. The tent and the yellow trays, which weren't more than shallow disposable bowls, were wasp traps.

I was accompanying the curator for the Ohio State University insect collection on his daily task of checking the wasp traps. This past summer, I was in Columbus, Ohio, as an AAAS Mass Media Fellow, sponsored by APS. I was working at National Public Radio affiliate WOSU-AM, and was wandering the halls of OSU while waiting to do an interview with a scientist for a story. After walking into the insect collection, the curator came up and talked to me. I soon found out he was part of a project to collect wasps from around the world, and that he was going to go collecting later that afternoon at a local site across the street. Curious as to how wasps were collected, and being on the look-out for another story idea, I said I'd go with him as soon as my other interview was finished.

Wasp collecting is simple enough. Scientists first fill yellow trays with water and dishwashing detergent. Wasps are drawn to the yellow color, and the detergent allows the surface tension of the water to break when a wasp lands, spelling doom for the unsuspecting insect. The mesh tent channels wasps up into a bottle of ethanol, where, unfortunately for them, they become part of what the scientists call "bug soup." They collect the wasps in plastic bags and store them in freezers back in the lab, where undergraduates and graduate students have the tedious task of documenting and mounting them.

At first glance, this seems to be relatively modest science. No one's trying to cure cancer or to solve the dark matter problem. They're just a handful of scientists who have devoted their careers to learning about a specific type of bug. But this basic research reminded me that science, at its purest, is nothing but a simple quest to understand Nature and all its tiny parts. Science is a grand story, a story about learning and exploring, concepts and abstractions, exotic particles and complex molecules. The road-side wasp traps are an example of how science doesn't just inhabit million-dollar laboratories or eccentric minds, but that it lives anywhere and everywhere, as tangible and real as a wasp sting. Like the way an elegant equation encapsulates a theory of physics, the simple story of collecting wasps by the road-side captures the grand tale of science.

Perhaps more so than print media, radio is all about storytelling. Some of my early inspiration to study physics was the stories of scientists, of the idiosyncratic Richard Feynman, and how characters like Albert Einstein, Sir Arthur Eddington, and Subrahmanyan Chandrasekhar developed the fantastic ideas behind black holes. At WOSU, my stories were of course much shorter and simpler, but I was able to call them my own. I was given the opportunity to find a story idea, report on it by conducting interviews, write it, and then produce it, combining my own voice with sound-bites and natural sounds to illustrate the story. I learned about and covered many topics, from earthquakes and bird songs to algal blooms and astronomy. And hearing yourself for the first time on your own clock radio is pretty strange, to say the least.

From this brief but rewarding summer experience, I learned a little bit about the importance and necessity of journalism. I didn't have any prior journalism experience, and ignorance would've made it easy to dismiss journalists as sensationalist, superficial, or unscrupulous, willing to do anything for an exclusive scoop. Sometimes, this may be true. But from doing a story on global warming I realized that, at their best, journalists occupy an essential place in society, as vanguards of information, with power to influence opinions, actions, and the way society progresses–or regresses. With the ever-growing impact of complex scientific ideas like global warming on people's lives, the way science communicators tell the story of science becomes increasingly important.

This fellowship corroborated my growing belief that stories are fundamental, that we are all protagonists in our own life stories, that our histories, our futures, and the way we understand the world and universe are all like cosmic strings, weaving an epic tapestry that is the human condition. Science–our pursuit to understand Nature–is a story that's an integral part of this epic. While some science stories are more complicated than others, with more subplots and characters, involving genomes and quarks, in their barest of forms they all take the shape of a simple story about a guy collecting wasps by the road.

Here's To My Health

By Rachel Courtland

Rachel Courtland

From my time in the laboratory, I know that you shouldn't drink coffee around the chemical hood. I also know that exercise is good, cigarettes are bad, nutrition is important, and hand-washing can head off a lot of trouble. But that's pretty much the extent of my health knowledge. When I tell people I studied physics, I pretty much mean studied only physics. Got a basic question about solid-state physics, cosmology, electromagnetism, mechanics, statistical mechanics, astrophysics, or optics? I'm your gal. Just don't ask me anything about biology.

I had this horrifying realization when I found out that APS was sponsoring my internship at the health and medicine desk at U.S. News and World Report in Washington, D.C. In the end, though, I found that my ignorance was an asset.

My lack of knowledge about the field meant I couldn't and thus didn't spend an inordinate amount of time going over every research paper. My physics training helped me quickly assess papers; even if the terms were foreign, the basic statistics and methodology were easy to evaluate. After going over background material, I got to the heart of reporting: interviews.

I was a little self-conscious at first, but spending the day on the phone with experts quickly became the most exhilarating part of the internship. One day, I'd be chatting about seasonal affective disorder and the FDA's drug approval process. The next, I was talking about raw oyster harvesting in the Pacific Northwest. I wrote about how researchers now think that humidity doesn't help the croup and about the ongoing efforts to find a way to prevent asthma, which often reduces lung function at an extraordinarily young age. Sometimes tracking down information was tricky. I once spent an entire afternoon trying to confirm the cost of a routine test.

For the most part, all the doctors and officials I spoke with were helpful, patient, and gracious. Even the pharmaceutical representative I called during dinnertime, on his cell phone, while he was away at a conference in Florida, took the time to answer all my questions, even my obnoxious, tough-guy ones.

My physics background also proved handy in the problem-solving aspects of writing process: finding the story, rearranging ideas, and eliminating clutter.

I've suspected for a while that science journalism would be a good career for me, but until I started work at U.S. News, I had no idea what it would be like. When I left graduate school with a masters, I thought I would work in science policy as a liaison between researchers and the government. But in the middle of a fellowship at the National Academy of Sciences, knee-deep in report writing, I found policy itself less interesting than the harrowing process of getting complex ideas out of my head and onto paper. In the future, I hope to write about a wider range of science topics, especially physics. I have APS to thank for getting me started on this path.

A Fond Farewell

Photo Credit: Ken Cole

On September 13, APS hosted a reception on Capitol Hill in honor of the retiring Chairman of the House Science Committee, Sherwood Boehlert (R-NY). The event was attended by several members of Congress, Congressional staff, members of the Administration, and numerous representatives of the Washington science policy community. In the picture, APS President John Hopfield (right) expresses his appreciation to Boehlert for years of staunch support for science. As a memento of the occasion, Hopfield presented Boehlert with a special doorstop edition of "The Physical Review: the First Hundred Years" (visible under Boehlert's left arm).

NAS Study Finds Barriers Remain for Women Physicists

A National Academy of Sciences (NAS) study analyzing the barriers to hiring and promotion experienced by women in academia concluded that women in science and engineering are hindered by bias and "outmoded institutional structures" in academia. Entitled *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, the NAS panel report called for a broad national effort to eliminate gender bias in universities in order to maximize the potential of women scientists and engineers in academia. While women now account for one-fifth of America's scientific and technical workforce–compared to only 3% some 40 years ago, those gains are not reflected in their representation on university and college faculty.

Among the more notable findings, the NAS panel dismissed the notion that the relative dearth of women in the upper ranks of science could be attributed to "innate" intellectual deficiencies. The report cited numerous studies that have found no significant biological differences between men and women in math and science that could account for their lower representation on faculties and in leadership positions.

The panel also found that women faculty are generally paid less and promoted more slowly than their male peers. Furthermore, such discrepancies don't appear to be based on productivity, the significance of their work, or other performance measures. Rather, it seems to stem from more arbitrary criteria, such as "assertiveness"–a trait which may be viewed as unacceptable in women, but desirable in men.

Nearly two dozen recommendations are cited in the report to address these issues. For instance, university administrators should

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"We felt like if we could perfect that bomb and stop that war, then we were doing a good thing. We were saving lives."

