APS NEWS

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

July 2007
Volume 16, No. 7
www.aps.org/publications/apsnews

Election Preview
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Executive Board Resolution Thanks Legislators for Support of Science

The APS Executive Board has passed a resolution thanking House and Senate policy makers for recently-passed legislation that strengthens the science, math and engineering activities of our nation.

"Sustaining and improving the standard of living of American citizens, achieving energy security and environmental sustainability, providing the jobs of tomorrow and defending our nation against aggressors all require federal investments in science education and research… The Board congratulates the Senate and House leadership and the White House for elevating science to a place of prominence on the federal agenda," the resolution states.

Bills authorizing increasing science funding have passed in both the House and the Senate with bipartisan support.

The Senate bill, S. 761, the America COMPETES act, passed by a vote of 88-8 on April 25. The bill authorizes nearly $60 billion for various programs for FY 2008 through FY 2011. The bill would double the NSF budget over five years and double the DOE Office of Science budget over 10 years.

The House of Representatives passed five separate authorization bills, which were then combined into one bill, H.R. 2272, the 21st Century Competitiveness Act of 2007. The bill would put the NSF budget and the NIST Scientific and Technical Research and Services budget on track to double in 10 years. The bill also addresses math and science education issues.

The President's budget request for FY2008, released in February, also supports increased funding for the DOE Office of Science, NSF, and NIST STRS.

Following the Senate passage of the America COMPETES act, APS president Leo Kadanoff sent an email to all APS members re-

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US physics team trains for competition in Iran

By Katherine McAlpine

Twenty-four high school students comprising the US Physics Olympiad team vied for five places on the traveling team at the University of Maryland from May 22nd to June 1st. Those chosen to travel will compete this month against teams from all over the world at Isfahan University of Technology in Isfahan, Iran.

Photo by Matt Payne

The traveling team members and two of their coaches. Left to right: Paul Stanley, Rui Hu, Jenny Kwan, Haofei Wei, Kenan Diab, Jason Larue, and Robert Shurtz.

Over 3,100 US Physics Team hopefuls took the preliminary examination in January, and 200 were given a second exam in March to determine the top 24 students. Performance, attitude, creativity, initiative, and evidence of progress are the factors that determine who participates in the International Physics Olympiad, which will take place July 13-22.

The ten-day camp mirrors the international competition as the students are scored on exam and laboratory performance. Scores on the seven exams and four "mystery labs" are the largest factor in deciding which five will form the traveling team.

In addition to the evaluations, students attend lectures by coaches and guest physicists Jim Gates, Jordan Goodman, and Richard Berg. These crash-courses help to fill them in on topics that are not discussed in most high school physics classrooms but may appear on the exams they will see in competition. Included topics are waves, modern physics, special relativity, and thermodynamics.

The content of these lectures is tough, but the tone is informal

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KGJ/APS © 2007

NASCAR Fans Find the Physics

University of Nebraska physics professor Diandra Leslie-Pelecky went behind the scenes at top racing shops, and onto the asphalt at the Daytona International Speedway in her quest to uncover the science behind NASCAR racing. In her public lecture on April 16, she gave Jacksonville residents and April Meeting attendees a taste of what she found.

Leslie-Pelecky became interested in NASCAR physics while watching a race one weekend, in which a car quite suddenly veered into the wall. She couldn't figure out what had caused the crash and set out to solve the conundrum. And she discovered there's a lot more to car racing than driving around in circles.

Any good NASCAR driver can recite this basic mantra: go fast, always turn left, and don't crash. Leslie-Pelecky says that the drivers are working at a point of constant unstable equilibrium. The key to maintaining that precarious balance is maintaining, as much as possible, the same amount of force on all four tires.

She found that the best NASCAR drivers are "intuitive physicists": they understand the complex interplay of the various forces at work on the track extremely well, from aerodynamics and acceleration to friction and energy dispersion upon impact.

Creation Museum Draws Scientific Fire

The May 28 opening of a $27 million Creation Museum in Petersburg, Kentucky, drew about 4000 visitors, dozens of protestors, and attention from national and international media.

The museum promotes a literal interpretation of the Bible's creation story, contradicting accepted scientific explanations of the origin of the universe, stars, Earth, and life.

Scientists from the region have signed petitions expressing their concern that the museum spreads lies about science and could confuse children.

The 60,000 square foot Creation Museum, located near Cincinnati, was built by the Answers in Genesis ministry, using funds from private donations.

Exhibits illustrate the biblical creation story, which claims that Earth is only 6,000 years old and was created by God in six 24-hour days. Adam and Eve are shown in the same scene as dinosaurs. The dinosaurs, according to the exhibits, were vegetarian before the fall. According to the museum, the Grand Canyon was created over the course of days, during the biblical flood. The museum's planetarium presents a biblical version of astronomy.

People who have seen the museum say it resembles a natural history museum, with exhibits that are attractive and high-tech.

"It's a very impressive-looking place," said Lawrence Krauss, a physicist at Case Western Reserve University and chair of the APS Forum on Physics and Society.

"The dinosaurs attract the youth; the clever exhibits entertain and have a polish that seems very scientific. They often look like NOVA specials," said Bob Riehemann, a physics and math professor at Thomas

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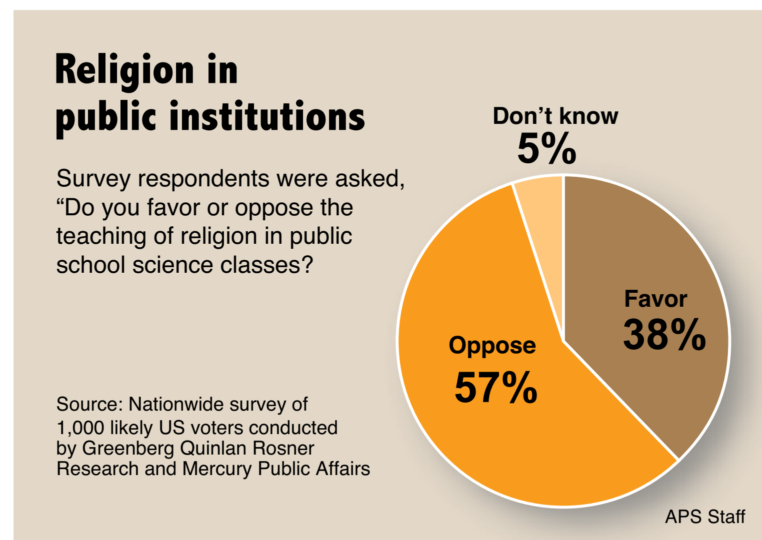
Study Yields Insights into Public Perceptions and Attitudes Towards Science

The data in this chart are taken from a survey conducted last summer and commissioned by a consortium of scientific societies. The results of the survey contain some good news for science: when asked, 53% of the respondents favored teaching evolution in public school science classes, a much higher percentage than favored either creationism (36%) or intelligent design (27%). But there was considerable uncertainty among the respondents, especially about intelligent design, many of whom were unsure when asked whether it should be taught. As the report from the polling agencies concludes, "the debate is not nearly as polarizing as previous polling would lead us to believe. In fact, there is more uncertainty than polarization. With this uncertainty [comes] opportunity; scientists can play a key educational role for the public."



More data from the survey can be found in an article at the following site: http://www.aps.org/publications/apsnews/acs.cfm.

Members in the Media

"We are now on the endgame."

***Lyn Evans**, CERN, on nearing completion of the LHC,* The New York Times*, May 15, 2007*

"Thus, we have more and more convincing evidence that the dark matter is real material–probably elementary particles. Now we need to detect those particles directly with laboratory experiments."

***Blas Cabrera**, Stanford University, on a recently discovered ring of dark matter around the remains of two galaxies that collided,* San Francisco Chronicle*, May 16, 2007*

"I see in the British press and the BBC signs of a very strong anti-Israel bias–a kind of blind hostility that whatever Israel does, it is always in the wrong–so this is not an isolated action of a small group of anti-Semitic conspirators. This represents a widespread feeling among British journalists."

***Steven Weinberg**, University of Texas, on his decision not to visit Britain after journalists' decision to boycott Israel,* Ha'aretz*, May 25, 2007*

"I want to help young artists. There are a lot of artists in the city who are working right now but not seriously thinking about showing their work."

***Paul So**, George Mason University, on his plans to start a program to teach art students the business side of art,* Washington Post*, May 28, 2007*

"A lot of the challenges that our country faces are economic and technical, and as a scientist and businessman, I can help solve them."

***Bill Foster**, Fermilab, on planning to run for Congress,* The Daily Herald *(Illinois) May 31, 2007*

"But I have the uneasy feeling that the U.S.A. is headed into asymptotic futility well before that."

***Jim Peebles**, Princeton University, commenting that there are more pressing worries than the fact that the universe will become "asymptotically empty" in billions of years,* The New York Times*, June 5, 2007*

"When you put a million grains of sand together, they exhibit behavior that you could not begin to predict."

***Douglas Durian**, University of Pennsylvania, NPR, May 19, 2007*

"Physicists don't get up in the morning to confirm the standard model."

***Ed Kearns**, Boston University,* Boston Globe*, May 28, 2007*

"It's important because we have a national problem with the level of science understanding in this country."

***Joseph Bellina**, Saint Mary's College, on hands-on methods of teaching science, Fox 28.com WSJV(South Bend, IN), June 4, 2007*

"This is a new class of matter acting like a wave."

***David Snoke**, University of Pittsburgh, on a polariton condensate,* Pittsburgh Post-Gazette*, May 23, 2007*

"Studying the elementary particles helps us understand the evolution of the universe in the first fraction of a second."

