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Woodstock West: Celebrating the New MgB_2 Superconductors

The excitement was palpable in the Grand Ballroom at the Westin Hotel in Seattle on Monday night, March 12, as physicists, attending the APS March Meeting from around the world, gathered for a mammoth technical session discussing the discovery and subsequent experimental results on the newly discovered superconducting compound magnesium diboride (MgB_2), first discovered less than two months ago in a laboratory in Japan. Speakers flew in from Japan, Korea, Switzerland, Italy, Britain, China, France, the Netherlands and Germany, in addition to numerous speakers from the US. A total of 79 ultra-short (2-minute) papers were presented, with the session running past one the following morning. It was quickly dubbed "Woodstock West," in memory of the so-called "Woodstock of Physics" at the 1987 APS March Meeting where the discovery of high-temperature superconductivity was first announced.

Like many historical breakthroughs in science, the compound's discovery was partially serendipitous (although this was not the view of the discoverers—see Members in the Media on page 2). Jun Akimitsu's research group at Aoyama-Gakuin University in Tokyo were attempting to make a chemical analogue of CaB_6, a semiconducting material that becomes ferromagnetic, like iron, when doped with a small amount of electrons. They tried to replace calcium with magnesium, which is directly above it in the periodic table. One of their starting materials was MgB_2, a common compound known since 1953, which had been overlooked by physicists for decades in the search for new superconductors. "It's just that nobody bothered to cool it down and measure its superconducting properties," says David Cardwell of Cambridge University.

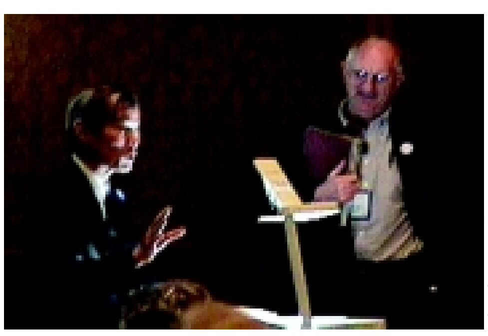

Photo by Antonio Bianconi

Jun Akimitsu makes a point as session co-chair John Clarke looks on.

It was while routinely measuring the properties of MgB_2 before using it as a dopant in high temperature superconductors that Akimitsu's group made the startling discovery that the compound had a transition temperature of about 39K. The previous highest transition temperature for a metallic superconductor — niobium tin — was 20K. Akimitsu's group and several others have already begun to explore whether it may be possible to raise the superconducting transition temperature of MgB_2 further by lacing the compound with other elements.

"Discovery of superconductivity at 39K in the simple hexagonal diboride compound MgB_2 proves that there are still remarkable scientific surprises," says J.D. Jorgensen of Argonne National Laboratory. From a physics standpoint, the chief interest in the compound is the possibility that the old BCS theory, which has proven useful for low temperature metallic materials but not for the higher temperature ceramic materials, might still be relevant at 40K, where the MgB_2 materials become superconducting. "How much this discovery changes the path of materials physics depends on whether

See MGB2 *on page 6*

APS Responds as Visa Problems Rise

If the number of calls for help received by the APS International Affairs office is any guide, more and more physicists abroad are being frustrated in their attempts to get the visas they need to pursue collaborations or attend meetings in the United States.

According to Irving Lerch, Director of International Affairs, the office is handling between three and five requests a week, many from physicists on the "sensitive countries" list like India, China and Russia, whereas a year ago the number might have been one or two a month. While the APS is often successful in interceding with consular officials with supporting information and clarifications, Lerch cautions that it is crucial for potential hosts to get involved. Helping with the proper documentation is of course essential, but it is also necessary to learn about some of the more common impediments to granting visas imposed by the law and various regulations.

"The State Department has a web site with a great deal of information and each major consulate also has a web site," he says. "Check with the visa office of the host institution and don't be afraid to dig into http://www.travel.state.gov/visa_services.html which contains more than enough information on visas to occupy the mordant curiosity of any concerned colleague."

When asked to explain the dramatic increase in visa problems, Lerch points to several possible factors. A major one is lack of adequate staff at some of the busiest consulates abroad. He cites one consulate which employs seven principal foreign service officers, 270 local service staff, and 270 support personnel assigned in Washington, DC, to

See VISA *on page 7*

Physics Teachers Gather at March Meeting

Edward Lee/APS

Bill Keller, a Washington state high school physics teacher, observes an image under the watchful eye of Lezlie DeWater from the Physics Education Group of the University of Washington. This activity was part of a workshop on teaching physics by inquiry, conducted by Lillian McDermott, the leader of this group.

March Meeting Prize and Award Recipients

Photo by William Stickney

Front row (l to r): Steven Oliver, Jacob Krich, Victor Emery, Mildred Dresselhaus (standing), Heather Lynch, Masao Doi. Back row: W. E. Moerner, Louis Brus, Donald Eigler, Arthur Gossard, Henry Glyde, Lewis Edelheit, James Faller, Klaus Schmidt-Rohr, Ellen Williams, Bertrand Halperin. Not shown: Vladimir Arnol'd, Alan Luther.

MgB_2 Session Hits the Web

Over a thousand people packed into the Grand Ballroom of the Westin Hotel in Seattle when the APS March-Meeting post-deadline session on Magnesium Diboride (MgB_2) began at 8 pm on March 12. Interest was intense, although the crowd had dwindled to perhaps a couple of hundred when the 79th and final paper was presented at about 1:15 am.

In addition to the physicists in the audience and at the podium, a team of APS staff members was ensconced at a special table in the front of the room, frantically collecting transparencies from the speakers who careened off the podium at the rate of one every 3 minutes, and then photographing the transparencies with a digital camera.

Meanwhile, in the back of the room, an audio-visual technician was recording the session both on video tape and on digital audio tapes. All of this information was transported back to APS headquarters in College Park, MD where the images of the transparencies were digitally enhanced and were correlated with the various talks. With the aid of special software, APS information technology specialists then synchronized the transparencies with the audio tapes, using the video tape as reference.

The result of these efforts was posted on the APS web site (http://www.aps.org) in batches as the talks became ready. All the talks were available by March 30. A visitor to the site who has the appropriate RealPlayer software can now click on a particular talk, see an abstract, and listen to the audio, with the relevant transparencies popping onto the monitor just when the speaker would have placed them on the overhead projector at the meeting. "This comes close to reproducing the experience of someone in the audience," said Jim Egan, APS Senior Systems Analyst, who spearheaded the information-technology part of the effort.