Daniel Gillespie*, on his work on the bomb in 1944, The New York Times, October 6, 2006*

"You'd have to be a lot more advanced to get a small yield on purpose than to get a small yield by accident. There's no reason to believe they were that brilliant."

Anthony Fainberg*, on North Korea's nuclear weapons test, Philadelphia Inquirer, October 11, 2006*

"It's vindication for an awful lot of people's faith in us."

John Mather*, NASA, on winning the Nobel Prize, Associated Press, October 3, 2006.*

NAS STUDY continued from page 3

require departments to demonstrate evidence of having conducted fair and broad talent searches before approving appointments. Institutions should consider forming a collaborative, self-monitoring body to recommend standards for recruitment, retention and promotion of faculty, capable of collecting data and tracking compliance across institutions. Ultimately, the kind of broad, sweeping cultural change in academia envisioned by the NAS panel must start at the top with trustees, university presidents and provosts.

In short, "Women are capable of contributing more to the nation's science and engineering research enterprise, but bias and outmoded practices governing academic success impede their progress almost every step of the way," said Donna Shalala, president of the University of Miami, who chaired the committee that produced the report. "Fundamental changes in the culture and opportunities at America's research universities are urgently needed. Unless a deeper talent pool is tapped, it will be difficult for our country to maintain our competitiveness in science and engineering."

These findings come on the heels of a 2005 international survey that found that most women physicists would choose a physics career all over again (*APS News*, August/September 2006). Yet at the same time, many had concerns about family and child-rearing responsibilities and feelings of isolation from colleagues, as well as concerns about funding, equipment and lab space. That survey was conducted by the Statistical Research Center of the American Institute of Physics (AIP), in conjunction with the 2005 Second International Conference of Women in Physics.

The AIP report is available online at http://www.aip.org/statistics/trends/gendertrends.html. The NAS report is available online at http://national-academies.org.

Viewpoint...

Back to School: What's the Point of a College Education?

By Janet D. Stemwedel

I have very strong feelings about what the point of a college education should be. First and foremost: a college education is not job training.

I'm not saying you should be unemployable when you graduate. But getting some specific set of facts or skills that prepares you for a particular job in a particular setting is a very narrow kind of education. It's the kind of education that you might be able to get in 18 months or less at a technical institute, or even in your first month on the job. If all you need is a particular "skill set," why slog through 4 (or 5, or 6, or 7, ...) years to get a bachelor's degree? Why go through that huge checklist of General Education courses that have no obvious connection to your intended career? Why, for that matter, complete all those major requirements that have no obvious connection to your intended career? Because everyone's doing it?

If all we gave you was job training, you'd be in a tough spot. Specific jobs can change quite a lot. Software engineers use different programming languages, and deal with different platforms, than they did only a few years ago. Scientists work with new techniques against the background of new discoveries. Teachers have to deal with constantly changing state standards (and the attendant standardized tests) and funding priorities. Chances are the specific job-related facts with which you walk out of here will be obsolete before you've paid off your student loans.

More than that, the economy can change rather drastically. Back when I graduated from college, a degree in computer science was an instant ticket to the good life. Start-ups were falling over each other to snatch up anyone who could write code. Twenty-two year olds were driving fancy cars and eating lunch at swanky restaurants, or playing ping-pong in the office while trying to work out in their heads how much their stock options were worth.

Boom, meet Bust. When the bubble burst, a solid education in computer science was no kind of guarantee that you'd be able to work as a programmer. Or that you'd be able to avoid living on your parents' couch.

A college degree that is just about training for a particular career in a particular field is a gigantic gamble. It leaves you vulnerable to changes large and small. I want a college education to give you something better. What is valuable about a college education is not something a lousy economic cycle can take away.

Back when the dot-com bubble was a-poppin', I was teaching Boethius. (Anucius Manlius Severinus Boethius, c. 480 - c. 526. You were thinking of someone else?)

So, Boethius was this big-time Roman patrician who was Master of the Offices for King Theodoric, until he was accused of treason and magic, tossed in jail, tortured, and killed in a particularly nasty way. Before his execution, he had a lot of time to mope. Indeed, how could he avoid wallowing in just how far he had fallen from having it all? While in prison, Boethius wrote *Consolations of Philosophy*, an imagined dialogue between himself and Lady Philosophy. Here's a synopsis:

***Boethius**: Boy, it really sucks to be me. I had everything and now I have nothing.*

***Lady Philosophy**: Dude, snap out of it. The stuff that really matters is the stuff that even a sudden change of fortune can't take from you.*

A job is nice. So is political power, a fancy chariot, hangers-on. But you can have all these things and still not be happy or fulfilled. And, if your happiness depends on having such things, you're pretty vulnerable to sudden reversals.

So how can a human find fulfillment that isn't all about having lots of stuff, or a high-paying job, or a top-rated sit-com? What do you have that's really yours? What is the piece of your life that no one can take away?

You have your mind. You have the ability to think about things, to experience the world, to decide what matters to you and how you want to pursue it. You have your sense of curiosity and wonder when you encounter something new and unexpected, and your sense of satisfaction when you figure something out. You have the power to imagine ways the world could be different. You even have the ability (the responsibility?) to try to make the world different.

This is what I think a college education should give you: lots of hands-on experience using your mind so you know different ways you can think about things and you start to figure out what you care about.

Yes, you may encounter a lot of facts in your college education, but the real value of those facts is that they give you experience thinking about them in different ways. What you come away with is the ability to think about different facts out there in the "real world." You get the ability to use the facts you encounter to draw your own conclusions rather than having to take someone else's word for it. (The thing about those other people who will just tell you what you should think? Sometimes they lie.)

Thinking is hard. It requires a lot more effort than floating through the world on auto-pilot. But once you get started, it's more addictive than potato chips. Thinking is fun. Even a little slice of a life of the mind (maybe reading a novel on the bus every morning) can counteract a fair bit of drudgery (like the job you're riding that bus to get to). The joe-job is sometimes unavoidable; you've got to eat. But nourishing your mind gives you something better than just biological existence.

A college education can do an awful lot to help you survive the job market. People who are good at thinking and who like to learn can be very adaptable in a changing economy. But a really good college education prepares you for life. It helps give you the mental tools to live a life that matters to *you*.

Janet D. Stemwedel is an assistant professor of philosophy at San Jose State University. She writes a blog called Adventures in Ethics and Science (http://scienceblogs.com/ethicsandscience). Before becoming a philosopher, she earned a Ph.D. in physical chemistry.

INSIDE THE BELTWAY: WASHINGTON ANALYSIS AND OPINION

Innovation and Competitiveness: the People's Business

By Michael S. Lubell, APS Director of Public Affairs

If Congress fails to fully fund the American Competitiveness Initiative before leaving town for good later this month, partisan bickering will not be the reason.

The need to address innovation and competitiveness has been one of the few issues on which Democrats and Republicans have been able to agree. And remarkably, they have come to consensus on just what kind of federal R&D spending is necessary to keep the nation's high-tech economy humming–for the new fiscal year, a 14.1 percent increase for the Department of Energy's Office of Science, a 7.8 percent increase for the National Science Foundation and an 18 percent increase (once earmarks are taken into consideration) for the core programs of the National Institute of Standards and Technology.

Even more remarkably, those are the very funding levels the White House has endorsed. So getting the budgets passed for these agencies should be a piece of cake, right? Wrong! Not for the 109th Congress.

Remember 1948? That year, Democrat Harry S. Truman scored what historians regard as the greatest upset in presidential campaign history. He did it by ignoring his Republican opponent, New York Governor Thomas E. Dewey, and running, instead, against what he called the Do-Nothing Congress. But if the 80th Congress did nothing, the 109th Congress, according to Hill analysts, has done even less the last two years–if that is mathematically possible.