***Ahren Sadoff**, Cornell University,* Ithaca Journal*, June 8, 2007*

"The brilliance of the free-electron laser gives us the hope that we will be able to get an X-ray diffraction pattern for a single macromolecule like a protein."

***Massimo Altarelli**, XFEL, on the X-ray Free-Electron Laser, to be built in Germany, BBC News.com, June 5, 2007*

QKD, Attosecond Physics Among DAMOP Meeting Highlights

The latest research in quantum key distribution, attosecond physics, and petawatt laser applications were among the highlights of the 8th annual meeting of the APS Division of Atomic, Molecular and Optical Physics. One of the largest conferences in this field in North America, the meeting was held June 5-9 in Calgary, Alberta, Canada, in conjunction with the corresponding section of the Canadian Association of Physicists.

Constant Fine-Tuning. Gerald Gabrielse of Harvard University described last year's ground-breaking new measurement of the electron magnetic moment, which has been used to determine the value of the fine structure constant. The prior measurement had stood since 1987, and the Harvard results were listed as the 2006 physics story of the year by the American Institute of Physics. Thanks to various new methods, the new measurement has an uncertainty about six times smaller, and shifts the values by 1.7 standard deviations.

Quantum Key Distribution. Quantum key distribution (QKD) is rapidly moving forward from proof of principle to validation of such a

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This Month in Physics History

July 1957: Bardeen, Cooper, and Schrieffer submit their paper, "Theory of Superconductivity"

Fifty years ago, in 1957, John Bardeen, Leon Cooper, and Robert Schrieffer presented their complete theory of superconductivity, finally explaining a phenomenon that had been a mystery to physicists since its discovery in 1911.

In 1911, Heike Kamerlingh Onnes, in his quest to study materials at ever lower temperatures, happened to find that the electrical resistance of some metallic materials suddenly vanished at temperatures near absolute zero. He called the phenomenon superconductivity, and scientists soon found additional materials that exhibited this property.

But no one could completely explain how it worked. For the next few decades, many prominent physicists worked to develop a theory of the mechanism underlying superconductivity, but no one had much success, and some despaired of figuring it out. One such physicist, Felix Bloch, was quoted as proposing "Bloch's theorem: Superconductivity is impossible."

Richard Feynman also later recalled that he had "spent an awful lot of time in trying to understand it and doing everything by means of which I could approach it… I developed an emotional block against the problem of superconductivity, so that when I learned about the BCS paper I could not bring myself to read it for a long time."

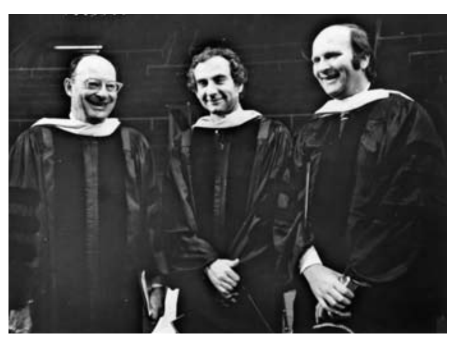
While theorists were making little progress in the years following Onnes's discovery, experimentalists were discovering some interesting features of superconductors. In 1933, Walther Meissner found that superconductors would expel a magnetic field, an effect that makes it possible to levitate a magnet. The discovery of the Meissner effect, as it is called, added a new wrinkle that any theory of superconductivity would have to explain. John Bardeen made an attempt at the problem of superconductivity, but then went on to other work.

Some physicists did have partial success in explaining superconductivity. The brothers Fritz and Heinz London came up with a theory that explained some of its features, but didn't provide a mechanism at the microscopic level. In 1950, Herbert Frohlich proposed that superconductivity might have to do with interactions between the electrons and the vibrations of the crystal lattice, or phonons. Around that time, experimenters observed that the critical temperature, at which a material becomes superconducting, is related to the atomic mass of the superconductor. Frohlich's theory did explain this isotope effect, but couldn't account for other properties of superconductivity such as the Meissner effect.

At the time, Bardeen had been working on other research, but the discovery of the isotope effect renewed his interest in the problem of superconductivity. Bardeen and David Pines built on the explanation of the isotope effect. They took into account the electron–phonon interactions that Frohlich had considered, but they also determined how at low energies in a crystal lattice, electrons could overcome the Coulomb repulsion and attract each other.

Another piece of the puzzle was contributed by Leon Cooper, who suggested that interactions with the lattice would allow electrons with opposite spins to combine to form strongly correlated pairs. The electrons in these Cooper pairs, as they are called, do not have to be close together, but they can move in a coordinated manner. Cooper realized the motion of these pairs could explain how electrons could flow with no resistance in a superconductor. These pairs would form at low temperature; adding energy would break up the pairs, returning the material to a normal, non-superconducting, state.

The next insight came from Robert Schrieffer, a student of Bardeen at the University of Illinois. In New York early in 1957 to attend the APS annual meeting, Schrieffer had an idea while riding on the subway. He figured out how to mathematically describe the enormous collection of Cooper pairs in a superconductor with one single wave function. Upon returning to Illinois, he told Bardeen and Cooper about the breakthrough, and they realized that the problem of superconductivity was solved.



(Source: AIP Emilio Segrè Visual Archives.)

Bardeen, Cooper and Schrieffer (left to right)

Bardeen, Cooper, and Schrieffer put all these insights together to form a complete theory, in which electrons, through interaction with lattice vibrations, form Cooper pairs, which move in a coordinated manner, rather than randomly as in a normal conductor, allowing electricity to flow with no resistance.

"Well, I think we've explained superconductivity," the usually quiet Bardeen announced one day. In April of that year, Bardeen, Cooper and Schrieffer published a short paper in *Physical Review* entitled "Microscopic Theory of Superconductivity." They submitted their full detailed report, appropriately titled "Theory of Superconductivity," to the *Physical Review* in July 1957, and it was published in December.

The BCS theory was extremely successful, explaining in detail the mechanism of superconductivity and associated effects, and it agreed amazingly well with experimental data. "All of the hitherto puzzling features of superconductors fitted neatly together like the pieces of a jigsaw puzzle," Bardeen later recalled. BCS theory was quickly accepted as correct.

Bardeen, Cooper, and Schrieffer were awarded the Nobel Prize in 1972 for their theory of superconductivity. This was Bardeen's second Nobel Prize in physics–his first was shared with William Shockley and Walter Brattian for the transistor in 1956.

This year marks the 50th anniversary of the BCS theory. The theory works for conventional superconductors, but does not explain the high temperature superconductors first discovered 20 years ago, so puzzles still remain. However, BCS theory has had an impact far beyond superconductivity, as scientists have found states analogous to the BCS superconductor in astrophysics and nuclear physics.

APS NEWS

Series II, Vol. 16, No.7
July 2007
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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.

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Nobel Laureates Tackle Middle East Problems

More than thirty Nobel laureates, including nine physicists, gathered in the ancient city of Petra, Jordan in May to discuss ways to improve education, environment, economy and health in the Middle East.

At the conference, the Nobel Laureates launched an effort to raise $10 million for a Middle East science fund to support scientific collaborations and projects to improve education in the Middle East. The fund would initially support projects in Israel, the Palestinian territory, and Jordan, and would eventually expand to include more of the Middle East.

The meeting, the third annual Petra Conference of Nobel Laureates was organized by the Elie Wiesel Foundation for Humanity and the King Abdullah II Fund for Development. Political leaders and youths from the region also attended the conference. Breakout session groups focused on environment, economy, health, and education.

David Gross, a 2004 Nobel laureate in physics and director of the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara, attended the conference. Gross is pushing for more opportunities for scientists in the region to collaborate. Israel and the Palestinian authority both make it difficult for scientists to work together, but "a lot of people in these countries are interested in peaceful collaboration," said Gross.

Another conference attendee, Val Fitch, 1980 Nobel laureate, joined a working group to push forward some environmental efforts in the region. He was inspired by youths from the region who attended the conference and discussed their experiences. "The situation in the Middle East is so miserable. I think any attempt to span the gulf [between Arabs and Israelis] is a good thing," said Fitch. He said the conference produced some good efforts at collaboration.

Gross, who also attended the first Petra conference in 2005, has been involved with promoting scientific collaboration in the Middle East for years. For example, he promotes SESAME, (Synchrotron-light for Experimental Science and Applications in the Middle East), a synchrotron under construction in Jordan that could be used for innovative physics, biology, and chemistry research by scientists from the Middle East.

Collaboration between scientists can make a difference, Gross says. "The example I like the most is the contact that occurred during the Cold War," he said. Even when relations between the Soviet Union and Western countries were strained, scientific cooperation continued. The communication between Soviet and Western scientists led to discussions about arms control, and once scientists had opened the discussion, it helped politicians discuss these issues. "I think physicists can be proud of their record," said Gross. "Because scientists talk the same language and feel part of an international community, they can often overcome political differences."

Fitch also believes that physicists and other scientists can do a lot of good. "I think of us as being able to solve any and all problems," he said.

The Art of a Scientist

Photo by Ernie Tretkoff

APS headquarters is on the fourth floor of the American Center for Physics in College Park, MD. Part of the ground floor serves as an art gallery, with exhibits that rotate twice a year. The most recent installation was unusual because one of the featured artists was Wally Gilbert, a theoretical physicist turned biologist who won the Nobel Prize in 1980. Gilbert takes digital photographs, which are then altered on the computer and blown up many-fold. He is shown here in front of one of his creations at the opening reception at the ACP in April. More of Gilbert's artwork can be viewed on his web site, wallygilbert.artspan.com .

US PHYSICS continued from page 1

and playful. Head coach Paul Stanley, in giving the students a rundown of what order of magnitude to expect when measuring atomic and subatomic lengths, admonished, "These are things you should know. Like the density of water. What's the density of water?"