See WEB SESSION *on page 7*

A Call to Action on Nanotech Initiative

Announced by then-President Clinton in January 2000, the National Nanotechnology Initiative has enjoyed strong federal support and funding in the first one year of its existence. However, the fledgling program could be in jeopardy because of expected decreases in funding for FY2002, according to the three speakers at a special evening session on the topic at the APS March Meeting in Seattle. Participating in the session were: Mildred Dresselhaus, former Director of the Office of Science at DOE, who has since returned to her professorship at MIT; Lance Haworth of NSF; and James Murday of the Department of Defense. A theme common to all the talks was the need for action on the

See NANOTECH *on page 7*

HIGHLIGHTS

Board and Council Minutes Now on the Web

Recent Executive Board and Council meeting minutes are now available on a new section of the APS web site, accessible to all members who have an APS Member Web Account (members who don't have one can easily set one up by visiting the site). A permanent link to the Meeting Minutes site can be found from the APS Governance Page at http://www.aps.org/exec.

In the January 2001 issue of *APS News*, APS President George Trilling stated, "I believe that it is extremely important that our members be well informed about the many activities of their Society," and added that the APS web site should play a major role in providing information to APS members. Making the minutes available is one way of realizing this presidential initiative, says Ken Cole, who, in his role as Administrator of Governing Committees is responsible for preparing the minutes and for posting them on the Web. "We hope our members will take advantage of this new way to learn about Society affairs," he added.

"Members in the Media"

"We believe there is a revolution going on at the nanoscale"

—David Tomanek, Michigan State University, speaking about nanotubes, NY Times, March 27, 2001

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"The fluctuations are much bigger than one would naively think. I am confidently making a bet that quantum foam will be detected."

—Jack Ng, University of North Carolina, NY Times, March 29, 2001

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"...extremely hard to analyze, extremely hard to predict"

—Sidney Perkowitz, Emory University, on the physics of foam (not quantum foam), Seattle Post-Intelligencer, March 12, 2001

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"We are convinced that SQUIDs can provide unique and useful information about hidden corrosion activity even if they are restricted to the laboratory."

—John Wikswo, Vanderbilt University, United Press International, March 14, 2001

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"The reason we want to fly an airplane on Venus is because it would be way cool."

—Geoffrey Landis, NASA Glenn Research Center, Albuquerque Journal, February 18, 2001

And now, some quotes in connection with the new metallic superconductor MgB_2 (see story on page 1). All from the *Associated Press*, March 13, 2001:

"It's just been downright screaming fun."

—Paul Canfield, Iowa State University

"People are working all hours, weekends. It's ideas now, and experimentation and new things coming all the time"

—David Larbalestier, University of Wisconsin

"Magnesium and boron are all over the earth, and they're cheap as hell"

—Paul Grant, Electric Power Research Institute

"Everyone could kick themselves. All those metallurgists work with very exotic materials. And now, you can buy this stuff off the shelf."

—Brian Schwartz, City University of New York.

"Sometimes our biases can get us into a lot of trouble, and scientific bias was probably what prevented this discovery"

—James Jorgensen, Argonne National Laboratory

"To the lay person, this seems like a low temperature, but to the scientific community it's really not that low."

—Robert Cava, Princeton University

"My years of struggling, step by step, and finally I got it. It was never serendipitous."

—Jun Akimitsu, Aoyama-Gaikun University

This Month in Physics History

May 1609: Galileo First Hears About the Telescope

Galileo Galilei is justly known for many contributions to science, as well as for his persecution and confinement under the Inquisition. But among his most memorable achievements is his adaptation of a novel instrument, the telescope, with which he observed the Moon, discovered four satellites of Jupiter, resolved nebular patches into stars, and observed the phases of Venus. In the process, he helped lead a revolution in cosmology—along with his fellow astronomers—that conclusively toppled the traditional Aristotelian model in favor of the Copernican system.

Historians generally agree that the telescope originated in the Netherlands, with two simultaneous patent applications appearing in October 1608; a third inventor apparently developed a telescope around the same time and attempted to sell it at the Frankfurt Fair. These designs consisted of a convex and concave lense in a tube, able to magnify objects by two or three times their original size. The news of the invention spread rapidly throughout Europe, and samples of the device soon followed. By April 1609, citizens could purchase three-powered spyglasses in local spectacle makers' shops in Paris; within four months, they were also available in Italy.

News of this marvelous new instrument for "seeing faraway things as though nearby" reached Galileo in May 1609, and he quickly duplicated the invention and constructed his own three-powered telescope that summer, then set about making improvements in the design. He presented an eight-powered instrument to the Venetian Senate in August, and was rewarded with a doubling of his salary and lifetime tenure at the University of Padua. By late October, he had completed a twenty-powered telescope, which is when he first turned it to the heavens to observe celestial bodies.

The telescope; inset of Galileo Galilei.

Galileo initially used the instrument for a series of observations of the Moon, which neared completion at the end of 1609, when Jupiter was at opposition and closest to the Earth, and hence the brightest object in the evening sky, apart from the Moon itself. After making the necessary adjustments, he began observing the planet, noting on 7 January 1610 that Jupiter appeared to have three fixed stars nearby. Intrigued, he returned to the planet the following evening, expecting the then-retrograde planet to have moved from east to west, leaving the three little stars behind. Instead, Jupiter seemed to have moved to the east — an interesting anomaly.

Puzzled by the planet's behavior, Galileo returned to the formation repeatedly, observing several key details. First, the little stars never left Jupiter, but appeared to be carried along with the planet. Second, as they were carried along, they changed their position with respect to each other and to Jupiter. Finally, there were four of these little stars. By the 15th of January, he concluded the objects were not fixed stars, but planetary bodies that revolved around Jupiter. The planet had four moons—strong support for Copernican theory. He published this groundbreaking observation in his book, *Sidereus Nuncius*, which appeared in Venice in the middle of March 1610, guaranteeing his fame and ensuring his place in scientific history.

Following the publication of the *Sidereus Nuncius*, Galileo continued to make observations of celestial objects. In July 1610, he first remarked on the strange appearances of Saturn, which sometimes seemed to be oval, sometimes two lateral bodies, and at other times solitary and perfectly spherical—another puzzling enigma. By December, he was able to verify the observations of other astronomers that Venus has phases similar to the Moon, providing additional proof that Venus orbits the Sun, in conformance with the Copernican System.