Except for the two spending bills covering Defense and Homeland Security, all other appropriations bills failed to make it to the Senate floor before October 1, the start of the new fiscal year. The upper chamber did little else, except for endless debates and a few pieces of legislation on highly-partisan wedge issues such as voter identification cards, sex education, gun control and border fences. On September 29 the Senate decided to call a halt to the dysfunctional agony. About all it could do was muster the votes needed to pass a Continuing Resolution that would keep the federal government running until November 17.

It's no wonder that in the latest polls two thirds of the public gives Congress a grade of F for performance. How that judgment will translate into Election-Day voting is not yet clear, but well regarded analysts, such as Charlie Cook and Thomas Mann, and polling organizations, such as the Rasmussen Reports and Zogby International, say the odds are better than even that the Democrats will take over at least one house.

That may or may not be good for the country, depending upon your perspective. But for the American Competitiveness Initiative (ACI), it could spell trouble. Here's why.

If the Republicans were to retain control of both the House and the Senate, they would likely pass the remaining appropriations bills in the one week the leadership has said it will keep Congress in town before adjourning sine die. They would probably do this by wrapping several of the existing bills together in minibuses or lump them all into one giant omnibus piece of legislation comprising thousands of pages that members will have no time to read before voting yea or nay. In this scenario, it is likely that ACI would receive virtually full funding.

But if the Democrats wrest control of both houses, they would have a great incentive to tie up the Senate, forcing a Continuing Resolution until February when the 110th Congress would convene under their control. If Democrats succeed in winning only one house, a year-long Continuing Resolution looms as a possibility.

Continuing Resolutions in the past have generally kept spending at the lowest of three levels–the previous year's spending, the appropriations passed by the House or the appropriations passed by the Senate. With ACI carrying big increases for Fiscal Year 2007, such a path forward would put science on hold for another year.

Of course the public could send their elected representatives a clear message when the pollsters call. Bury the partisan hatchets and begin doing the people's business, as members of Congress are fond of calling their work. Let's hope they do.

Letters

Beltway Columns Feature Superficial Analysis

How much longer do you need to fill page space with Michael Lubell's rants? ("Inside the Beltway," *APS News*, August/September 2006.) The APS members deserve to get some insightful and original thought about Washington political events. What we get in Lubell's column, instead, are sophomoric opinions.

For example, in his latest "analysis" he muses that "it's hard to see why the Middle East should be such a focus of American foreign policy–except for our extraordinary dependence on foreign sources of oil." I guess Lubell hasn't noticed that the Middle East is also a high foreign policy concern of the entire industrial world, due to the dependence of Europe, Japan, and China on foreign sources of oil (actually, Lubell obliquely mentions this two paragraphs later). But beyond that, the Middle East is roiling with an Islamic fundamentalist movement. I should hope we focus on that.

Is this the best "Washington Analysis and Opinion" that the APS can find to inform its critical and highly educated members? If APS can't do better than this, then it shouldn't do a political column at all.

Thomas J. Karr
Baltimore, Maryland

AIP Survey Finds Increase in Physics Degrees

The number of bachelor's degrees in physics continues to increase, and PhD production is expected to increase in the next few years as well, according to a recent report by the AIP Statistical Research Center.

The 2004 Enrollments and Degrees Report reports the results of a survey sent to all 767 US physics departments in the fall of 2004.

Among other findings, the survey found that increasing numbers of undergraduates are taking an introductory physics course; about 362,000 students took an introductory class in 2004.

In 2004, US physics departments awarded 4965 bachelor's degrees, a 36% increase over the low in 1999.

In fact, there had been steady declines in the 1990's, but now undergraduate degree production has risen sharply for the fifth year in a row, the report states. Physics bachelor's degrees account for less than 0.4% of the bachelor's degrees awarded in the US. Foreign citizens make up only about 6% of bachelors recipients.

About one-third of new bachelor's degree recipients immediately enroll in graduate school in physics or astronomy, and an additional fifth immediately enroll in graduate school in some other field, mostly engineering. The rest enter the workforce.

The number of US citizens enrolling as first year graduate students increased slightly from 2003 to 2004, and is up by 50% from the low in 1998. However, the number of foreign citizens enrolling as first year graduate students fell by 11% from 2003 to 2004. The total number of first year graduate students in the fall of 2004 was 3040, a decrease of 4% from the previous year.

Some foreign students who expected to enroll in a graduate program were delayed by visa problems. Previous surveys found that in 2002 about 20% of foreign students were at least initially prevented from attending their intended graduate program. By 2004, only 12% were delayed or prevented from attending.

Foreign students made up about 43% of the first year students at US physics departments in 2004. This is the lowest percentage since the early 1990's. According to the report, this is attributable more to changes in US citizen enrollment

AIP SURVEY continued on page 7

MATHER, SMOOT continued from page 1

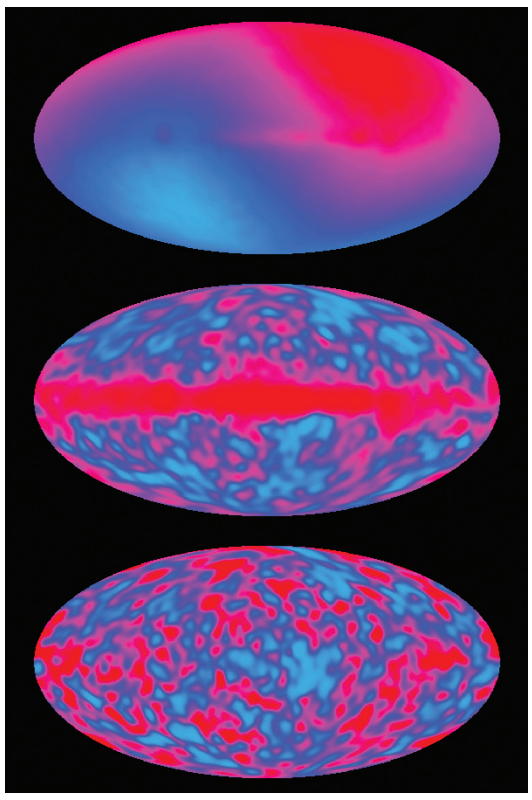
proposed that denser portions served as seeds for galaxies that formed later.

COBE was the first experiment sensitive enough to confirm the predicted temperature variations encoded in the map of the microwave background. COBE found variations at the level of parts per hundred thousand against an overall average temperature of 2.7 K. COBE was also the first to provide a very precise average temperature of the universe: 2.726 K.

It was not an easy experiment to perform. The faint variations in the CMB temperature had to be measured against a foreground cloud of microwave radiation coming from our solar system, our galaxy and other celestial objects. Furthermore, the motion of Earth around the sun, the sun around the Milky Way, and the Milky Way within our local cluster of galaxies also had to be taken into account.

Mather and Smoot, together with other members of the COBE project collaboration, first announced the discovery. The 1992 APS April meeting in Washington, DC. (See the 1992 press release announcing the COBE mapping breakthrough at www.aip.org/pnu/1992/split/pnu077-1.htm)

APS Executive Officer Judy Franz was at the APS meeting fourteen years ago."I remember attending the COBE talk in '92," says Franz. "We all knew it was exciting at the time. In recent years, people tended to ask not whether it was worthy of a Nobel Prize, but when the Nobel Committee would get around to presenting them with the award. I'm glad they finally ended the suspense."



Credit: COBE/DMR Science Team.

Different contributions to the Cosmic Microwave Background Radiation based on two years of COBE Observation.

"The COBE project was a very difficult and speculative experiment," APS President John Hopfield added upon learning of the prize. "It was extraordinary to carry out the measurement so well. Mather and Smoot are richly deserving of the Nobel Prize. In these political times I add my fervent hope that our level of investment in US physical science research and education once again becomes adequate, and that American science may still be strong enough to receive such awards twenty years hence."