A few numbers were offered in reply, and Stanley answered the question, "One."

"Depends on units," a student from the front called out.

"Yes, it depends on units, but one works," Stanley insisted.

"What's the density of air, Paul," smart-aleck coach Boris Zbarsky, graduate student in math at the University of Chicago, goaded from the back. His banter elicited laughter from the quicker students.

"One," said Stanley.

According to student Jenny Kwan, a senior from California, lectures are made more enjoyable for the terrible puns and curious analogies used by the coaches. Her favorite was relativity in terms of monkeys and bananas, explained by coach Andrew Lin, a physics graduate of Yale University.

The mystery labs are truly challenging. The students walk into the room and are offered a bench full of equipment and a task. For example, on Monday they were given lasers and screens, among other equipment, with the mission of finding the thickness of their hair.

This lab, popular in undergraduate curriculum, required the high school students to use diffraction. They had only recently learned behaviors of light waves in a lecture the previous morning.

The laboratory is a highlight for most of the students. If they have lab experience at all, it was generally on poor equipment. Student Aleksandra Stankiewicz of Minneapolis delighted in the accuracy of the University of Maryland equipment, saying that her results helped correct her theoretical understanding.

The coaches enjoy the challenge of keeping up with the students. Stanley said that the students often connect with former participants and even learn problems from previous years. "They sneak up on us. They're better every year."

Robert Shurtz, academic director and physics teacher at Hawken School in Ohio, drew up the schedule according to the official syllabus given to each international team. He said the hardest part is "dealing with a fairly wide range of backgrounds." Students are responsible for knowing mechanics, electricity, and magnetism ahead of time.

Warren Turner, laboratory coach and assistant professor at Westfield State College, discussed the unusual caliber of the US Physics Team students. "Most (high school) physics teachers see only one or two of these students in their careers. Here we see 24 every year."

The coaches receive a modest honorarium for their efforts, but considering the long hours, the primary reward is sharing their knowledge of physics with these exceptionally talented, motivated, and interested students.

The camaraderie among students and coaches helps keep participants coming back year after year. Six of this year's students went to physics camp last year, and some former participants, such as Zbarsky and Lin, return as coaches after graduating high school. Even the guest speakers at the closing ceremony, gold medalists from the late 1990s, remarked that it was "great to be back."

Aside from near-complete immersion in physics, the students toured Capitol Hill, meeting some Senators and Representatives. They visited the Spy Museum as well, where Stanley, associate professor at Beloit College in Wisconsin, purchased an electrical pen to shock unsuspecting secretaries and reporters.

Other than such expeditions, their days were physics-filled from 8:30 a.m. to 9:30 at night. During midday breaks, favorite activities included Frisbee and "mind games" such as the Settlers of Catan and Zendo.

The ten-day camp ended with a banquet on Friday, June 1st where the members of the traveling team were announced. The 2007 competitors are Kenan Diab, a senior from Hawken School in Ohio; Rui Hu, a junior from the Charter School of Wilmington in Delaware; Jenny Kwan, a senior from San Marcos High School in California; Jason Larue, a senior from Miami Palmetto Senior High; and Haofei Wei, a senior from Oklahoma School of Science and Math.

They will fly to Isfahan, Iran to match wits with the most promising young physicists worldwide. Last year's team, competing in Singapore, brought home four gold medals and one silver.

The American Association of Physics Teachers is responsible for the identification of the team and organizing the training camp at the University of Maryland. They also sponsor the team and seek congressional funding with help from the American Institute of Physics. Apart from contributing through AIP membership, the APS makes a separate financial contribution to the US Physics Team.

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system's practical feasibility. Gregor Weihs of the University of Waterloo's Institute of Quantum Computing reported on his group's free-space QKD experiment linking a source to receivers in two different buildings separated by about 1.8 km, with no direct line of sight between the two endpoints. The system includes error correction and privacy amplification, and is based on the distribution of entangled photon pairs via optical telescopes.

At the same session, NIST's Joshua Bienfang described how telecommunications clock-recovery techniques can enable the continuous operation of both free-space and fiber QKD systems with GHz transmission rates. His approach can also reduce a free-space systems exposure to solar background photons, thereby reducing the quantum-bit error rate and improving overall system performance.

Attosecond Physics. Sarah Baker of Imperial College in London described a new technique for probing the ultrafast structural rearrangements of light molecules after ionization, demonstrated by her research group earlier this year. The technique is called PACER (Probing Attosecond Dynamics by Chirp Encoded Recollision), and it uses high-harmonic generation to investigate the motion of intramolecular nuclei.

This is possible because the strength of harmonic emission on return of the electron wavepacket is weaker the more nuclear motion has occurred since ionization. Moreover, since different harmonic orders are emitted at different times, it is possible to gain dynamical information simply by recording a harmonic spectrum and studying the change in signal over time.

Single Photon Optics. Mikhail Lukin of Harvard University described two novel approaches for realizing controlled, deterministic nonlinear optics at a single-photon level. Both combine electromagnetically induced transparency and slow light with the tight confinement of photons and atoms. Initial proof-of-principle experiments showed strong coupling between individual CdSe quantum dots and surface plasmons on nano-sized conducting wire.

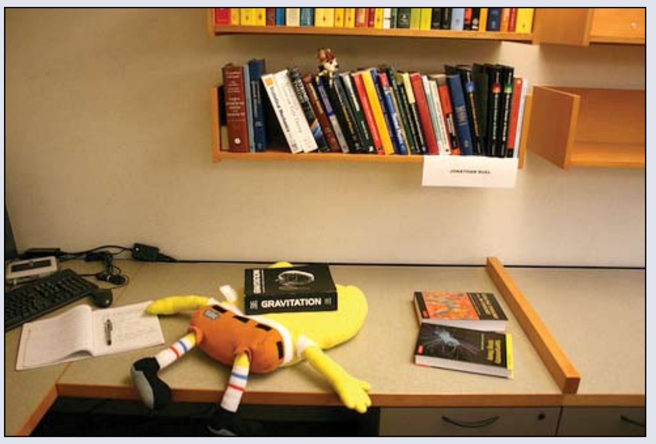
Powerful Laser Light. Todd Ditmire of the University of Texas described how his team is developing a unique petawatt peak power laser using a combination of high peak power chirped pulse amplification technologies. With the Texas Petawatt Laser, it will be possible to probe such exotic physics as Gbar pressures in heated solids, radiative hydrodynamics, and nuclear fusion.

At the same session, Donald Umstadter of the University of Nebraska, Lincoln (UNL), reported on the first experimental results from a new high-power (150 terawatt) laser called Diocles, now in operation at UNL. Scientists are using the ultra-high-intensity light from Diocles to study relativistic laser plasma interactions, which generate bright femtosecond pulses of x-ray and charged particle beams. The laser has potential applications in biomedicine, defense and homeland security, as well as physical science research.

zero gravity

The Lighter Side of Science

Learning the Laws of Physics the Hard Way



Submitted by Jonathan Ruel

Letters

Wind Power Has Great Potential

The letter by Frits de Wette (Claims for Wind Power Greatly Overblown, *APS News* May 2007) makes a few good points but completely ignores the literature that evaluates the wind energy potential, grid integration, and technology in the US and in Europe. For example, the on-shore wind electric potential of the US has been analyzed in considerable detail[1]. Taking into account restrictive land use constraints and economics, the potential is over 1200 GWavg, about 90 percent of which is located in the Great Plains. This potential is understated by about 30 percent since maximum wind turbine tower height was assumed to be 45 m, and towers as high as 100 m are currently being used. This also ignores the US offshore wind electric potential which is very conservatively estimated at about 100 GWavg. Compared to the total US generated electrical power of 440 GWavg (2005), there is clearly the possibility that wind generated electricity could make a substantial contribution to the power supply in the US, especially if energy efficiency and conservation were taken seriously.

Wind turbines are designed to produce power locally at the least possible cost for a given wind regime, which results in a capacity factor (the ratio of average power to maximum power) of about 30 percent. However, it is possible to design wind turbines [2] with a much higher capacity factor. For example, a capacity factor of about 50 percent is possible if the cost of electricity increases by about 10 percent, and even higher capacity factors are obtainable but at an ever-increasing cost. Moreover, if large premiums are paid for wind-generated electricity, as is the case in Germany, then capacity factors of 15-20 percent are tolerable. Since maximizing profitability is the only consideration for the wind turbine owner, low capacity factors are a perfectly reasonable choice.

Good wind resources are usually located far from consumers, and large amounts of intermittent energy are not easily handled by utilities, so that transmission and storage issues must be acknowledged and overcome if intermittent wind energy is ever to contribute significantly to demand. This analysis [3] has been done, and one can conclude that it is technically and economically feasible to transform intermittent wind energy to a reliable power source for distant consumers by combining large-scale wind turbine arrays with high voltage transmission lines and compressed air energy storage (CAES).

CAES is based on gas turbine technology and uses compressed air stored in underground structures (solution mined salt caverns or porous rock in a stratigraphic or structural trap) as the storage medium. This is a proven technology, with plants operating in the US and Germany, and is the lowest cost utility scale storage technology available.

Such an approach to wind energy integration has been taken by a group of Iowa utilities, who are building a 268 MW CAES plant with underground porous rock storage. More details are available at www.isepa.com.

Current wind energy development relies on utilities to provide transmission and back-up for the intermittent power, often without compensation. This is the reason behind the hostility on the part of some utilities and system managers to intermittent renewable energy, and it is evident in the E.ON report cited by de Wette. Of course, demanding anything without compensation is a good way to make bitter enemies. While it may be justifiable for small numbers of wind turbines on a grid, this should not be expected to continue.