The product of craftsmen, rather than an invention of scientists, the telescope nonetheless enjoys an important place in history as the prototype of modern scientific instruments. The observations made by Galileo and his scientific colleagues revealed hitherto unsuspected phenomena in the heavens and had a profound impact on the 17th century controversy between followers of the traditional geocentric astronomy and those who favored the heliocentric system of Copernicus.

A Typical Galilean Telescope

Galileo's famous telescope for observing Jupiter's moons had a convex lens with a focal length of about 30-40 inches and a concave ocular lens of about 2 inches, contained in a little tube that could be adjusted for focusing. The instrument's magnification was between 15 and 20, and the aperture of the convex lens was 0.5 to 1 inch, yielding a field of view of about 15 inches in 100 yards (i.e., 15 arc-minutes). This small field of view meant that only a quarter of the full Moon could be accommodated. However, the Galilean telescope could be used for terrestrial and celestial observations interchangeably, unlike the astronomical telescope described by Johannes Kepler in 1611, which employed both a convex objective and a convex ocular, resulting in an inverted image.

—Adapted primarily from information provided by The Galileo Project (http://es.rice.edu/ES/humsoc/Galileo)

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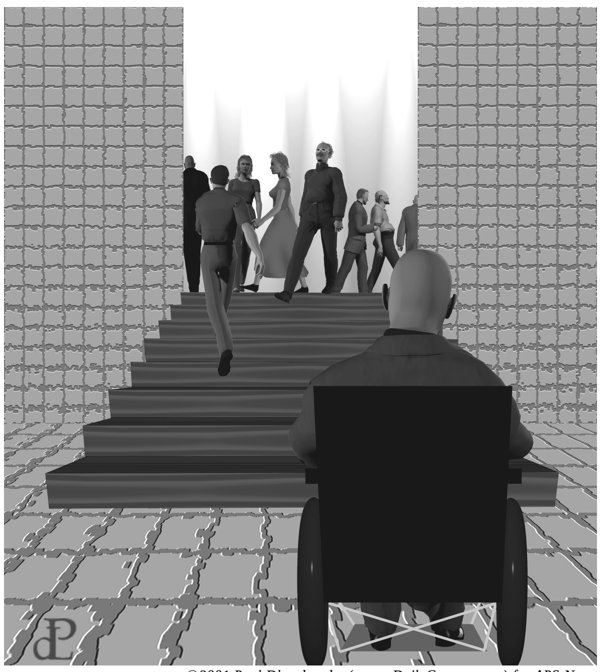
Tackling Issues of the Disabled Head-On

When Noah Hershkowitz, a professor at the University of Wisconsin (and an APS fellow), attends a scientific conference, the first challenge he encounters is the hotel. Hershkowitz suffers from multiple sclerosis and is wheelchair-bound, and invariably ends up having to ask hotel staff to make numerous accommodations, from removing extra furniture or a bathroom door to allow access of his wheelchair, to adding an extra grab bar in the bathroom, or temporary ramp at the front entrance to enable him to navigate the steps to the lobby.



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While the regular sessions at a recent meeting in New Orleans proved reasonably accessible to him, he wasn't able to attend one reception since it required maneuvering a small flight of stairs, with no wheelchair access available. However, "Since wheelchairs are the wrong height for receptions where people are all standing, I wasn't too disappointed," he says.

Hershkowitz is not alone in his frustrations. Charles Siegal, an attorney based in LA who earned a PhD in physics in 1972, suffered from polio as a youth, which limits substantially the use of his arms and legs, although he generally manages to function without the use of wheelchairs, crutches or canes. Still, lengthy passageways in airports or hotels, or long walks between meeting rooms, can take their toll. Disabled persons also struggle with the lack of electronic hearing aids, raised speaker platforms, thick carpeting, and so on.

Addressing these and other obstacles faced by disabled scientists is the objective of the newly formed APS Task Force on Disabilities (see August/September 2000 *APS News*); both Hershkowitz and Siegal are members. The task force has already suggested a list of the most common deficiencies in hotels and conference centers, and is hopeful that with the strong support of the APS and other professional organizations, hotels will be encouraged to improve in this area. And, as Siegal points out, it is hardly a matter of charity. "As an increasing number of people with substantial disabilities move into the workforce, they will demand goods and services to meet their quite specialized needs," he says.

Many concerns can be addressed with accommodations that "are almost trivial," says Siegal, such as the physics professor at Carnegie Mellon University (where he attended graduate school) who allowed him to use a small lab office to eat his lunch to save him the arduous walk to the college cafeteria. And there are many state and federal laws in place that require more elaborate accommodations, although these are not always complied with.

The scientific community can also contribute to improving access for disabled persons in more long-term, even creative ways. "I would like to think that the Society's members would deploy their skills to address issues of people with disabilities," says Siegal. "The scientific and technological community can have a huge impact on the lives of people with disabilities, not just by being attuned to their own students and co-workers, but by recognizing problems for which technological solutions are the best ones."

For example, Siegal points out that advances in medicine and microprocessor technology have enabled implantation in the retina of devices to assist those with visual impairments. His fellow task force member, John Gardner (Oregon State University), has spent a substantial part of his career developing software to allow people with print impairments to use computers. An inventor named Ralf Hotchkiss who received his undergraduate degree in physics won a McArthur Prize for designing wheelchairs that can be built in developing countries out of bicycle parts. In fact, Hotchkiss recently demonstrated such a wheelchair capable of walking up and down the curb and navigating a broad range of terrain in both urban and rural areas.

Concludes Siegal, "As I see it, the purpose of the APS task force is not simply to point out problems its disabled members encounter, but to suggest things Society members might do to lower or erase the walls that stand in the way of those with disabilities — be they students, professionals in the physical or other sciences, or in society at large — from realizing potentials that their disabilities sometimes mask."

SQUID Detectives Could Save US Billions

When it comes to measuring the magnetic fields associated with so many processes in nature, from brain activity to oil deposits, one of physicists' best friends is the SQUID, or Superconducting Quantum Interference Device. SQUIDs have been around for several decades, but continuing improvements have opened new applications for them. At the March APS meeting, John Wikswo of Vanderbilt described SQUID studies of hidden corrosion in aging aircraft parts.