Since then, other CMB detectors–notably Boomerang and DASI–added more and more detail to the microwave background. The most recent and best microwave measurements have been presented by the WMAP detector, which supplies the best values for important cosmological parameters. These include the age of the universe, the overall curvature of spacetime, and the time when the first atoms formed, as well as the first star.

NRC continued from page 2

in these fields, noting that most of the funding increase has occurred at DOE, NIST, and NSF. These agencies provide most of the funding for AMO science.

"There has been remarkable scientific progress in AMO physics in the past 10 years," said Eisenstein. "Several of the funding agencies have done well in supporting AMO science."

However, the report expresses some concern about the decline in research funding in general and in basic research funding in particular at Department of Defense agencies. "This is troubling especially because fundamental scientific research has been a critical part of the nation's defense strategy for more than half a century," it states.

The committee also called for continued attention and funding for theoretical research. "Given that progress on the experimental side has been phenomenal, this is exactly the time that theoretical science can play an important role," said Eisenstein.

Funding will be of critical importance to addressing six broad "grand challenges" that the committee identified.

The report also notes that there are "very significant added pressures . . . on research group budgets," because of the high cost of instrumentation and the complexity of the science involved.

With regard to workforce challenges, the committee "agrees with many other observers that the number of American students choosing physical sciences as a career is dangerously low. Without remediation, this problem is likely to open up an unacceptable expertise gap between the United States and other countries." It also noted the importance of international collaboration to future advances in these fields.

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

TASK FORCE continued from page 1

retain this segment of its membership, she said. "All those who think of themselves as as physicists are important to the community."

As part of its study, the task force made use of a recent survey of industrial members. The survey found that industrial physicists use physics on the job, but they are less likely to attend APS meetings and publish in APS journals. They are connected to the APS primarily through *Physics Today* and *APS News*. Most (almost 70 percent) belong to some other professional society in addition to APS. According to the survey, many industrial physicists are unaware of the Forum on Industrial and Applied Physics (FIAP) and its activities. "These people feel like they're on the outside," said Duke.

One finding of the survey was that industrial physicists, who do not often attend APS meetings, need improved ways to network. The task force recommended investigating the possibility of facilitating an online network, similar to myspace.com, which would enable networking and interactions among industrial physicists and would contain a list of persons together with their expertise. The task force also recommends improving the on-line search engine for APS meetings, the Bulletin of the American Physical Society (BAPS) to enable more complex searches. An improved search of the archives of APS meeting programs could help industrial physicists to find experts in a certain field of physics who can be consulted about a problem, find students with certain skills for job openings, and restrict the search to a geographic region to allow face-to-face interaction with experts without having to travel.

The Society should also improve recognition for industrial members, the task force says. Industrial members do not receive a proportionate share of APS awards, prizes, and Fellowship, according to the task force. This issue should be addressed and remedied, the task force suggests, and efforts should be made to secure more active participation of its industrial members in APS , especially prize and award committees. More Fellowship slots should be allotted to industrial physicists, and the APS should sponsor a prize for the industrial applications of physics in the biannual years that the American Institute of Physics (AIP) Prize for the Industrial Applications of Physics is not awarded.

Academic physicists publish papers and attend meetings, and are rewarded for those activities. "That culture is not shared by the new industrial physics community," said Duke. "The new industrial physics members have a different value system." They produce products, not knowledge. Industrial physicists are discouraged from attending meetings and publishing papers so that they will not give away trade secrets. Therefore, recognition for industrial members needs to take into account their different value system, the task force says.

Since industrial physicists need access to all the physics literature, not just APS journals, one important finding of the survey was that they need ways to locate information from a variety of sources. Many work as consultants or in small companies and do not have institutional access to the literature.

One currently available resource industrial physicists may find useful is Scitation, a free online search engine for physics literature. Many industrial physicists could use this tool, but may not be aware of it or know how to use it, so the task force recommended APS draw attention to this resource. However, although Scitation offers a way to search for papers, users must still have a subscription to the journal or purchase individual articles in order to access the full text of articles they wish to view.

Expanding and improving APS member article packs could also help industrial members, especially those in small companies that don't have journal subscriptions. Currently APS members can purchase article packs of 20 APS journal articles for $50. Those article packs are limited to articles published in the past three years. The task force suggests that to make those article packs more useful to industrial members, this be expanded to include all online issues of APS journals. They also recommend that those who purchase an article should be allowed to share it with their colleagues as long as no copyright laws are broken.

The task force also recommends creating new categories of membership that would bundle journal article packs with the membership fee. These classes of membership might be attractive to industrial consultants and physicists at small companies.

Because industrial physicists need access to all the physics literature, not just APS journals, the task force recommends APS "work with other AIP member societies to create all-AIP-and- member-society journal packs for individual APS members and to allow AIP and member societies to create similar offerings to small firms as well as individual members." This is an important recommendation, the task force emphasized. "This is what the APS is all about: Disseminating the knowledge of physics to the folks that can use this knowledge to create products and services that serve mankind and generate economic prosperity. This is a high calling for the APS in the 21st century," the task force report says. However, this recommendation will be challenging to implement, and would require coordination with AIP and other member societies.

APS staff and committees will consider and attempt to implement the task force recommendations.

The other members of the task force were Alex Panchula, Stefan Zollner, Mohsen Yeganeh (Exxon Research & Engineering), and Chris Armstrong, (Keithley Instruments). Judy Franz served as APS liaison.

Ninety Years of Optics Innovation Highlight 2006 Laser Science Meeting

Single-pixel digital cameras and new images showing how the brain recovers from stroke were among the highlights at Frontiers in Optics 2006–the 90th Annual Meeting of the Optical Society of America (OSA)–held October 8-12 in Rochester, New York. Co-located with Laser Science XXII, the annual conference of the APS Division of Laser Science, the meeting also celebrated 90 years of innovations in optics.

In a plenary and awards presentation, Nobel Laureate Steven Chu, the director of Lawrence Livermore National Laboratory, provided a scientist's perspective on the global energy problem, with emphasis on climate change, then outlined our current options and some areas of energy research that may lead to society-transforming technologies.

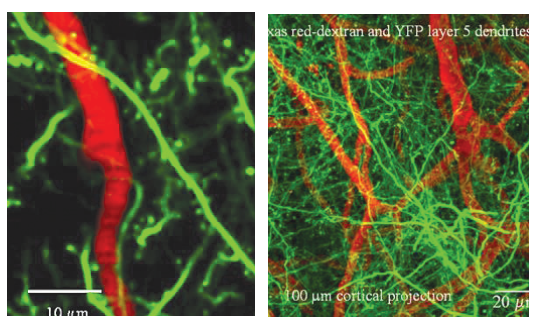
Lee Goldstein of Harvard Medical School described evidence that optical tests can detect the signs of Alzheimer's disease in the eye even before symptoms appear in the brain.

Single-Pixel Digital Cameras. A single-pixel camera, scientists at Rice University believe, could eventually lead to a consumer product that requires less power consumption and storage space without sacrificing image detail. The new approach aims to confront one of the basic dilemmas of digital imaging, namely the huge waste of data in going from a million numbers (the light levels from a picture taken with a megapixel camera) to something like 10,000 numbers, corresponding to the result of a data-reduction transformation that takes place right on the chip inside the camera.

The Rice camera gets rid of the million pixels and views the scene with a single pixel. Instead of looking once at the object using a million pixels, it looks 10,000 times using one pixel. In each of those viewings, however, the light from the object reflects off the myriad surfaces of a digital micromirror device, the same technology used in projection TVs and digital movie projectors.

How the Brain Recovers from Stroke. New study results provide encouraging new information on how the brain can recover after severe strokes if treated early. It is the first published experiment monitoring blood flow and individual brain cells at the same time. Tim Murphy of the University of British Columbia said the result suggests that rapid treatment could offer new hope to human stroke patients.