It is unfortunate that renewable energy advocates continue to use hand-waving arguments to justify, or simply ignore the difficulties with, integrating large amounts of intermittent renewable energy on the grid, and that skeptics refuse to examine the issues carefully. One can show [4] that it is possible to power a modern industrial economy using intermittent renewable energy, and that it is not technical or economic limitations, but our lack of imagination that prevents us from taking this approach.

Alfred Cavallo
New York, NY

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4. Cavallo, A.J., 2007, *Energy*, 32, 120-127.

Why Not Go Where the Winds Really Blow?

With reference to the letters on wind power in the March and May issues of *APS News*: while it is wonderful to generate electricity (inefficiently) in our own back yards, WHY NOT GO TO WHERE THE WINDS REALLY BLOW? Among sailors, the winds of the far southern hemisphere are well known, particularly at >40 degrees S. latitude. They are known as the furious forties, or even more so the frightful 50's, or smashing 60's. Locations falling into this category would be such as (the infamous) Cape Horn, southern New Zealand and Cape of Good Hope, S. Africa. There are also numerous isolated islands, more like rocks, in the southern oceans, e.g. there is a solitary rock about 300 km south of Cape Horn–just imagine the winds. Locations as above have few calm days where the wind drops to only about 60 km/hr.

The next question is how to move the energy extracted to populated areas, particularly in the case of the more remote of the above sites. Perhaps underseas very high-voltage cables are even currently available; if not, then perhaps this would be a worthwhile area for engineering research. Alternately, possibly the energy could be transported in another form–say electrolysis to generate hydrogen, and maybe that could even be converted to methane or propane. Also, energy-consuming industries might be relocated to near these surplus electric generation areas; e.g. aluminum metal extraction.

Russell W. Dreyfus
Sarasota, FL

US Qualifies as a "Rogue State"

I applaud the emphasis on the human dimension in Elizabeth Turpen's Back Page article (*APS News*, April 2007). But she concentrates on the possibility of pure fissile material becoming available, primarily to terrorists but also to "rogue states". The crucial human dimension, however, is the feelings, of both governments and the people, in countries which have not yet made nuclear weapons but might do so. We should recognize those who have decided not to do so and give them and their countries honor and thus enhance their legitimate national pride.

Associated with that is the human dimension in the United States government which persists in arrogant and non-scientific attitudes. Most scientists argue that the Anti-Ballistic Missile program will not work. The US Senate failed to ratify a test ban when it has been shown that in every postulated scenario the US would be safer with such a ban than without. The military still maintains a stockpile of 10,000 nuclear weapons when 100 should be enough to scare anyone. It must be recognized that in much of the world these three counterproductive actions are enough to classify the USA as a "rogue state". Many scientists and others overseas, with considerable justification, argue that the USA is, in effect, the principal violator of the Nuclear Non-Proliferation treaty, earlier of sections 4 and 6 and recently of sections 1 and 2.

During the cold war between the USSR and USA there were many personal scientific interchanges, in some of which I participated. I and many others have suggested that these personal interactions were crucial in keeping the war cold. Where now are the daily interactions between Iran and the USA? A former minister in the Iranian government recently told me privately that whereas most Iranians were not interested in nuclear energy as recently as 5 years ago, now 70% of the people would vote for a strong supportive position, as a matter of national pride. We need to help them find national pride in peaceful activities for the benefit of the region and the world, instead of the more warlike uses which we, unfortunately, have taught them.

Richard Wilson
Cambridge, MA

Premature Praise for California

In his essay, "Climate Change is all about Energy" that appeared as the Back Page in the May 2007 issue of *APS News*, Drew Shindell writes, "Primarily through mandating more efficient use of energy, California has held its per capita energy use roughly constant since the early 1970s. During this same period, per capita energy use has gone up ~50%, nationwide."

This last statement is not correct. Since the early 1970s, the nation's per capita energy consumption has remained relatively constant–apparently similar to California's (see http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1.pdf). Inasmuch as California's energy consumption has pretty much tracked that of the rest of the nation it might be a bit premature to sing praises to that state's regulatory policies.

John Scofield
Oberlin, OH

Drew Shindell replies:

In my essay on climate change, I referred to California's successful energy efficiency program. I should have made clear, however, that the efficiency gains that greatly diverge from the national average were in the electricity sector. California's per capita electricity use has been roughly constant since the 1970s, while the US as a whole has seen per capita electricity use increase by ~50%. As stated in the essay, the remarkable success in California is primarily due to gains in building, appliances, and utilities. These could be replicated nationwide, and indeed some other states and cities are adopting similar regulations. As electricity generation is the single largest contributor to US greenhouse gas emissions, California demonstrates that increased efficiency can lead to substantial reductions in global warming emissions, with ancillary benefits such as reduction of air pollution and reliance on imported oil. Clearly other sectors of the economy that contribute to overall energy use, such as transportation and industrial emissions, also need to be addressed.

Inconsistency is an Acceptable Price for Democracy

I'm not sure what point Michael Lubell is trying to make with his column about term limits in the May, 2007 issue. Very few of the members of Congress who made term-limit pledges actually honored those pledges in 2006. Instead, those who were replaced failed to get re-elected for a litany of reasons from rampant corruption to lack of character to anger over the war. Mr. Lubell laments the loss of consistency in policy as a result of the election and, recalling the term-limit pledges and the bills passed twelve years ago after the last major "change" election, imagines that the new members are there because of term limits. What actually happened was that we had an election, in which the voters chose new representatives because of the less than satisfactory performance of the old ones. Is he lamenting our democratic political process because of the lack of consistency it occasionally engenders? Or is he, as I suspect, saying that mandatory term limits should be approached with caution? The latter is a perfectly good argument to make, but I must confess a lack of dismay that some of the new members still need to be educated about competitiveness issues and the need for science funding, when I weigh that minor inconvenience against the value of being able to change our government when change is needed. I, for one, will not mourn the "consistency" of the old Republican majority. We should all gladly suffer a little inconsistency and uncertainty about our pet issues, such as science funding, to preserve the means of peaceful change and accountability that elections provide. And I can think of few worse examples to illustrate the dangers of mandatory term limits than the 2006 elections. From where I sit, the 2006 elections demonstrated the benefits of turnover in government, if anything at all.

Andrew Puckett
Newport News, VA

Need a Comprehensive View of Climate Change

I read Drew Shindell's Back Page (*APS News*, May 2007) with interest and appreciate his discussion of the physics of climate change and its relation to energy consumption. It stimulated my interest while at the same time increasing my frustration at ever hoping to gain a comprehensive view of the dynamic equilibrium that results in the climate we have. Lay articles as well as those written for the general physics community seldom (never in my experience) deal with more than one or a few of the mechanisms that affect our climate; and then usually not with enough quantitative (or even ball-park semi-quantitative) detail to allow evaluation of their relative importance.

For example, if an author quotes the amount of carbon emitted into the atmosphere per person per year, I would also like to know how much carbon is absorbed per acre per year of forest, agricultural land, or surface water. Knowing the fractional imbalance in the emission would be an important part of a quantitative understanding.

Likewise, although everyone talks about carbon dioxide, very few talk about methane or ozone like Shindell did. But he gave no quantitative hint about the relative importance of the latter two relative to carbon dioxide.

Water vapor in the air is an infra-red active absorber; why is it not discussed? Is it important or not? If the surface temperature of Earth rises, then the rate of evaporation of water should increase. Will this lead to a run-away effect in global warming or will there be an increase in cloud cover, reflecting sunlight, that reduces insolation?

I sure would appreciate a more comprehensive article on climate equilibrium than the usual one.

Aare Onton
Saratoga, CA

Science Fiction Storytelling, Star Trek Style and Beyond

By Alaina G. Levine

***Editor's Note**: This is the third in a series of articles profiling people trained in physics who have gone on to make their mark in a variety of careers. The first article appeared in the April* APS News.

If you conduct a Google search for "Andre Bormanis", the first thing you'll find is that he is one of the privileged few to have their biography listed on startrek.com, the official website of all that was and is Star Trek (ST). He didn't explore strange new worlds, but rather helped shape them when he served the…um… enterprise, initially as science consultant for ST: The Next Generation, ST: Deep Space Nine, and ST: Voyager, and then later as a writer, story editor, and producer for the last series, ST: Enterprise.

The physics-trained scriptwriter doesn't go to Star Trek conventions anymore, although he still hangs with his buddy Bob Picardo, who played the holographic doctor on Voyager. Bormanis is quick to point out that for him, serving as the Star Trek science consultant was simply a gig, though a successful one at that, which was obviously bolstered by his formal education in atoms, stars, and globular clusters.

"Like physics, storytelling involves problem solving, formulating hypotheses, exploring unexpected connections between phenomena, and seeking a solution," Bormanis explains. In writing, "The premise of the story is the hypothesis. Connections you explore become the plot. The solution is the climax and resolution of the story."

Bormanis holds a Bachelor's in physics (with minors in math and English) from the University of Arizona and a Master's in science, technology and public policy, with a focus on the space program, from George Washington University (GWU).