According to a 1996 Battelle study, corrosion costs the US a staggering $300 billion per year in infrastructure maintenance, and up to a third of this cost can be prevented with the proper anti-corrosion measures. Whereas traditional techniques provide month-to-month information on surface corrosion activity, SQUIDs can provide hour-by-hour pictures of sub-surface corrosion occurring at microscopic rates. (SQUIDs can detect corrosion rates as small as 70 millionths of an inch per year in aluminum, Wikswo says.) The Vanderbilt team studied corrosion in aircraft lap joints, pieces of overlapping metal fastened with rivets or spot welds. While humid air did not increase corrosion appreciably in the lap joints, they determined that distilled water increased it significantly, presumably by activating dried chemical deposits within the metal. Contrary to common wisdom, however, salt water did not increase corrosion appreciably compared to distilled water. The researchers envision the SQUID as a lab tool that can provide advice on aircraft maintenance and the effectiveness of various anti-corrosion compounds.

Helene Grossman of LBL/UC-Berkeley demonstrated the use of SQUIDs to perform faster and more sensitive immunoassays, the detection of small levels of bacteria, viruses, or other proteins and chemicals in biological or industrial samples. In the SQUID technique, one adds magnetic particles to the sample of interest. The particles have specific antibodies or other binding compounds attached to them.

In addition, the particles are superparamagnetic, meaning that they line up with an applied magnetic field even for a short time after the field turns off. Exposed to such a field in the sample, particles which attach to the microorganism or molecule of interest stay aligned longer than unattached particles, providing a signal that can reveal as few as 30,000 attached magnetic particles. By contrast, the widely used ELISA immunoassay only detects as few as 100,000 labeled particles. The researchers are working to improve the SQUID's sensitivity by a factor of 4000 so that the detection of single microorganisms comes within reach.

— Phillip F. Schewe and Benjamin P. Stein

Broad or Narrow? Members Debate APS Meeting Structure

Editor's note: This is the first of two articles by Jordan Raddick on "centrifugal forces" within the APS. This article concentrates on the dynamics of APS society-wide and divisional meetings. Next month's will look at the dynamics that leads to the formation of new divisions and topical groups.

APS sponsors two general meetings a year, and many of the Society's divisions hold their own separate meetings as well. Outgoing APS President James Langer, writing in the Back Page of this month's *APS News*, fears that the increasing number of meetings threatens to divide the society. "It's not playing to the strength of a broad based membership of APS," he says.

The interplay between the divisional meetings and the society-wide general meetings has often been a source of controversy within the Society. Recently, the controversy has come up again because of Langer's concerns, because of the shrinking size of the April meeting, and because of the increasing tendency of divisions to concentrate their efforts in stand-alone meetings. The issues the meetings create are complex and defy easy solutions.

In the middle decades of the twentieth century, the Society typically met five times a year. The most general meeting came in January, when APS met jointly in New York with the American Association of Physics Teachers. Other APS meetings focused on specific topics in physics — the March meeting focused on condensed matter and materials science, while the April meeting focused on particle and nuclear physics. After World War II, when government funding for physics was high, researchers started several smaller meetings focusing on more specific topics. Attendance at the general meetings, especially the January meeting, dwindled. "It just got smaller and smaller," said Judy Franz, Executive Officer of APS. As early as 1968, the meeting left its traditional New York venue and began traveling about the country. In 1992, the January meeting was discontinued altogether.

Today, some people are afraid that the same fate could befall the April Meeting, which used to be held in Washington every year, but now moves around the country (although this year it was back in the nation's capital). The meeting focuses on particle, nuclear and astrophysics, and it attracts few attendees from other disciplines. While the March meeting typically attracts over 5,000 attendees, the April meeting has recently had fewer than 1,000. "It's smaller than some of the divisional meetings," Franz said. Attendance has been declining partly because government funding for travel expenses has declined in recent years, with particular restrictions affecting DOE grants that fund participants at the April meeting (see *APS News*, April 2000).

The meeting is now too small to take up an entire convention center. "If you have a convention center, but you don't need a convention center, that creates an expense," Franz said. As a result of this expense, the meeting has been in financial straits three of the past four years. To reduce expenses and to more accurately conform to the size of the gathering, the 2001 meeting was held in a hotel.

In 1998, Franz worked with then-President Andrew Sessler to expand the April meeting and move it to the fall, where it would be spaced farther on the calendar from the March meeting. Franz worked with the Divisions of Astrophysics, Nuclear Physics, and Particle Physics to move the meeting, while Sessler urged the Division of Plasma Physics (DPP) to schedule their own fall meeting together with it. "A large number of the senior leadership [of DPP] was in favor of the new arrangement," Franz said. But the divisional membership as a whole voted the idea down. The APS general meeting remained in April, and DPP continues to hold separate meetings.

Separate divisional meetings like DPP's lead Langer to worry about "centrifugal forces" within APS — forces that tend to divide the society into specialized research areas rather than uniting it to represent physics as a whole. Interaction between research areas is "a very practical necessity," Langer said — for example, his own research in condensed matter physics requires knowledge of algorithms studied in computational physics. "The APS has to be an agent for helping those interactions to occur," he said. He worries that if physicists only go to small, specialized meetings, they will lose the benefits of interacting with other research areas.

Of course, there are also benefits to smaller meetings. At smaller meetings, scientists can interact more personally with their friends and colleagues, and that personal interaction can lead to deeper discussion of research problems. "You can really learn a lot," said Shi-Yi Chen, who studies computational fluid dynamics at Johns Hopkins University. Chen works on a committee to organize the divisional meeting for the Division of Computational Physics (DCOMP), which will be held this June in Cambridge, Massachusetts.

Over the years, DCOMP's annual meeeting has alternated between being at the March meeting, at a separate meeting, or at an international meeting that is cosponsored by the International Union of Pure and Applied Physicists (IUPAP). "We don't have a steady tradition," said Bob Peterkin,

See STRUCTURE *on page 6*

LETTERS

The Last Word on Science, Religion and Creationists

Editor's Note: Last November we published a Back Page by Stephen Brush on the battle between science and creationism. This triggered a deluge of letters, which then led to a series of replies, which have now generated even more replies... With the current batch of letters, this discussion in our pages is now at an end. Please don't send us any more on this topic; they won't be published.

I was disappointed to see the recent letter by Robert Gentry in *APS News*. In *Science*, Oct. 6, 1989 Odom and Rink rather thoroughly discussed the anamolous RICHs known as Polonium halos. Adequate mechanisms for the halo production were presented. Gentry's interpretation and subsequent cosmological speculations are, as Pauli would say, "Not even wrong."