Murphy and his colleagues watched how the disruption of blood flow affects the structure of microscopic nerve cells (neurons) in the brains of live mice. The researchers studied special mice with brain neurons that contain the YFP protein, which lights up in response to laser light. In addition, the researchers introduced a fluorescent polymer that fails to enter blood cells but gets absorbed by plasma, the liquid portion of blood. When irradiated, the plasma glows and blood cells show up as dark structures on a bright background. This enables the team to look simultaneously at blood flow as well as important nerve-cell structures that can be damaged during a stroke.



On the left a close-up view of spine vessel relationship in mouse brain in vivo. On the right, projection image showing Texas-Red labeled vasculature and green labeled dendrites taken from a transgenic mouse before induction of ischemia in vivo. Note the cerebral vessels coursing through the dendritic arbors.

Murphy's team found that if blood flow is restored within 10 to 60 minutes following even severe stroke conditions, the dendrite and spine structure is mostly restored, demonstrating that the brain's ability to recover from a stroke may be even more remarkable than previously thought. Preliminary measurements suggest that the nerve cells with recovered structure restore their function as well, according to the researchers.

Fiber Optic Stealth Transmissions. Bernard Wu and Evgenii Narimanov of Princeton University presented a method for transmitting secret messages over existing public fiber-optic networks. This technique could immediately allow inexpensive, widespread, and secure transmission of confidential and sensitive data by governments and businesses.

Wu and Narimanov's technique is not the usual form of encryption, in which computer software scrambles a message. Instead, this is a more hardware-oriented form of encryption–it uses the real-world properties of an optical-fiber network to cloak a message. The sender transmits an optical signal that is so faint that it is very hard to detect, let alone decode. The method takes advantage of the fact that real-world fiber optics systems inevitably have low levels of "noise," random jitters in the light waves that transmit information through the network. The new technique hides the secret message in this optical noise.

Shape-Shifting Blood Cells. Responding to various chemical and temperature changes, living cells change their shape and their volume. The outer layers (membranes) of red blood cells, for example, can change by tens of nanometers on time scales of tens of milliseconds. Now an MIT group has figured out a way of studying such tiny, quick fluctuations, and how they are related to the cell's osmotic behavior–that is, to the cell's ongoing effort to maintain a balance in the concentration of ions between itself and its surroundings. It can do this, for instance, by admitting or expelling water. If the osmotic imbalance becomes too great, however, the cells can burst, an action called lysis. Diseased cells are more prone to lysis.

Gabriel Popescu, a researcher in the MIT laser spectroscopy lab of Michael Feld, says that their optical microscopy measurements of the role of osmotic pressure in red blood cell flickering are likely to help in understanding clinical problems such as the effects of the malaria virus on the red blood cell membrane and changes in the mechanical properties of the cells during sickle cell disease.

New Eye Instrumentation. Employing methods from astronomy and physics, researchers presented advances in eye instrumentation that promise to detect eye diseases much earlier. Ann Elsner and Benno Petrig of Indiana University presented a new tool for detecting eye diseases resulting from diabetic retinopathy, a class of retina-related eye diseases that affects 45 percent of those with diabetes and includes diabetes-related cataracts and glaucoma.

Other research groups are using a technique borrowed from astronomy, called adaptive optics (AO), which uses a special mirror whose surface can be deformed to help a telescope remove the effect of atmospheric distortion to obtain clearer images of far-away objects. Over the last five years, researchers have introduced laser-based ophthalmoscopes that use AO technology.

Yuhua Zhang of the University of California, Berkeley presented a new-generation AO scanning laser ophthalmoscope (AOSLO) that uses a micro-electro-mechanical deformable mirror. This miniature, flexible mirror could potentially be mass-produced, thus offering the prospect of a smaller, more cost-effective AO system.

ETS Announces Newly Revised GRE Test

Starting in the fall of 2007, the Educational Testing Service will introduce some changes to the GRE general test.

Physics departments need to be aware of these changes, says Ted Hodapp, APS Director of Education, so they can advise students who may be preparing for this test, and so they understand what the the scores mean when considering applications to their graduate programs. Many faculty members are involved with admissions to their graduate programs, and almost all graduate programs require applicants to take the GRE general and subject tests. The physics subject test will remain unchanged.

In the new general test, both the verbal and quantitative sections will focus more on the skills necessary for success in graduate school. The verbal reasoning section of the new test will place less emphasis on vocabulary and more emphasis on skills related to graduate work, such as complex reasoning. There will be more reading passages. The new quantitative reasoning section will have fewer geometry questions and more

ETS continued on page 7

zero gravity

And the winner is...

Last March *APS News* announced a contest for the best physics crossword puzzle. Our panel of experts took into account both the intrinsic merit of the puzzle and the amount of physics content, and has come up with three prize-winning puzzles. Top prize goes to Gary Hodes of the Weizmann Institute in Israel, whose puzzle is reproduced on this page. The other prize-winning puzzles were submitted by Michael A. Pelizzari and Stephen Irons. All three will receive a copy of the book "Physics in the Twentieth Century." Readers are cautioned that (a) Hodes's puzzle is very hard (it is in the style of a "cryptic crossword"); and (b) the numbering system is unconventional, since in many places numbers are repeated, once for across and once for down. Answers to the puzzle appear with the online version of this issue.