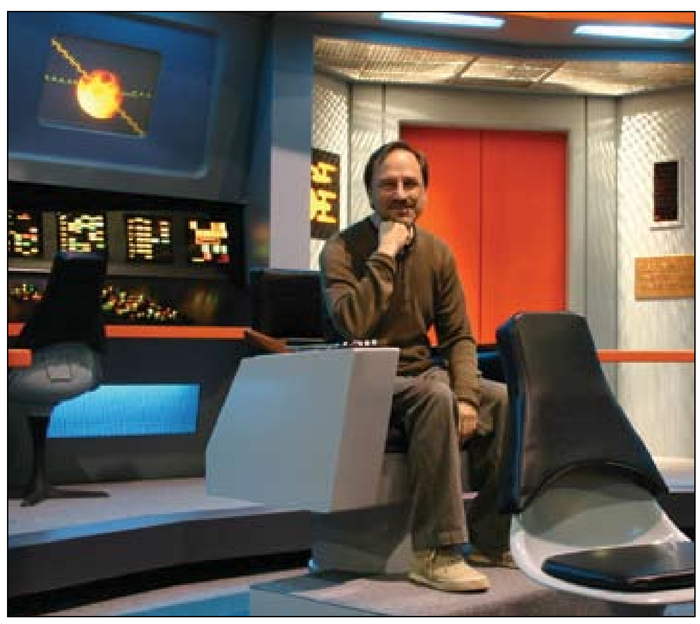
After graduating with his undergraduate degree, he completed a year of post baccalaureate study each in physics and music composition, but found physics graduate school not to his liking. "I didn't have a good reason for being there," he says. "Graduate school was a fallback plan because I couldn't get a job. But starting a PhD in physics as a fallback plan is a bad idea."

He eventually got a job in software development and education in his home city of Phoenix, but having had "the writing bug" since he was a youngster, he soon realized he "had a hankering for some kind of creative arts career," says Bormanis.

He reconnected with friends who were making a living as comedy writers in La La Land at about the same time that the new Star Trek franchise, The Next Generation, launched. Bormanis found himself wondering if he could come up with innovative ideas for a script.

On his own he learned about TV script format and structure, and over a few months, he massaged some ideas into a workable script. Through Bormanis's connections, the script landed in the lap of a Star Trek producer who liked it, but did not purchase it. Bormanis was encouraged, however, and signed up for some scriptwriting classes at Arizona State University (ASU) to hone his new- found craft.

While at ASU, under the apprenticeship of Steve Geller, who had written the award-winning screenplay for the film version of Slaughterhouse-Five, Bormanis received a NASA Space Grant Fellowship to pursue graduate studies at George Washington University. He spent two years there, working on his Master's, all the while becoming a master at not only scriptwriting, but also the battering business of Hollywood as well.


Andre Bormanis fills in for Captain Kirk on the bridge of the Enterprise

Call after call to agents was left unreturned.

In 1993, Bormanis decided he would make one more call to actualize his dream. And like a scene from a movie, not only did he get an agent on the phone who was interested in his work, but more importantly, the woman had a possible job opportunity for him–the position of science consultant to the Star Trek series. With Bormanis' background in physics and writing, the agent was certain he would be perfect for the part.

He flew to Hollywood, where he "auditioned" for the break-out role, by writing a set of tech notes to accompany an actual script for Deep Space Nine. A few weeks later, as Bormanis was completing his fellowship at GWU, he was offered the job as science consultant.

Bormanis's continuing mission at Star Trek was simple: use his knowledge of science to punctuate scripts and make them believable within the realm of the Star Trek universe. He provided suggestions for changes in science content, "filled in the spaces with techno babble", and incorporated both real and invented Star Trek "scientific theory", of which there is an exhaustive history and nomenclature, says Bormanis.

One of his favorite examples of the fictitious Star Trek scientific landscape in which he dwelled revolves around the so-called "Heisenberg Compensators". According to the shows' producers, these "devices" are employed in teleportation to deal with the fact that the Heisenberg Uncertainty Principle states that "you cannot know a subatomic particle's exact position and its exact velocity at the same time," the 1994 Time Magazine article, "Reconfigure the Modulators!" explained. So if you don't know this information, how can you teleport someone and not end up with a mess? Simple. The "Heisenberg Compensators" save the day. And how do they work, you ask? Michael Okuda, a technical advisor on Star Trek, famously countered, "They work just fine, thank you."

Bormanis's physics background was clearly an advantage in his science consulting job. Not only did he better understand the technical "subjects" of time travel, phase shifting, and tricorders, but he was also able to better comprehend and apply terminology from other scientific specialties such as medicine, oceanography, and geology as well. This ability to grasp interdisciplinary technology came in handy on more than a few occasions, and sometimes generated controversy from Bormanis's own fan base.

For one ST episode dealing with a disease, Bormanis recommended the use of the word "antibody" in the script, to accurately describe what the body secretes to fight foreign antigens, such as bacteria, to produce an immune response. Entertainment overruled fact, however, and the producers felt using the word "antigen" in place of "antibody" sounded "cooler", despite its blatant inaccuracy, recalls a tickled Bormanis. When the episode aired, he received emails from irate science aficionados who were insistent on pointing out what they perceived as a mistake on Bormanis's part.

When the last Star Trek show went off the air in 2005, Bormanis emerged victorious from the experience like a Klingon after battle. He had worked his way up to being a writer and producer on Enterprise, and had gained valuable expertise in the broad operations of a television program. He even wrote a book about the science of the show, entitled "Star Trek Science Logs".

He immediately jumped into other projects, working as a producer and story editor on the now defunct show Threshold, which teamed him with his previous Star Trek collaborators, including Brent Spiner, the actor who played Data on The Next Generation.

Bormanis continues to pursue his love of science fiction storytelling. He is currently busy pitching, writing, and researching various new television and film projects.

He easily rattles off the benefits of having studied physics for his career. "It teaches you to think logically, how to work through a problem and stick with it until you finish, and it encourages creativity," he says. And as Andre Bormanis lays in a course for his triumphant future, it is logical that physics will help make it so.

Proposed European Missile Shield's Politics Overshadow Feasibility

Recent media coverage of the United States' plan to install a missile defense shield in Europe has largely focused on the political implications of the shield, paying little attention to the technical difficulties it faces, experts say.

The 10 midcourse interceptor missiles the United States plans on installing in Poland are an unproven defense against a long-range ballistic missile attack, said Frederick K. Lamb, who co-chaired a 2003 APS study on boost-phase intercept systems for missile defense. The existing ground-based midcourse defense system has been tested fewer than a dozen times, scoring six intercepts out of 11 trials since October 1999.

"Not a single test of this system has ever been carried out under realistic combat conditions," said Lamb.

The tests have been scripted scenarios performed under operationally unrealistic conditions, according to the Arms Control Association, a Washington, D.C., based nonpartisan membership organization that supports effective arms control policies. They have taken place at slower speeds and lower altitudes than would be expected in a real attack, and the intercepting missiles were preprogrammed with information on the target.

Russia has been the most outspoken opponent of the new $3.5 billion missile defense system, with President Vladimir Putin last week saying Russia will take "appropriate measures" to counter the system. Washington says the system is essential for protecting the United States and Europe from rogue states like Iran and North Korea. Putin said he believes the system will be used to track Russian military activities.

In July, when North Korea was conducting missile test launches, the missile defense system in Fort Greely, Alaska, was switched from testing status to operational status, suggesting the military's confidence in the system.

"To advertise that this system is ready is misleading," Lamb said. "This system has no demonstrated capability, period."

–Turner Brinton, courtesy of Inside Science News Service

INSIDE THE BELTWAY: WASHINGTON ANALYSIS AND OPINION

Primary Analysis

by Michael S. Lubell, APS Director of Public Affairs

"How do you manage to do it?" a colleague asked me over coffee at the recent DAMOP meeting in Calgary.

"Do what?" I answered, my physicist's ego reflexively aroused.

"Figure out how to get things done in Washington–physicists aren't cut out for politics. And you seem to be pretty good at it."

It was not the first time I had to confront the question. Here's my answer.

Washington really is like physics: problem solving, boundary conditions and laws. It's just that the laws aren't Newton's, Ampere's or Boyle's. But laws, nonetheless, or rules, more appropriately. Once you understand them, you can be a winner.

Members of Congress are pretty smart, on average. And so are the pundits who put food–expensive, elegant food, at that–on the table pontificating about them at their expense. But for the most part, politicians and pundits get their smarts from experience and cultured intuition.

It works extraordinarily well, in most cases. But sometimes lack of analytical training trips them up.

Don't expect me to deliver succulent morsels of politicians' missteps. I'm not about to squander any political good will I've accumulated in the dozen years I've been in Washington by sticking my stiletto into our fine public servants. But pundits are another matter.

Case in point: the presidential primaries. With sixteen months to go before the 2008 elections and primary fatigue already cutting into Ambien and Lunesta's market share, how many times have columnists and talking heads claimed that both parties will choose their candidates by February 5, 2008!

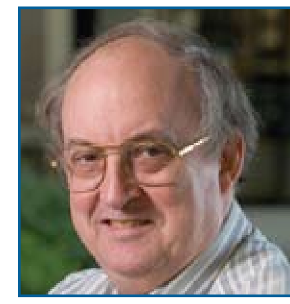
BELTWAY cont'd on page 7

2007 GENERAL ELECTION PREVIEW

It's that time of year again, when APS members have the opportunity to elect next year's leadership from a slate of candidates selected by the APS Nominating Committee. Brief biographical descriptions for each candidate can be found below. Those elected will begin their terms on 1 January 2008. Members will elect a Vice President, Chair-Elect of the Nominating Committee, and two General Councillors. All votes must be entered by Noon, Central Daylight Time, September 1, 2007. Expanded biographical information, candidates' statements, and further information about the election can be found at www.aps.org/about/governance/election/index.cfm .