Wayne Hayes
Greenville Technical College

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I was somewhat appalled by the letter favoring "recent creation" in the March *APS News*. Clearly scientific training does not clear away what most of us see as irrational beliefs. However, nothing we may write to the author will likely change his mind. We need to be aware of how beliefs are melded into one's world view and be careful in attacking what we feel is irrational. The psychologist Gregory Lester published an excellent article ("Why Bad Beliefs Don't Die", *Skeptical Inquirer*, November/December 2000) on irrational beliefs and how skeptics can best work to dislodge them. His techniques are patience, patience, and patience.

Tom Barber
Houston, Texas

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Adrian L. Melott's letter in the March *APS News* is replete with misrepresentations of my January letter. Big Bang cosmology is the precursor to the evolution of the life itself. Linked invariably with the question of the origin of man, it is hard to understand how a cosmological theory developed by man can ever explain the very existence of man. Theories propounded by man, even the elusive TOE, cannot bring anything into being and only a Creator can do that—even quantum vacuum fluctuations do not bring the vacuum into being!

I am an evangelical Armenian who believes that man was created in the image of God and thus has the ability to "detect" God in a more convincing fashion than we have in inferring the reality of, say, the microworld. Our belief that "Man shall not live on bread alone" surpasses all scientific knowledge and lies at the very foundation of the humanity of man. Our purpose for doing science and reading Scripture is to reconcile in man scientific knowledge with revealed truths.

Moorad Alexanian
UNC at Wilmington

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I'm wondering why the letters to *APS News* have become a literary discussion group about works of fantasy. You can have fans of J.R.R. Tolkien write in and debate the details of *Lord of the Rings*. I'm not against people doing that. I'm just wondering why this is taking place in *APS News*. I thought APS stood for American Physical Society. I thought *APS News* was supposed to be about physics.

I'm not against people inventing elaborate fantasy world such as *Lord of the Rings*, and describing the details. I've done this myself. (See my homepage at http://www.geocities.com/jefferywinkler) I'm just wondering why this is taking place in *APS News* which used to be about physics. I'm very interested in mythology, legends, folklore, religion, the occult, and modern fantasy novels, film, and television, but I didn't know that these subjects were now under the domain of the American Physical Society. Perhaps I'll write a paper on the Force in Star Wars, and submit it to *Physical Review Letters*.

Jeffery Winkler
Hanford, California

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The editors are to be congratulated for publishing Robert Gentry's creationist letter in front of Patricia Schwarz's letter on religious apologetics (*APS News* March 2001). Gentry's letter shows the dangers of mixing religion in science, dangers which Schwarz seems to want to gloss over.

Gentry is one of a handful of otherwise technical people who want to read the Bible literally although he has yet to choose which of the biblical versions of creation he wants taught. Gentry's letter is typical of creationism in action as described in the accompanying article by Adrian L. Melott ("Kansan Dissects Soft Creationism"). Overlooking the overwhelming evidence for a multi-billion-year-old universe and for evolution, Gentry finds some (to him) problem with age dating and loudly proclaims that the Earth is only a few thousand years old. This is a classic case of "argument from ignorance" and "God is in the gaps" rhetoric. One of the current crop of creationists, Phillip Johnson, a UC-Berkeley criminal law professor, wants to replace science with something he calls theistic science. In short, he wants scientists to look for God's hand in everything. This is akin to the Dark Ages view that angels moved the planets. While these so-called "intelligent design" advocates claim they don't know who the "intelligent designer" is, in private they admit they are promoting the concept of an ultraconservative fundamentalist Christian God. What makes their deceptive sales pitch so dangerous is that they now have allies in the White House, Congress and the Justice Department.

Our local rabbi has pointed out that Genesis can be read about 70 different ways because, in the original Hebrew, there are no capitals and no punctuation and the verb tense is very, very unclear. He has termed people who read the Bible literally as "metaphorically impaired". With religious leaders like him science will continue to advance. But under fundamentalists like Robert Gentry and Phillip Johnson civilization will sink once again into a world of ignorance with superstitious beliefs that spirits inhabit everything.

The APS and the American Association of Physics Teachers need to become very active in turning back this vicious assault on science.

Gary L. Bennett
Emmett, Idaho

Keyworth's SDI Comments are "Déjà Vu"

George Keyworth (Back Page, February 2001) devotes a quarter of his remarks, which are supposedly on future weapons, to the ridiculous and irrelevant claim that Ronald Reagan was a strategic thinker, and then tops even that by stating that "SDI was effective in restoring counter-force deterrence to its more stable alternative..." This is patently false, SDI was a research program, it never produced any functioning "defense!"

As for future weapons, Keyworth's piece is Reagan's SDI speech all over again, full of extravagant but very vague promises: "digital defense will result from displacing the nuclear weapon. This is not, by any means, to imply that nuclear weapons can, or will, go away." So what good it is really? The main advantage of chip-laden and space-based weapons seems to be that 3rd world countries won't have them, so the US can launch zero-US-causality strikes against them whenever the president needs a headline. The contribution to US security seems marginal at best.

The real threat to the US is loose nukes and political instability in the former Soviet Union, but somehow our hardware peddling "defense experts" never display any real interest or urgency about that.

Ted Lawry
Boulder, Colorado

Alert Reader Catches URL Error

While trying to look up the reference cited in David Lupfer's letter "Science Textbooks Riddled with Errors" in the April issue, I discovered that the website http://www.psrc-onhne.org does not exist. After some effort I found the correct address at http://www.psrc-online.org. Apparently even the letters about science textbooks are riddled with errors.

Laurence Lurio
Argonne National Laboratory

INSIDE THE BELTWAY: *A Washington Analysis*

Budget Bombs!

By Michael S. Lubell, APS Director of Public Affairs

Storm flags began flying last February when President Bush released his Budget Blueprint. Although short on specifics, the Administration's first funding go-round set a somber tone for a community that had its spirits buoyed last year, when the NSF and the DOE's Office of Science received impressive increases.

For Fiscal Year 2002, however, the Bush Blueprint called for reductions in the research accounts for DOE, NASA and NSF, which D. Allan Bromley, science advisor to former President Bush, strongly criticized in a March 9 *New York Times* Op-Ed (reprinted in last month's *APS News*). With the Office of Science and Technology Policy a virtual tomb and no science patron on the White House scene, only the National Institutes of Health emerged with a strong budgetary guarantee.

On April 5, the Senate reset priorities. Later that day, President Bush again dramatized his commitment to biomedical research in remarks before the American Society of Newspaper Editors, when he said that his budget would finish the job of doubling NIH by 2003. But then he added, emphatically, "Basic research gets big increases too."

I nearly uncorked a bottle of Moët. But it would have been premature. When the presidential budget hit the streets four days later, his words rang terribly hollow.