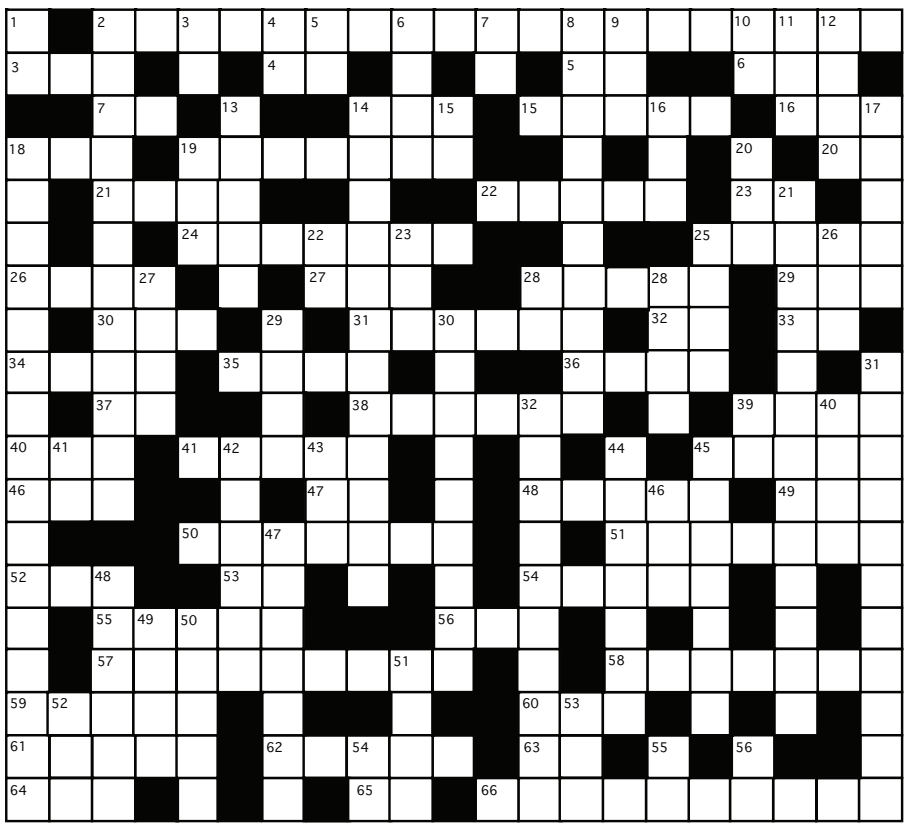
Clues

Across

2 This is an actual difference
3 A useful place to send papers
4 Unidirectional flow
5 Reversed voltage drop
6 What you need for this puzzle
7 Straight from the wall
14 Charges sometimes do this
15 He's on the level
16 This has one in the form of a band
18 A striptease at the atomic level
19 Low temperature resistance unit?
20 An increasingly common referee comment
21 French Canadian research council
22 This word is in the correct position
23 This term becomes less common because of email
24 Flows - at the moment
25 Type of number
26 Rotates
27 Opposite of 23 down
28 Scatter-brained scientist
29 Basic electrical properties
30 Transpond NSF
31 One of the most important compo nents of a Gordon conference
32 Force
33 A chemist's answer for a biological mishap to physicists
34 Will force you to eat
35 Elves might use this technique
36 It's both a solid and a gas.
37 A weighty term
38 You'll find a horse here in equilibrium
39 A Roman lab coat?
40 Only one electron at a time
41 These are positively left behind
45 Philanthropic species
46 A Gaussian system of units for slow people
47 A more international system
48 Has a well-defined internal crystal structure
49 Narrowly fluoresces
50 A particular family
51 A very small unknown object
52 Popular length units
53 Eyes see backwards
54 A certain type of pot does this
55 Violet
56 A unit of 24 across
57 Captain's ruling springs to mind
58 This will mess things up
59 A unit you can't resist
60 This outshines 15 down
61 This guy is still on the up–for the moment
62 Sticky particles
63 392 Hz or some multiple
64 Letters useful also for public relations
65 A junction
66 spin fast to get away from the smell

Down

1 A curious element
2 A very short length of wood
3 Distance
4 45 down of 45 across
5 Below this value, things really move
6 Male cats are made of these
7 Can be noisy
8 Occurs in physics but not in commerce
9 Not quite microwaves
10 Energy of an electron gas
11 Not positive about this abbreviation
12 Complement of red
13 Think sharply
14 A positive outcome of a crusade
15 A heavy leader
16 Go to great lengths to amass some time
17 2 by 24 across
18 A lamp inherited from ones central American forefathers
19...Handbook of Chemistry and Physics
20 This technique resonates with many users
21 A stupid mixup over a molten element
22 Unit of energy
23 An archaic form of 20 across
25 High level proceedings
26 Energy – even for laymen
27 Environmentally friendly way of getting down to detail
28 Some physicists prefer to work on this
29 Grind
30 A law to boast about
31 Transports by four wheels, not two
32 Not heavy but intermittent
39 Directional
40 This club is for some physicists
41 16 across has one of these
42 An Oxford university address
43 Like 20 down
44 Having eyes that are charged
45 A lot of people live there
46 A current limiter
47 Spread by an urge to dive
48 Most got their first physics lessons here
49 Not the most interesting of scientists
50 For a particle, this could be either a little or a lot of energy
51 A unit of time
52 Logic circuit
53 Another version of 51 down
54 Increasing potential energy
55 Not as far as 9 down
56 A few cases of this published in reputable journals



Nine Physicists Honored at November Division Meetings

Five APS prizes and awards will be awarded this month, honoring nine physicists for their work in plasma physics and fluid dynamics. The 2006 James Clerk Maxwell Prize, Excellence in Plasma Physics Award and Rosenbluth Award will be presented during the annual meeting of the APS Division of Plasma Physics, to be held October 30 to November 3 in Philadelphia, Pennsylvania. The 2006 Fluid Dynamics Prize and Andreas Acrivos Award will be presented during the annual meeting of the APS Division of Fluid Dynamics, to be held November 19-21 in Tampa Bay, Florida.

James Clerk Maxwell Prize

Chandrashekhar J. Joshi
University of California Los Angeles

Citation: "For his insight and leadership in applying plasma concepts to high energy electron and positron acceleration, and for his creative exploration of related aspects of plasma physics."

Joshi is a Distinguished Professor of Electrical Engineering at UCLA. He is also the director of the Center for High Frequency Electronics and heads the Neptune Laboratory for Advanced Accelerator Research at UCLA. He received his PhD in 1978 from Hull University in the UK. Following a two year stint as a research associate at the National Research Council of Canada, where he worked on laser-plasma interactions, he joined UCLA. Joshi has built a strong research group that has done pioneering work in the areas of laser-plasma instabilities, plasma-based light sources, laser-fusion, and basic plasma experiments. His group is best known, however, for developing the field of plasma-based particle accelerators over the past two decades. He is also a past recipient of DPP's Excellence in Plasma Physics Award.

Award for Excellence in Plasma Physics Research

Ryosuke Kodama
Osaka University

Peter Norreys
Rutherford Appleton Laboratory

Max Tabak
Lawrence Livermore National Laboratory

Kazuo Tanaka
Osaka University

Scott Wilks
Lawrence Livermore National Laboratory

Citation: "For developing the Fast Ignition inertial fusion concept and for demonstrating key aspects of it in a series of experiments that have catalyzed the world-wide effort on the concept."

Kodama is a professor of engineering at Osaka University. He studied electrical engineering and science at Osaka University, earning his PhD degree in 1990. He was a visiting researcher at Clarendon Laboratory, Oxford University and Central Laser Facility, Rutherford Appleton in UK from 1990 to 1992, when he joined Osaka University's Institute of Laser Engineering. He is now exploring high energy density science in methods of introducing a plasma photonics concept to control intense light and high energy density charged particles.

Norreys started his study of laser-plasma interaction physics at Royal Hollow College, University of London. After obtaining his PhD in 1988, he was awarded a JSPS post-doctoral fellowship at the Institute of Laser Engineering at Osaka University, Japan. He took up a position at the Rutherford Appleton Laboratory upon his return to the UK in 1990. He has held a number of UK research council grants that have investigated high intensity laser-plasma interaction physics relevant to fast ignition of fusion targets. He has led the Physics Group at the Central Laser Facility since 2001, and is currently a visiting professor of physics at the Blackett Laboratory, Imperial College London.

Tabak received his PhD from the University of California, Berkeley in 1975 in experimental high energy physics. He followed this work with post-doctoral training in elementary particles at the Weizmann Institute of Science and at Carnegie Mellon University. Since 1980, Tabak has been associated with Lawrence Livermore National Laboratory and is now a group leader in the Defense and Nuclear Technology Department as well as Associate Program Leader for Inertial Fusion Target Design in the Fusion Energy Program. His current research involves designing optimized implosion systems and reducing ignition laser requirements for Fast Ignition.

Tanaka finished his PhD at the Laboratory for Laser Energetics, University of Rochester in 1982. He stayed at the University of Rochester for three years and then he joined the faculty at Osaka University. His major interests include fast ignition, laser plasma interactions, and equations of state. He reported the first deuterium fuel implosion using foam spherical shells and fast ignition integral experiments as invited talks at the APS.

Rosenbluth Award

Cameron Geddes
Lawrence Berkeley National Laboratory

Citation: "For experimental and computational studies of channel-guided laser wakefield accelerators."

Geddes is a physicist in the LOASIS program at Lawrence Berkeley National Laboratory, where he works on laser-driven particle acceleration and intense laser-matter interaction. He received his PhD in physics in 2005 from the University of California, Berkeley. His thesis work demonstrated the first laser-driven accelerator in which the laser pulse propagation was controlled by a preformed plasma channel, resulting in production of mono-energetic beams for the first time in a laser wakefield accelerator.

Fluid Dynamics Prize

Thomas Lundgren
University of Minnesota

Citation: "For his insightful theoretical contributions to numerous areas of fluid mechanics, most notably in the fields of turbulence and vortex dynamics."

Biographical information unavailable at press time.