Vice President

William Bardeen
Fermilab



William Allan Bardeen received his AB degree from Cornell University in 1962 and his PhD degree in physics from the University of Minnesota in 1968. Following research appointments at the Institute for Theoretical Physics at Stony Brook and the Institute for Advanced Study at Princeton, he was an Assistant and Associate Professor in the Physics Department at Stanford University. In 1975 Bardeen joined the staff of the Fermi National Accelerator Laboratory, where he has served as Head of the Theoretical Physics Department. He has been a member of the Executive Committee of the Division of Particles and Fields of the APS and served on the Editorial Boards of the *Physical Review* and the *Journal of Mathematical Physics*. Bardeen was elected Fellow of the APS in 1984. He was inducted as a Fellow of the American Academy of Arts and Sciences in 1998 and elected a Member of the National Academy of Sciences in 1999. In 2002 Bardeen was awarded an honorary degree by the University of Minnesota. He has also served as a Member and Trustee of the Aspen Center for Physics. Bardeen was awarded the 1996 J.J. Sakurai Prize of the APS for his work on anomalies and perturbative quantum chromodynamics. In 1985, he was awarded a John Simon Guggenheim Memorial Foundation Fellowship for research on the application of quantum field theory to elementary particle physics. Previously, he received the Senior Scientist Award of the Alexander von Humboldt Foundation and an Alfred P. Sloan Foundation Fellowship for research in theoretical physics.

Curtis Callan
Princeton University

Curtis Callan received his AB in physics from Haverford College in 1961 and his PhD from Princeton in 1964. In 1967, after postdoctoral work at Princeton, he took up an assistant professorship in physics at Harvard University. In 1969, he moved back to Princeton as a long-term member of the Institute for Advanced Study and rejoined Princeton University in 1972 as a professor of physics. He has remained at Princeton ever since and is currently the J. S. McDonnell Distinguished University Professor of Physics. Callan has held visiting professorships at the University of Paris, the Ecole Normale Superieure (Paris), the Institute for Advanced Study, the Stanford Linear Accelerator Center and Caltech, where he was Gordon Moore Scholar. His administrative responsibilities at Princeton have included being chair of the Physics Department and helping establish the Lewis-Sigler Institute for Integrative Genomics. He is the founding director of the Princeton Center for Theoretical Physics, an enterprise devoted to enhancing the postdoctoral training of theorists in frontier areas where physics engages other fields. His work for the physics community at large includes service on visiting committees of physics departments and national laboratories in the US and abroad, membership on the board of the NSF Institute for Theoretical Physics at UCSB, and chairmanship of the Nominating Committee of the APS. Callan is a long-time member, and was chairman from 1990 to 1995, of JASON, a group that advises the US government on national security implications of science and technology. This activity has given him insight into the role of science in the "real" world and, incidentally, greatly broadened his horizons in physics itself. Callan was elected to membership in the National Academy of Sciences in 1987. He received the 2000 Sakurai Prize for Particle Theory of the APS and was the recipient of the 2004 Dirac Medal of the International Center for Theoretical Physics. He has held a Sloan Fellowship, is a Fellow of the American Physical Society, and is also a member of the American Academy of Arts and Sciences.

Chair Elect, Nominating Committee

Angela Olinto
University of Chicago

Angela V. Olinto is Professor in the Department of Astronomy and Astrophysics and the Enrico Fermi Institute, and a member of the Kavli Institute for Cosmological Physics at the University of Chicago. Her research interests are in astroparticle physics and cosmology. Olinto received her B.S. in Physics from the Pontificia Universidade Católica, Rio de Janeiro, Brazil and her PhD in Physics from the Massachusetts Institute of Technology (1987) for work on the physics of quark stars. At Fermilab, she worked on inflationary theory and cosmic magnetic fields. Her recent work has focused on the nature of the dark matter in the universe and the origin of the highest energy cosmic particles. She is a member of the international collaboration of the Pierre Auger Observatory. Olinto was Chair of the Department of Astronomy and Astrophysics at the University of Chicago. She is a Fellow of the APS, a trustee of the Aspen Center for Physics, and has served on many advisory committees for the NRC, DOE, NSF, and NASA. In 2006, she received the Chaire d'Excellence Award of the French Agence Nationale de Recherche.

Jorge Pullin
Louisiana State University

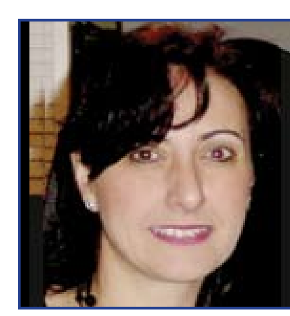
Jorge Pullin is the Horace Hearne Chair in Theoretical Physics at the Louisiana State University. His research interests center in theoretical gravitational physics, both in its classical and quantum aspects, including the application of numerical techniques. He recently served as the chair of the Topical Group in Gravitation of the APS. His administrative experience also includes serving as associate director of Penn State's Center for Gravitational Physics and Geometry and as co-director of the Horace Hearne Jr. Institute for Theoretical Physics at Louisiana State. He is the managing editor of *International Journal of Modern Physics D* and serves on the editorial board of *New Journal of Physics* and served on the board of *Classical and Quantum Gravity* (both journals of the Institute of Physics UK). He is one of the US representatives at the International Committee for General Relativity and Gravitation. He has received several distinctions, including Alfred P. Sloan, John S. Guggenheim and Fulbright fellowships, a Career Award from the National Science Foundation and the Edward Bouchet Award of the APS. He is also a corresponding member of the National Academies of Science of Argentina and Mexico and of the Latin American Academy of Sciences. He is a fellow of APS, of the Institute of Physics (UK), and the American Association for the Advancement of Science. He got his doctorate in physics from the Balseiro Institute in Argentina in 1989.

General Councillor

Ani Aprahamian
Notre Dame University

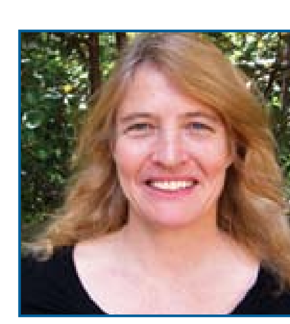
Ani Aprahamian has been a professor of physics at the University of Notre Dame since 1989. She received her PhD in Nuclear Chemistry from Clark University working at the High Flux Beam Reactor at Brookhaven National Laboratory. She was a postdoctoral fellow at Lawrence Livermore National Laboratory. She has been the PI and director of the Nuclear Structure Laboratory at the University of Notre Dame, and the Chair of the Physics Department. Ani is a fellow of the APS, the Reilly Center for Science, Technology, and Values, and the "collegium" at Notre Dame. She has worked on many university committees on Academic Life, Cultural Diversity, Campus Climate, sexual discrimination, and Academic Affirmative Action. She has served on the APS committee on the Status of Women, International Freedom of Scientists, and various Division of Nuclear Physics committees including encouraging competitive enhancement of women (WECAN).

Marcela Carena
Fermilab



Marcela Carena is a senior scientist at the Fermi National Accelerator Laboratory in Batavia, Illinois. She received her Diploma in Physics from the Instituto Balseiro of Bariloche, Argentina in 1985, and her PhD in Physics from the University of Hamburg in 1989. She was a John Stuart Bell Fellow at CERN from 1993-1995 and was awarded a Marie Curie Fellowship in 1996. She has been a staff scientist at Fermilab since 1997. Carena is a theoretical particle physicist working at the frontiers of physics beyond the Standard Model. She is a member of the APS Committee on International Scientific Affairs. She is a former member of the APS Division of Particles and Fields Executive Committee, the current chair of the DPF Nominating Committee and a Fellow of the APS. She serves on the Particle Physics Project Prioritization Panel (P5) of the U.S. DOE/NSF High Energy Physics Advisory Panel. She originated an innovative visitor program that brings Latin American students to pursue research at Fermilab as part of the graduate education at their home institutions. She has given public outreach lectures in conjunction with physics workshops and in the Fermilab area. Carena is married and has two children.

Katherine Freese
University of Michigan



Katherine Freese is Professor of Physics at the University of Michigan and Associate Director of the Michigan Center for Theoretical Physics (MCTP). Her research is in the area of theoretical cosmology, at the interface of particle physics and astrophysics. She received her BA in Physics from Princeton University her MA in Physics in 1981 from Columbia University; and her PhD in Physics in 1984 from the University of Chicago, where she was recipient of the William Rainey Harper Award Fellowship. Her first postdoctoral position was at the Harvard/Smithsonian Center for Astrophysics, followed by a postdoc-

PREVIEW continued on page 7

MUSEUM cont'd from page 1

More College in Crestview Hills, Kentucky.

Riehemann toured the museum and took note of many examples of how the museum misrepresented science. "A constant theme is the idea that creation science accepts many of the regular physical mechanisms but finds ways to speed them up via catastrophic events," he said.

The exhibits try to convince viewers that creationists and the scientists both start with the same facts, but interpret them differently. "They never talk about what science really is," said Krauss.

The National Center for Science Education, an organization that promotes the teaching of evolution, has circulated a petition to scientists in Ohio, Kentucky, and Indiana. By early June nearly 1000 scientists had signed the statement, which calls the museum scientifically inaccurate, and expresses the concern that "Students who accept this material as scientifically valid are unlikely to succeed in science courses at the college level. These students will need remedial instruction in the nature of science, as well as in the specific areas of science misrepresented by Answers in Genesis."

In addition, DefCon, the Campaign to Defend the Constitution, an organization that aims to combat the influence of the religious right, has circulated a petition opposing Answers in Genesis' "nefarious campaign to institutionalize a lie." Nearly 25,000 concerned citizens and more than 4,000 educators signed the DefCon petition. DefCon also distributed a pamphlet developed by Krauss entitled, "Top 10 Reasons why the Universe, the Sun, Earth, and Life are not 6000 years old: A Primer."

This museum may not change many people's minds about science, since many of the visitors probably already believe the biblical creation story. "I'd say most of the people that go are going there for validation," said Krauss.

However, Krauss and others worry that some people may visit the museum because they are just curious, and those people, especially children, may come away confused. "And that means we'll have a harder job convincing them," said Krauss.