Should Congress follow through on his plan, physics could suffer a decline worthy of the recent drop in the Dow. Here's how I read the numbers.

At NSF, one of the few bright spots is science education, a Bush priority, which would jump 11.0 percent. But elsewhere, the picture is pretty grim. Research and Related Activities would fall 0.5 percent, with Physics, aside from Frontiers Centers and facilities operations, suffering a 9.8 percent drop. For Materials Research, the corresponding cut would be 4.5 percent. And, since the Administration zeroes out new construction, Major Research Equipment would decline 20.6 percent.

The DOE budget is only marginally better. Overall, the Office of Science would get a 0.1 percent increase, amounting to $4.4 million. But increases in Program Direction would chew up $17.5 million, and Safeguards and Security would devour $13.8 million more, leaving the other programs to make up the difference. Biological and Environmental Research, a perennial recipient of congressional pork, would give back $39.5 million, allowing the Spallation Neutron Source to proceed on course with a $13.4 million increase.

All other major DOE science programs would be virtually flat-funded. But many of them could come under increasing pressure when DOE modifies its Energy Supply and Defense Programs requests, pending the report of Vice President Cheney's Energy Task Force. Both of these activities are likely to see increases, and the Office of Management and Budget has said that it will not submit a supplemental request.

The DOE budget also projects a 5.7 percent decline in Environmental Management, but to achieve the savings, the Department would have to rewrite tripartite cleanup agreements and in some cases get judges to vacate court orders.

These uncertainties leave the science programs in limbo. But if current funding holds, High Energy Physics would grow $4.1 million, with SLAC and Fermilab operations rising $20 million and LHC construction declining $9.9 million. And university research would give back $5.6 million or 5.0 percent.

In Nuclear Physics, which remains flat, support for RHIC would rise by $1 million, but the scant 0.9 percent increase would force Brookhaven to curtail its running schedule by more than 25 percent. University research would be held constant, except for heavy ion physics, which would decline

See BELTWAY *on page 7*

Early Artists Did Use Optics

The March 2001 issue of *APS News* contained a letter from Matthew Lybanon repeating information from a year-old article in *The New Yorker* about David Hockney's observation that some early artists appeared to have used optical aids. His letter says "there is a great deal of skepticism in the art world about Hockney's ideas." Whether or not that overstates the case at the time, certainly much has transpired in the intervening year that Lybanon was unaware of when he wrote his letter. A few weeks after *The New Yorker* article appeared I was introduced to Hockney by a colleague at the Guggenheim, resulting in an unusual, and remarkably productive, collaboration between an artist and a scientist. On May 3, 2000 Hockney and I presented our early optical discoveries to a group of eminent art historians in a day-long symposium organized for this purpose at the National Gallery of Art in Washington, DC. Space limitations permitted us to publish only a portion of our scientific evidence in the July 2000 issue of *Optics and Photonics News*, and we will have a second manuscript with considerable additional material finished shortly. Also, this fall, Viking will publish his book *Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters*. These discoveries convincingly demonstrate optical instruments were in use—by artists, not scientists—nearly 200 years earlier than previously even thought possible, and account for the remarkable transformation in the reality of portraits that occurred early in the 15th century. As such, they have many implications for the history of science as well as for the history of art.

Charles M. Falco
University of Arizona

VIEWPOINT…

A Modest Proposal: Recruit Undergraduate Majors

by Carl Wieman

Over the last several years I have visited the physics departments at many of the major research universities in this country. A recurring theme at essentially all of them is the desire for more good graduate students, particularly those fluent in English. In response to this shortage the recruiting of prospective graduate students has correspondingly escalated so that most PhD granting physics departments are now investing large amounts of faculty time and money in the process. Including the fellowship money being offered to attract prospective students, numbers on the order of $100K per year are becoming common at major departments.

Most of these same institutions where there are such intensive efforts to recruit graduate students appear to make little or no effort to recruit undergraduates to major in physics. I would like to propose that all physics departments with PhD programs should commit to putting at least 10% of the faculty time and money that they are currently spending on graduate recruiting into such undergraduate recruiting. The shrinking number and the much more dramatically shrinking fraction of undergraduate students that are choosing to major in physics are of course the ultimate reason for the shortage of good graduate students. This trend towards fewer undergraduate majors is the most dramatic at PhD granting institutions (see AIP statistics). An extrapolation of the data from the past decade would predict that the last physics major will graduate in about the year 2010 and will almost certainly be from a four-year college. The reasons for this trend are complicated and there are many possible ways and rewards for attacking the problem. My 10% proposal is intended to be only one small specific step.

There is considerable reason to think that better recruiting would have an impact on this depressing trend in the number of undergraduate physics majors. The study of why students leave the sciences (which they do in droves from the physical sciences) suggests that a major factor for student's switching to other majors is the lack of advice and counseling (and implicitly just contact) from faculty. According to the departmental reviews carried out by the National Task Force on Undergraduate Physics Education, departments that have been unusually successful at attracting physical science majors all indicate that a significant factor in these successes is personal contact and recruiting of students by faculty.

Of course increasing the number of majors at one's own institution is unlikely to have much direct beneficial impact on one's own graduate program because few physics majors stay at the same institution for graduate school. So, strictly from the perspective of enhancing the graduate program, the optimum strategy of each department is to spend all of its resources on recruiting grad students, while counting on everyone else dividing their recruiting resources between graduates and undergraduates. Unfortunately, all PhD granting departments seem to have come to this same conclusion, producing the dismal outcome we see at present. Clearly the best interests of all would be better served if every such research department agreed to put this modest fraction (10%) of their recruiting resources into increasing the number of undergraduate physics majors. In this case the words of Benjamin Franklin apply nicely, "We must all hang together, or assuredly we shall all hang separately."

Carl E. Wieman is a Distinguished Professor of Physics and Fellow of JILA at the University of Colorado. Although he is a member of the APS-AIP-AAPT National Task Force on Undergraduate physics education, this letter represents his personal opinion and not necessarily that of the Task Force.

New Membership Booth Debuts

The new APS membership booth debuted at the March Meeting in Seattle. Kathleen Hajduk of the Membership Department explains the many benefits of membership to an interested passer by.

zero gravity

Rattle in Seattle Creates Earthquake Art

Two weeks before the onset of the APS March Meeting in Seattle, the city was rocked by a magnitude 6.8 earthquake, cracking sidewalks, toppling building facades, and even cracking the capital dome in Olympia. Fortunately, major structural damage was less than expected, since the quake was located about 30 miles below Earth's surface. The meeting took place without a hitch. But further north, in the sleepy settlement of Port Townsend, Mother Nature offered striking visual evidence that earthquakes have an artistic bent as well.