Andreas Acrivos Award

Eric Lauga
MIT

Citation: "For his dissertation, 'Slip, Swim, Mix, Pack: Fluid Mechanics at the Micron Scale,' a treatment of slip and mixing relevant to micron-scale geometries, swimming of micro-organisms, and self-assembly of colloidal particles."

Lauga received an undergraduate degree from the Ecole Polytechnique in France in 1998, and then joined the Corps de Mines program at the Ecole des Mines in Paris, during which he spent a year at the University of California, San Diego. After receiving the French equivalent of a master's degree from the University of Paris IV, he went on to earn his PhD in 2005 from Harvard University. His thesis work concerned theoretical investigations of flow behavior at the micron scale. He is currently an assistant professor of applied mathematics at MIT, focusing on problems in biofluid mechanics and microfluidics.

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than to changes in the number of foreigners enrolling.

There were 1090 PhDs awarded in the class of 2004, about 26% fewer than the number of PhDs produced about a decade ago.

On average, PhD recipients in 2002 and 2003 reported taking six years of full time study and research to complete their degrees.

PhD production has been flat for the past several years. Based on first year enrollment figures and the average time it takes students to earn a degree, the report's authors predict steady increases in the number of physics PhDs through the 2009-2010 academic year. The proportion of PhDs earned by foreign citizens has increased from 45% in 2000 to 54% in 2004, but the study predicts that US citizens will be the majority again within a few years.

In the PhD class of 2003, 68% accepted a postdoc as their first position. The percentage accepting postdocs continues to increase, according to the report.

The proportion of bachelors degrees in physics awarded to women increased since 1993 to a high of 23% in 2001, and has leveled out since then. The proportion of PhDs awarded to women dropped to 16% in 2004, down from the high of 18% in 2003.

Minorities continue to be underrepresented among physics degree recipients at all levels, the report states.

Historically black colleges and universities (HBCUs) accounted for 52% of all physics bachelors and 31% of PhDs conferred to African Americans, the study found.

ANNOUNCEMENTS

APS CONGRESSIONAL SCIENCE FELLOWSHIP 2007-2008

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

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

TERM OF APPOINTMENT is one year, beginning in September of 2007 with participation in a two-week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

A STIPEND of $50,000 is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

APPLICATION should consist of a letter of intent of approximately two pages, a list of key publications, a two-page resume, and three letters of reference. Please see the APS website (http://www.aps.org/public_affairs/fellow/index.cfm) for detailed information on materials required for applying and other information on the program.

ALL APPLICATION MATERIALS MUST BE POSTMARKED BY JANUARY 15, 2007 AND SHOULD BE SENT TO THE FOLLOWING ADDRESS:

APS Congressional Science Fellowship Program
c/o Jackie Beamon-Kiene
APS Executive Office
One Physics Ellipse
College Park, MD 20740-3843

Now Appearing in RMP: Recently Posted Reviews and Colloquia

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

Tests of the standard electroweak model in nuclear beta decay
Nathal Severijns, Marcus Beck and Oscar Naviliat–Cuncic

The standard model of elementary particle physics has established itself through its great success in the description of a wealth of physical phenomena. Despite its success, however, many open questions towards its general validity remain. The present article reviews the current status of precision tests of the electroweak model in the low energy sector by considering nuclear beta decay, which is a semileptonic strangeness–conserving process involving to lowest order only the lightest leptons and quarks interacting via exchange of heavy vector bosons. The potential and prospects of such precision measurements, in particular, are emphasized to look for physics beyond the standard model.

WEBSITE continued from page 1

A calendar of upcoming meetings and a set of quick links will also enhance usability of the new site for APS members.

Throughout the redesign process, Beaconfire Consulting assisted APS staff with the strategy, architecture, and design and development of the new site. APS has also hired a new staff member, Kelly Osborn, to coordinate content for the website. She will stay in touch with all APS departments to ensure that content is up-to-date and well organized.

The new site will be updated regularly to feature different APS programs and highlight news items, so users should check back often.

ETS continued from page 6

questions related to "real-life" scenarios. The new analytical writing measure will use more focused prompts to reduce the possibility of reliance on memorized materials.

ETS will also change the way the test is administered. The GRE general test had been a computer-based adaptive test, which presented questions to the test taker according to performance on previous questions. Starting in the fall of 2007, the GRE will be a linear test, with all test takers receiving the same questions. The test will be administered on computer on approximately 30 days per year, and starting times will be staggered across time zones to address security concerns.

The new test will have a new scoring scale, and scores on the new test cannot be compared directly with scores on the old version, though ETS will issue a concordance table that will help users understand the relationship between old and new scores.

More information about the revised GRE can be found at www.ets.org/gre.

The Back Page

The Mother (Nature) of All Wars?

Modern Wars, Global Terrorism, and Complexity Science

by Neil F. Johnson

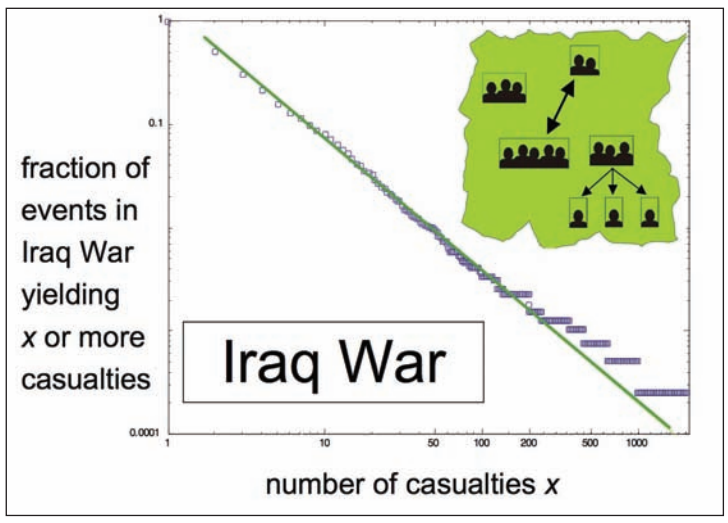
It has become hard for us to watch a nightly news bulletin without hearing phrases such as "thirty dead in Iraq," "five wounded in Afghanistan," "three guerrilla attacks in Colombia," or "ten killed in a terrorist bomb in Indonesia." We are then typically presented with a number of studio experts who try to explain away the numbers by drawing on idiosyncratic details of the conflict in question. Although often unconvincing, their approach is perfectly defensible given the very different origins, motivations, locations and durations of these separate conflicts. However recent research by a multi-disciplinary team of Complexity scientists suggests that all these sociological, political and strategic experts may have missed something crucial.

Using techniques from the physics of Complex Systems, the research team has shown that the dynamics underlying all such modern conflicts, including global terrorism, are remarkably universal. Furthermore they have developed a physics-based theory describing the dynamics of insurgent group formation and attacks, which neatly explains the universal patterns observed in all modern wars and terrorism. The implications are quite sobering: Regardless of the origins and locations of modern conflicts, the insurgent groups in each case are operating in the same way. In short, it is effectively the same enemy on all fronts.

There are two reasons why the field of human conflict should be of interest to a physicist. First, the increased availability of computerized datasets means that there is a data revolution underway across the social sciences–just as the field of astronomy recently caught alight as a result of improved data collection. Human conflict is as old as mankind itself–however, a lack of reliable time-series data in the past has kept it out of reach of the quantitative sciences. This has now changed with the media, governments and non-governmental organizations all now regularly collecting data on ongoing conflicts. Admittedly the analysis of their datasets is not always straightforward–not only do the individual agencies differ in their numbers, but the way in which the figures are reported can differ quite markedly. Extensive cross-checks from the various sources must therefore be carried out prior to any data analysis.