Riehemann pointed out how confusing it would be to a typical visitor, who does not have the ability to evaluate the technical arguments used by Answers in Genesis. "If one looks through the technical matter in the bookstore, it is possible to find references to Calabi-Yau manifolds and the work of Witten and Strominger," he said. "Most people are completely overwhelmed by this material–and very, very impressed by it."

Scientists can help the public understand and evaluate the museum's arguments, said Riehemann. "No one, to my knowledge, objects to the right of AIG to have a museum and present their views. However, in a population ill-equipped to distinguish the silliness of AIG science from the real thing, it is important that the scientific community acknowledge the museum, but also to comment on the low quality of the content in order to assist the public in its evaluation."

The Creation Museum expects to attract about 250,000 visitors in its first year.

The Petersburg, KY Creation Museum is the largest, but not the only museum promoting the biblical creation story. Dozens of smaller creationist museums exist in the United States, and a $300,000 creation museum opened in the small town of Big Valley, in Alberta, Canada in early June.

BOARD continued from page 1

questing that they thank their senators for passing this legislation. "The Senate has done something important, and it will benefit from being told so," Kadanoff's letter to members says.

In early June the APS Executive Board voted by email to pass the resolution expressing appreciation to both the House and the Senate.

The House and Senate authorization bills must still be reconciled in conference. Authorization bills set the maximum allowable spending levels; actual funding levels will be set by appropriations bills, which have not yet been passed.

On June 6 the House Appropriations Committee approved the House Energy and Water Development Appropriations bill, which allocates $4.516 billion to the DOE Office of Science for FY08, an increase of $716.8 million over the FY07 budget and $116.2 million above the President's request.

The APS Executive Board resolution also thanks the House Energy and Water Development Appropriations Subcommittee for this allocation.

The full text of the board resolution is posted on the APS web site at http://www.aps.org/policy/issues/resolution.cfm .

BELTWAY cont'd from page 5

Super Tuesday, as it used to be called, is now known as Power Ball Tuesday, or, in the high-tech ad lingo, Giga Tuesday. It's the day on which both parties will select about forty percent of their delegates.

Political "wisdom" holds that to compete effectively on that quasi-national primary day, candidates will have to amass hundreds of millions of dollars. Otherwise, they will be out of the running. With the field whittled to just two or three, pundits say, someone will emerge with enough delegates to lock up the nomination.

Is that so? Let's do the analysis. For brevity, I'm going to focus on the Democrats.

First the boundary conditions: Democrats, who currently have 8 announced candidates, will send 5110 delegates to their August 2008 convention in Denver. Of those, 314 will be "super-delegates"–governors, Senate and House members and non-voting congressional representatives of the District of Columbia and the territories. The selection process will begin on January 14 with the Iowa caucuses and end on June 3 with primaries in Montana and South Dakota. By February 5, voters will have chosen 2401 delegates.

Now the rules: Any candidate receiving 15 percent of the vote in any caucus or primary will receive a proportional share of the delegates elected. Typically, delegates will be bound to vote for the candidate they have endorsed on the first convention ballot. All "super-delegates" will remain officially uncommitted, although they may endorse candidates at any time. Primary candidates who choose public matching funds must limit their spending to slightly less than $45 million.

Finally, the analysis: With the primary schedule so compressed and about $22 million in public matching funds available to any candidate, what are the odds that any of them will drop out before February 5? With delegates allocated proportionately, even if only Clinton, Edwards and Obama compete effectively, what are the odds that one of them emerges from Giga Tuesday with enough delegates to have the nomination locked up? And, finally–forget about February 5–what are the odds that anyone will have a majority of the 4,081 delegates chosen by April 1?

If you answered slim, slim and slim, you're on the right track, which leads me to my conclusion: We might not know the nominee until after the convention. And that means if you want to get an issue–for example, science–on the presidential agenda, you have to hit virtually every candidate's primary campaign starting now.

ANNOUNCEMENT

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**

Electronic and transport properties of nanotubes

Jean-Christophe Charlier, Xavier Blase and Stephan Roche

Carbon nanotubes are of great fundamental and applied interest, given their unusual electronic properties linked to their specific topology. This article reviews the electronic structure and transport properties of these 1D systems, including localization effects due to defects and the Aharonov-Bohm effect.

PREVIEW continued from page 6

toral fellowship at the Kavli Institute for Theoretical Physics at Santa Barbara and a Presidential Fellowship at the University of California, Berkeley. She was an Assistant Professor at MIT from 1987-1991, where she was recipient of a SLOAN Foundation Fellowship as well as an NSF Presidential Young Investigator Award. She is now Professor of Physics at the University of Michigan. Freese has served on many advisory panels and committees, including: Member of the Board of the Kavli Institute for Theoretical Physics in Santa Barbara from 2000-2003; General Member of the Board of the Aspen Center for Physics from 1993-2003; she is currently a member of the Astronomy and Astrophysics Advisory Committee (AAAC) mandated by Congress; she currently serves on the DMSAG (Dark Matter Scientific Advisory Group).

Jen-Chieh Peng
University of Illinois Urbana-Champaign

Jen-Chieh Peng is Professor of Physics at the University of Illinois at Urbana-Champaign. He received his bachelor's degree in physics from Tunghai University in Taiwan in 1970 and his PhD in nuclear physics from the University of Pittsburgh in 1975. He worked as a researcher at CEN Saclay, France and the University of Pittsburgh before joining the Physics Division of Los Alamos National Laboratory in 1978. He became a Laboratory Fellow at Los Alamos in 1996. He joined the Department of Physics at the University of Illinois in February 2002. His research interest includes a range of topics in nuclear and particle physics. Peng is a Fellow of the APS. He currently serves as a member of the Division of Nuclear Physics Fellowship Committee. He also served recently as a member of the APS Committee of International Freedom of Scientists and the APS Forum on International Physics. He is currently on the Program Advisory Committee of the J-PARC accelerator facility in Japan and the Advisory Committee of the Institute of Physics, Academia Sinica, and served recently as a member of the Program Advisory Committee of the Jefferson Lab. He just completed a two-year term as the President of the Overseas Chinese Physics Association

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International Councillor

Se-Jung Oh
Seoul National University, Korea

Se-Jung Oh received his PhD in physics from Stanford University in 1982, and worked at Xerox Palo Alto Research Center until he returned to Seoul National University, his Alma Mater (BS in physics in 1975). He is now a full professor at Department of Physics and Astronomy, director of the Center for Strongly Correlated Materials Research (CSCMR), and has been serving as the Dean of College of Natural Sciences since 2004. He is also the chairperson of the Association of Deans of college of natural sciences in Korea, vice president of the Korean Physical Society, an executive board member of the Korean Vacuum Society, and a full member of the Korean Academy of Science and Technology. He is currently a member of the International Advisory Board (1998-2007) of the Vacuum Ultraviolet Radiation Physics (VUV), and has served as a member or a chairperson of the organizing or program committees of various international conferences. He also served as a foreign guest editor for the *Journal of the Physical Society of Japan* (2004-2005). S.-J. Oh's research interest focuses on the study of electronic structures of strongly correlated electron systems, especially transition metal compounds and rare-earth materials. He has also been quite active in advising Korean government on science and technology policies. Early on he served as a member of the Presidential Commission for the 21st Century of Korea in the committee of science, technology and environments ('89-'94), and later became a member of the Presidential Advisory Council on Science and Technology in Korea and served for 3 terms between 1999-2006. He is currently a member of the Committee for the Promotion of Basic Research in Korean government. He also spent much effort for the public understanding of science and the promotion of science education.

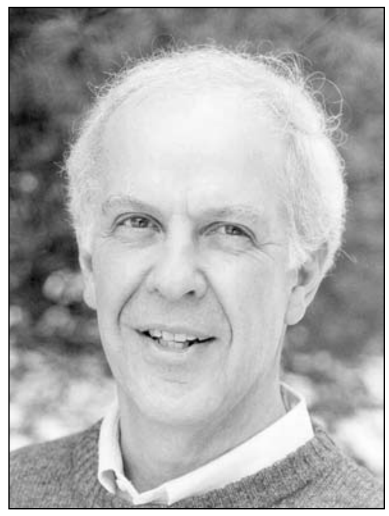
Sabyasachi (Shobo) Bhattacharya
Tata Institute of Fundamental Research

Sabyasachi (Shobo) Bhattacharya is an experimental condensed matter physicist. He is currently Director of the Tata Institute of Fundamental Research (TIFR), Mumbai, India and a Senior Professor in its Department of Condensed Matter Physics and Materials Science. Bhattacharya received his undergraduate education in India at Presidency College, Kolkata and University of Delhi and his PhD in physics in 1978 from Northwestern University. He spent his post-doctoral years at the University of Rhode Island, Francis Bitter National Magnet Laboratory and as a James Franck Fellow at the University of Chicago. Subsequently, he worked at Exxon Corporate Research, New Jersey and at the NEC Research Institute, Princeton. In 2002 he left NEC, where he was a NEC Fellow, to join TIFR. He has also been a frequent visitor at the International Centre of Theoretical Physics in Trieste over the last two decades. His research activities over the years include complex fluids such as liquid crystals, micelles, microemulsions and glass forming liquids, as well as dynamics of disordered condensed matter systems such as vortex matter in superconductors, sliding charge density waves and glassy systems in general. His current research interests include scanning probe studies of domain wall dynamics in systems such as ferroelectrics, ferromagnets and multiferroics, as well as optical tweezer-based studies of complex fluids. Bhattacharya is a fellow of the APS and of the National Science Academy, India. He also serves as a member on the Commission on Structure and Dynamics of Condensed Matter of the International Union of Pure and Applied Physics (IUPAP), the editorial board of *Reports on Progress in Physics of the Institute of Physics*, UK, the Scientific Advisory Committee to the Cabinet, Government of India and the Basic Sciences Steering Committee of the Planning Commission, Government of India.