A local shop called Mind Over Matter displayed a sand-tracing pendulum, featuring a pointed weight at the end of a long wire suspended over a tray of sand. The vibrations of the quake produced an intricate, rose-like shape in the sand. "You never think about an earthquake as being artistic — it's violent and destructive," Norman MacLeod, president of Gaelic Wolf Consulting in Port Townsend, told *ABC News*. "But in the middle of all that chaos, this fine, delicate artwork was created."

Images of the unusual pendulum pattern were distributed over the Internet, and quickly spread around the world. MacLeod, who posted the images on his Web site (http://www.gaelwolf.com/pendulum.html), has received thousands of letters from people theorizing about what the shape might mean: the eye of Poseidon, a rose, or even (for conspiracy buffs) a recording of a top secret government weapon designed to trigger earthquakes.

The Earthquake Rose. Scientists believe the squiggly lines at the center of the pattern were formed during the quake's most intense trembles.

Seismologists are a bit more circumspect in their conclusions. "The pattern shows the three-dimensional pattern of the quake. It's a nice little seismogram that helps people understand how the ground was moving at the time of the quake," says Bill Steele, a seismologist at the University of Washington. Modern seismograms record the north-south, east-west and vertical shakings of a quake. The information is then fed into a computer that creates a three-dimensional reading.

While the sand carved by the pendulum offers a less precise reading of the multidirectional tremors of the quake, it preserves two features of the earthquake waves in particular. The "flower" in the center records the surface movements associated with the higher frequency waves that arrived first. The outer larger amplitude oscillations record the lower frequency waves that arrived later.

Sadly, the Earthquake Rose is no more. Shop owner Jason Ward had intended to take a mold of the pattern. But before this could be done, his three-year-old son accidentally kicked the pendulum — and erased the sand's design. At least Ward still has the photographs.

RESEARCH NEWS BRIEFS

The Latest on Carbon Nanotubes

A carbon nanotube integrated circuit, with a thousand nanotubes acting like transistors, has been devised by Phaedon Avouris of IBM. Nanometer-wide tubes made of carbon chickenwire have for some years been expected to become an active ingredient in electronics. Besides their strong mechanical properties, nanotubes have a variety of useful electrical properties. Nanotubes, for example, can sustain current densities hundreds of times greater than those of common metals and are created in both metallic and semiconducting form. Speaking at the APS March meeting in Seattle, Avouris described how, in a mixed batch of nanotubes, one can short out the metallic nanotubes (with a surge of voltage) while leaving the semiconducting ones intact for use as circuit elements.

Other nanotube highlights from the same meeting:

- David Tomanek of Michigan State reported that experimental measurements of nanotube heat conductivity went as high as 3000 watts/m/K, almost as high as that of diamond. He predicted that nanotube performance would reach levels of 6600 watts/m/K. The ability to conduct heat will come in handy for future circuits needing to dispose of lots of heat from tight places.
- Mathieu Kociak of the CNRS lab, University of Paris-South, announced the first observation of superconductivity in nanotube ropes. "This represents the first observation of superconductivity in a system with such a small number of conduction channels," said Kociak, referring to the meager material substrate over which the supercurrent must flow, namely the aggregate of essentially two-dimensional surfaces of nanotubes. The researchers hope to raise the transition temperatures, presently only 300-400 mK, through judicious doping.
- Jason Hafner of Harvard reported using single nanotubes (with diameters of .9-2.8 nm) as extensions on the ends of atomic force microscope probes. Not only does this narrow the probe profile, resulting in greater spatial resolution when imaging a variety of biomolecules (such as immunoglobulins) but, when used to seek out specific molecules on a sample surface, the nanotube probe could help in studying tip-sample adhesion. Hafner referred to this approach as "chemical force microscopy" (CFM).
- Finally, Masako Yudasaka of the NEC lab in Japan reported on the enormous pressures that arise when C60 molecules are encased inside nanotubes, (an arrangement called "peapods". The force on the C60 is only a nano-Newton, but by dividing by the area of the tube, one arrives at a pressure of .1 giga-Pascal. In other words the buckyball can act like a piston for facilitating novel forms of tailored chemistry. Yudasaka also described her work with nanotubes that flare out like cones (typical size: 2 nm small diameter, length of 50 nm, and opening angle of 20 degrees). These "nano-horns" might be useful for absorbing gases (replacing other forms of activated carbon in filters).

Molecular Beacons for Cancer

Aiming to detect cancers early, safely, and inexpensively, Britton Chance of the University of Pennsylvania and his colleagues have created "molecular beacons," tiny capsules that are opened by specific biochemical activity related to a tumor. At the APS March Meeting, Chance described molecular beacons designed to detect 1-2 mm sub-surface breast tumors inexpensively and without ionizing radiation. Injected into the body, the capsules remain sealed until opened by specific enzymes associated with breast cancer. The beacons then fluoresce near-infrared light in response to light beaming from a small device outside the body. That same device then detects the signal from the beacons. (The beacons emit enough near-infrared light so that some of it gets through the body.) The device is designed to cost only several thousand dollars, Chance said, and is based on off-the-shelf CD and cell-phone technology. The molecular beacon has successfully been tested in mice, and human tests are planned. The technique does not require uncomfortable compression of the breast, which is what often is required for women under 40 years of age who receive mammograms. Self-tests for breast cancer may eventually be possible with this technique, Chance said.

— Phillip F. Schewe and Benjamin P. Stein

AIP Report Identifies Strongest PMD Programs

A new report from the American Institute of Physics (AIP) identifies 22 US schools with the strongest professional master's degree (PMD) programs in the country, an issue of great concern to educators because of declining enrollments in physics. The report, which was supported by the Sloan Foundation, defines PMD physics programs as those that address the current needs of the economy, as well as the needs of students, by providing both fundamental knowledge and specialized skills. The complete report, including the list of the 22 best PMD programs, can be found at http://www.aip.org/professionalmasters/profmshigh.htm .

Report co-author Roman Czujko, who heads AIP's Employment and Education Statistics Division, says that the rationale behind compiling such a study is that while physics enrollments are declining, the demand for students who are technologically trained is on the rise. "We tried to identify schools that were doing a good job of preparing physics students for the workforce," he says. In addition, students must be prepared to work in a variety of industrial settings, according to Jim Stith, director of AIP's Physics Resource Center, ranging from technical positions in traditional engineering companies to analysts in financial firms. "Their education must provide the foundation that enables them to quickly assess problems in diverse situations and allows them to formulate solutions," he says.