The second reason touches the fascinating aspect of Complexity Science itself. In particular, modern wars seem to exhibit all the common characteristics of Complex Systems: (1) There is feedback, both at the microscopic and macroscopic scale, yielding a system with memory and non-Markovian dynamics. (2) The time-series of events is non-stationary. (3) There are many types of "particle," according to the various armed actors, and they interact in possibly time-dependent ways. The war's evolution is then driven by this ecology of agents. (4) The agents can adapt their behavior and decisions based on past outcomes. The system is far from equilibrium and can exhibit extreme behavior–for example, if the strategies of several groups of agents suddenly coincide. (5) The observed war constitutes a single realization of the system's possible trajectories. (6) The system is open, with this coupling to the environment making it hard to distinguish between exogenous (i.e. outside) and endogenous (i.e. internal, self-generated) effects.

Mike Spagat from the University of London, Jorge Restrepo and Roberto Zarama in Bogota, Colombia, and I have compiled, cross-checked and analyzed event datasets for a wide variety of ongoing and recent wars, including acts of global terrorism. In each case, we plotted the histogram of the number of events within a given war with x or more casualties, versus x, on a log-log plot. What we found was really quite startling. Although wars are the antithesis of a ordered system, the datapoints for each war fell neatly on to a straight line (see the figure). This suggests a power-law behavior, which we then confirmed statistically. We repeated this exercise for wars as diverse as Israel, Senegal, Peru, Afghanistan and Colombia. In each case we obtained a power-law, i.e. the fraction of events with x casualties varies as x^{-a}. This finding is remarkable given the different conditions, locations and durations of these separate wars. For example, the Iraq war is being fought in the desert and cities and is fairly recent, while the twenty-year old Colombian war is being fought in mountainous jungle regions against a back-drop of drug-trafficking and Mafia activity. This power-law finding also has some very important practical implications in terms of military planning.



Log-log plot of the fraction of all events in the Iraq War with x or more casualties, versus x. Squares are actual war data. The line is produced by the physics-based analytic model (see inset). All modern wars, including terrorism, show power-law like behavior with exponents in the vicinity of 2.5. The analytic model considers insurgent armies as an ecology of attack units, which undergo frequent coalescence and fragmentation. The number of dark shadows is proportional to the number of casualties which each attack unit can typically inflict in a conflict event. Full details are given in e-print "Universal patterns underlying ongoing wars and terrorism," by Neil F. Johnson, Mike Spagat, Jorge A. Restrepo, Oscar Becerra, Juan Camilo Bohorquez, Nicolas Suarez, Elvira Maria Restrepo, Roberto Zarama, which is available at http://xxx.lanl.gov/abs/physics/0605035

It means there is no typical size of event–unlike the bell-curve for population heights, for example, which is centered around an average height. Deadly events with many casualties will occur–rarely, but they will occur. This is again unlike the case of heights, where the chances that someone will be taller than ten feet are truly negligible.

But the surprises don't stop there. Not only did we obtain straight-line slopes, but these slopes all produced a power-law exponent α near 2.5. Furthermore Aaron Clauset and coworkers recently analyzed an extensive database of global terror events, and also obtained a power-law–with an α value equal to 2.5. By contrast when we looked at data from older wars–such as the civil wars in the US, Spain and Russia –we found no statistical evidence for a power-law at all. Furthermore, the power-law exponent is insensitive to any systematic over- or under-reporting of casualties, because the overall number of casualties is just a normalizing factor. Hence the power-law signature successfully focuses on the war's internal pattern of events and hence casualties, as opposed to simply monitoring the aggregate number.

But why should 2.5 be such a magic number for modern wars and global terrorism? To answer this, we developed a model of dynamical group-formation to describe an insurgent force. Our cue came from the fact that most modern wars, including terrorism, can be characterized by an asymmetric 'David-and-Goliath' structure in which a small, but agile, insurgent force faces a much stronger, but more rigid, institutional force such as a state's army. Because of its less rigid structure, the insurgent force is able to self-organize itself into a loosely connected soup of attack units which combine and dissociate over time in response to their own ad hoc operations, and in response to the state army's operations. These attack units are shown in the inset in the figure. The number of dark shadows in each unit is proportional to the number of casualties that that unit will inflict in a typical conflict event. Each attack unit comprises a group of people, weapons, explosives, machines, or even information, which temporarily organizes itself to act as a single unit. In the case of people, this means that they are probably connected by a common location, or by some common communication system. However, an attack unit may also consist of a combination of people and objects–for example, explosives plus a few people, such as in the case of suicide bombers. Such an attack unit, while only containing a few people, could have a high attack strength. Information could also be a valuable part of an attack unit. A lone suicide bomber who knows when a certain place will be densely populated–for example a military canteen at lunchtimes–and who knows how to get into such a place unnoticed, will also represent an attack unit with a high attack strength. When a given attack unit undertakes an attack, it creates a number of casualties proportional to its strength–hence the distribution of attack-unit strengths will reflect the distribution of casualties which arise in the war.

When our model is solved analytically, it produces a power-law with $\alpha = 2.5$. If we then make the group formation-dissociation probabilities depend on the existing group sizes, this α value can be moved toward 2.0 or 3.0, thereby incorporating all the results for modern wars. Generalizing the model further to include multiple insurgent groups, yields a near-perfect fit with the real data over the entire range of x, including the nonlinear deviations at high and low x. Hence we can explain the entire range of casualty events in all modern wars and terrorism using slight variations of the same basic model.

While outside the realm of traditional physics, this new line of physics research has led to a novel quantitative understanding of current world conflicts, terrorism and insurgent warfare. In particular, it suggests that the dynamics of insurgent group formation are the same across all arenas–from the jungles of Colombia through to the deserts of Iraq, and including the entire world stage of global terrorism. In short, the way in which modern wars and terrorism are being waged has less to do with geography or ideology, and more to do with the day-to-day mechanics of human insurgency–in other words, it is simply the way in which insurgent groups of human beings fight when faced with a much stronger, but more rigid, opponent. As a consequence of this, it would seem that unless the stronger, but more rigid, opponent can change its tactics, the same statistical patterns of casualties will be repeated indefinitely into the future.

What about the future of this research? Having looked at event sizes, we are now focusing on their timing–not only in ongoing wars, but also in organized crime activity including homicides, kidnappings and extortion. With the help of Sean Gourley, Juan Camilo Bohorquez and Elvira Restrepo at the Universidad de Los Andes in Colombia, we have successfully created multi-agent models which mimic the decision-making dynamics of insurgent groups, just as had been done earlier for groups of financial traders within the so-called Econophysics community (see Financial Market Complexity (Oxford University Press, 2003)). By analyzing the size, timing and spatial coordinates of a given event, as well as the groups involved, we are now able to reconstruct the possible trails which a particular insurgent group might have followed. Just as in a multi-species ecological setting within the natural world, we are interested in determining the behaviors and possible protocols which arise when a particular group from insurgent army A happens to cross the path of a particular group from insurgent army B. In particular, we are trying to deduce whether they decide to fight each other, collaborate, ignore each other–or even consciously avoid each other. Going further, we know that wars like the ones in Colombia and Afghanistan have taken place against the backdrop of an illicit trade such as drug trafficking. This activity provides an effective nutrient supply in the form of money for buying supplies and weapons, and thereby helps feed the war as a whole. So just like a fungus will thrive in a forest, or a cancer tumour will thrive in a host, these armed groups are fed by a rich source of nutrients which allows them to self-organize into a robust structure. Admittedly, just like a jungle itself, this is all very far from our everyday experiences as physicists. But the exciting news is that the tools to help answer such unlikely questions are now beginning to emerge –and they are emerging from a very unlikely source: Physics.

Neil Johnson is a Professor of Physics at Oxford University, where he runs a research group focusing on complex systems in the classical and quantum domains. See "Financial Market Complexity," (Oxford University Press, 2003) and "Two's Company, Three is Complexity" (Oneworld Publishing, 2007) for more details.