The Back Page

The Violence of Our Knowledge: On Higher Education and Peace Making

By Parker J. Palmer



Non-violence was not a live notion for me until I stumbled across the Quaker tradition. Until then all I knew about Quakers was their wonderful oatmeal—and it turns out they don't even make it. But thirty-three years ago, at age thirty-five, I discovered a Quaker living-learning community near Philadelphia called Pendle Hill where I worked for eleven years as dean of studies and writer in residence.

The core Quaker belief is that there is an inner teacher, an inner light in every human being, a sacred core worthy of respect. When I asked why the community at Pendle Hill made decisions via a laborious, tedious, time-consuming and utterly maddening process called consensual decision-making, I was told, "Because making decisions by majority rule is a form of violence."

Violence is not just about bombing or shooting or hitting people. Violence is any way we have of violating the integrity of the other. Racism and sexism are violence. Derogatory labeling of any sort constitutes violence. Rendering other people invisible or irrelevant is an act of violence. So is manipulating people towards our ends as if they were objects that existed only to serve our purposes.

But it is possible to have lively, rigorous, engaged intellectual debate that is conflictual but utterly non-violent because it does not violate the integrity of those speaking and listening. What I like about the Quaker way of decision-making is how it embraces and affirms the creative potential of conflict, because consensus forces us to hold the tension of opposites. We are forced to hold that tension long enough that it might pull us open to a new way of looking at things–to a third possibility that has yet escaped both parties to this particular debate. Non-violence does not involve the absence of conflict. Anybody who's ever tried to "speak truth to power" knows it's an act that brings conflict. And yet it is an act that, taken with integrity, creates this pole of opposition which can stretch a whole society open to something new.

I also learned from Quakers that one key to non-violence is avoiding the arrogance of believing that I know how others should live their lives. Instead, I need to look within and ask myself the question, "Am I living in that light and power that takes away the need for violence?" Quakers do not have a prescription for running a nation-state. They have an understanding of personal responsibility. We need to engage in an ongoing self-examination of the seeds of violence that we plant with our attitudes and actions, plants that we have the power to uproot.

"The pursuit of truth, a life of inquiry, involves constantly making yourself vulnerable"

This brings me to my understanding of violence within the university. When I was a graduate student at the University of California, Berkeley, I had a friend who felt brutalized by his graduate student experience. When he left with PhD in hand, I felt certain that he would go out into the world as a professor who loved and cared for students. But he did not. He became one of the most brutalizing professors I have ever known. One thing that happens in academic life is the generational passing on of wounds. If violence is done to me in this community, and I come back to this community in a role of authority, it sometimes (not always) happens that I don't know what to do with my wound except to work it out on other people: "This was my initiation rite and it's going to be yours too."

The irony is that the university explicitly promotes authentic inquiry and genuine discourse, both non-violent ways of being in the world. Violence in the university comes not from our explicit mission but from our "hidden curriculum." Imagine a political science professor teaching a course on the values of democracy, but teaching it in a way that essentially says to students, "Listen to what I say, sit down, shut up, make notes on it and feed it back to me at the end of the term." What students are learning is not the values of democracy but the habits that keep you safe in a totalitarian society. The hidden curriculum is inculcating a completely contradictory set of values via pedagogical violence.

Another part of our hidden curriculum is the notion that competition is the best way to induce learning and elicit truth. That's the theory–I call it a myth. I have been in many situations where the intellectual competition was fierce. But what I observed there was not the generation of new ideas, not the pursuit of truth, but people reaching for old ideas that they knew how to wield as weapons, so that they could protect their flank, fend off the opposition, and emerge unbloodied and unbowed. Nothing in my experience says that fierce interpersonal competition will bring us closer to new truth. Rather, it drives us back to ideas with which we are well-acquainted, because with them we're not vulnerable: we know all the possible criticisms that we might hear and we are prepared to defend ourselves on every front.

The pursuit of truth, a genuine life of inquiry, involves constantly making yourself vulnerable to the half-formed thought, the tentative probe, the idea that you can barely bring to articulation. You will not do that in the midst of battlefield conditions. Under the conditions of intense competition, we listen not for what is strong, well-shaped and well-informed in the other's ideas, for that which might amplify our own thinking. Rather, we listen for the weakest link–and we pounce on it.

How often in the thirty years I've been traveling in higher education has someone said to me, "I like ninety-nine percent of what you said, but there was one thing that was dead wrong, and I am going to beat you up about it!" These are not the conditions under which the mission of the university is advanced. Under conditions of fear, students are not induced to learn. They are induced instead to play it very close to the vest. So we have a hidden curriculum in the university called "the cult of competition" that I think plants seeds of violence among us.

The deformations that lead us toward violence of this sort begin in the epistemological root system of our educational enterprise. Every epistemology, I suggest, tends to become an ethic.

Our conventional epistemology includes the habit of objectification, of approaching whatever we are studying–a literary text, a phenomenon from the natural world, or some data about human behavior–and making it into an object. The theory is that if we do not make it an object by holding it at distance, we will commit the grave sin of tainting it with our subjectivity. And the subjective self is thought to be nothing more than a source of bias, ignorance, and error.

But real scientists don't objectify that way. Real scientists engage the things of the world with imagination and intuition as well as intellect, logic, and information. As a young woman, the great biologist Barbara McClintock became fascinated with the phenomenon of genetic transposition. But at the time, her science lacked the instruments that now allow now direct observation of the data, and lacked a theoretical structure to make sense of the questions she was raising. She experienced a lot of marginalization as a scientist until she reached her early eighties, when she received a Nobel Prize. Someone later asked her, "Tell me, how do you do science?" McClintock said, "All I can really tell you about doing real science is you've got to have a feeling for the organism."

I was educated at some of the best institutions in this country about the history of the Third Reich–the murder of six million Jews, persons with mental and physical disability, Gypsies, protesting Christians, anyone who didn't fit the mold. And I was taught that history at such objectified distance that I somehow ended up feeling that all of that had happened on another planet to another species. My professors were not revisionists; they did not say it did not happen. But they gave the facts and figure such an antiseptic presentation that the whole thing seemed unreal, unrelated to me.

There were two things in particular that I should have learned but did not because of this tendency towards objectification. One was that the very community in which I grew up practiced its own form of systemic anti-Semitism during my childhood. I should have known, as part of being a truly educated person, that what animated the Third Reich was not about another planet and another species, but about my own hometown and people I knew.

I also failed to learn that I have within myself a certain "fascism of the heart." When the difference between you and me gets too great, when your version of what is good or true or beautiful becomes too threatening to mine, I will find some way to kill you. I won't do it with a bullet or a gas chamber. But I will do it with a label, a dismissive name, any way of rendering you irrelevant to my life in order to reduce the tension between your view of reality and mine.

Another part of our "objectivist" epistemology that plants the seeds of violence is reductionism. If the objects of our study have no subjective reality, no inner truth, then we can simply reduce them to whatever terms meet our needs, whatever framing fits our logic. But when we do that, we end up with a world of objects to which we are free to do violence.

If the self is nothing more than a social construct, if the self has no ontological reality to it, then why not just reengineer it, manipulate it, or eliminate it if it gets too annoying? If we reduce the world to our own convenient terms, what is to keep us from doing violence when the shape of the world doesn't fit our theory or our needs?

"...when your version of what is good or true or beautiful becomes too threatening to mine, I will find some way to kill you."

Reductionism diminishes our scholarship as well as our ethical lives. You cannot possibly be a good scholar if you do not know how to receive and perceive the other on its own terms. What physicist or astronomer or chemist ever got anywhere by trying to reduce the amazing phenomena he or she is working with to the convenient frames that work for his or her own mind, at this moment, given the shape of our knowledge? That's not where discovery comes from; that's not where breakthroughs emerge.

So what can we do about the violence of our knowledge? We don't need to import a new culture to the academy. We need to reclaim the best of the culture in which we have always been rooted. For example, scholars at their best always have respect for otherness, whether it comes to subatomic particles or people. If we could reclaim that simple epistemological principle that knowing requires respect, we could get a good start on reducing violence in the academy.

We can reaffirm that learning to hold ambiguity, contradiction, paradox and tension, without seeking quick, simplistic resolutions, is at the core of being an educated person. The tension we feel as we experience otherness need not lead to violence: it can lead to opening ourselves to a larger view of reality, which is what scholarship, teaching and learning are supposed to be about.

We can also try to overcome the deep divide that runs down the middle of the academy between the "soft" virtues of the heart and the "hard" virtues of the mind. This is an utterly bogus division because the human self does not operate out of airtight compartments: heart and mind work together. If we want genuine rigor that is capable of advancing thought–inviting the tentative probe, the challenging question, the admission of ignorance–we must have deep hospitality in our classroom and other settings of discourse. These are the behaviors that induce rigor, and they will not happen in a hostile, inhospitable space.

So I invite us as educators to confront the question "What are the seeds of violence in our institutional and personal lives?" If we are willing to do so, we can make an immediate and lasting contribution to the world in which we live.

Parker J. Palmer is a writer, traveling teacher, and activist who focuses on issues in education, community, leadership, spirituality and social change. Author of seven books, including The Courage to Teach, *he holds ten honorary doctorates, and in 1998 was named by The Leadership Project (a national survey of 10,000 administrators and faculty) as one of the thirty "most influential senior leaders" in higher education and one of the ten key "agenda-setters" of the past decade. This article is adapted from a public lecture he delivered on November 29, 2001 at the University of Wisconsin, Madison.*