PMD physics programs are needed because of the increasing demand for employees with scientific and technological skill who are also able to work outside of an academic setting. Over the last decade, the US economy has been growing at an unprecedented rate, driven to a large extent by technological innovation, and this has resulted in an especially strong demand for employees with scientific and technological skills. "Physics skills are superb preparation for employment, but they are more valuable and useful if accompanied by the broader set of skills needed to be a successful employee," says Bernard Khoury, executive director of the American Association of Physics Teachers. In fact, the growth of PMD programs "is a clear indication that universities are acknowledging this employment reality."

Of course, master's degree programs come in a variety of shapes and sizes, according to Czujko. While some are focused on only one specialization, many have multiple specializations, some have a general track along side of a specialized focus, and still others only offer a general academic curriculum.

Nevertheless, the report found that successful PMD programs have a combination of features that fall into four general categories: bridge building (connecting the physics department to the world outside academics); programmatic emphasis (drawing on the expertise of physics faculty, as well as faculty from other disciplines at the university); research experiences (internships or other off-campus work experiences based on a collaboration with a corporation or government laboratory); and non-technical aspects, such as classes that address the unique needs of students in areas like oral and written communication, and team work.

In addition to the 22 strongest PMD physics programs, the report also lists 17 other strong PMD programs and 22 new programs still to young to be evaluated. The University of Arizona is among the latter, having recently initiated a professional master's degree program, in industrial and applied physics. Launched last year and sponsored by the Sloan Foundation, the program educates students to work in interdisciplinary teams on complex problems involving rapidly changing science and technology and to gain proficiency in computational techniques. Students also learn how to effectively communicate their scientific mission at all levels, and to understand business and legal issues associated with their scientific projects. The university has parallel PMD programs in applied biosciences and mathematical sciences.

MEETING BRIEFS

APS New England Section, March 30-31, 2001, Middlebury, Vermont

The APS New England section held its annual spring meeting at Middlebury College in Vermont in March, in conjunction with the corresponding geographical section of the American Association of Physics Teachers. Friday afternoon's program centered on the theme of chaos, complexity and self-organization, and featured talks on nonlinear dynamics and mixing dynamical systems. Thomas Moore of Pomona College was the keynote speaker at the banquet later that evening, summarizing lessons he learned about reforming the introductory calculus-based physics course at Pomona. In addition to assorted topics in general physics, Saturday morning's program focused on chaos, complexity and self-organization in the high school and college classroom. In addition, two general interest invited talks were given outlined six ideas that helped shape physics, and applied chaos to ship dynamics and wave propagation.

APS New York Section, April 6-7, 2001, Yorktown Heights, New York

The APS New York Section held its annual spring meeting at the IBM T.J. Watson Research Center, organized around the theme of the physics of self-organized nanostructures, including nanocrystals, nanowires and nanoporous templates. Each of the three half-day sessions — two on Friday and one on Saturday morning — consisted of an introductory tutorial followed by a series of topical presentations by such luminaries in the field as Lynn Boatner of Oak Ridge National Laboratory; IBM's own Frances Ross; Leonid Tsybeskov of the University of Rochester; and Alexei Ekimov of Nanocrystal Technology. Louis Brus of Columbia University was Friday evening's banquet speaker, summarizing current trends in nanostructured materials physics.

APS Ohio Section, April 20-21, 2001, Kent, Ohio

The APS Ohio Section held its annual spring meeting in April at Kent State University. Friday afternoon's session featured talks on membrane protein structure, solid state NMR, and the dynamics of heme proteins determined by synchrotron Mössbauer scattering, followed by a tour of the university's Liquid Crystal Institute. Thomas Weber, director of NSF's Division of Materials Research, gave a public presentation following the evening banquet, outlining NSF initiatives in information technology research, nanoscale science and engineering, and biocomplexity in the environment. Saturday morning featured two additional invited lectures on the collapse mechanism in lung surfactant systems, and scanning near-field infrared microscopy of single living cells.

Structure, *from page 3*

vice-chair of DCOMP. "We've been almost randomly alternating the last several years." In 2001, the alternation sends the division's annual meeting to a separate meeting. Jim Gubernatis, chair-elect of DCOMP, explained that the division will hold its annual meeting separate from the March meeting, in part because DCOMP represents all areas of physics, not just condensed matter. "At the March meeting, DCOMP tends to lose its identity," he said. "Having a stand-alone meeting gives us more flexibility in planning a meeting to meet the needs of our entire membership."

Gubernatis estimates that about 250 physicists will attend the June meeting. The morning sessions will be plenary sessions that focus on issues of general interest to computational physics. Afternoon sessions will include discipline-specific invited and submitted talks, plus a special session on scientific visualization and a town hall meeeting on the education of a computational physicist. The meeting will small enough to allow all members to attend each plenary session, with no conflicting parallel sessions. "Hopefully the structure and topics reflect our particular needs as a division," Gubernatis said.

Computational physicists' needs as a discipline are unique, Peterkin explained. Most DCOMP members are researchers who use computers to study specific topics in physics, so most DCOMP members are cross-registered with other divisions. At the March meeting, many DCOMP members would be busy attending sessions in their research areas, and would not have time to work with other computational physicists. "[DCOMP divisional meetings] offer expert practitioners and students… the opportunity to interact closely with other expert practitioners," Peterkin said. Peterkin explained that since many members of DCOMP study condensed matter physics, the division will be well-represented at the March meeting; furthermore, computational physicists who do not study condensed matter were unlikely to go to the March meeting anyway. But Langer worries that the absence of DCOMP presentations from the March meeting will deprive other scientists of the opportunity to learn from computational physics.

Individual scientists need to consider the relative merits of attending large and small meetings, both for their own research and for physics in general. As more divisions sponsor their own meetings, scientists have more meetings to choose from. As government funding for travel expenses shrinks, the pressure to decide becomes more immediate. James Langer fears that the increased numbers of small meetings will excessively decentralize the APS. His fears underscore the fact that decisions of individual scientists could help shape the future of the society and its divisions.

MgB_2, *from page 1*

MgB_2 is a solitary example of a new way of making high-temperature superconductors, or whether it represents only the tip of the iceberg," says Princeton University's Robert Cava. "For the high-T_c copper oxides, we haven't found the bottom of the iceberg yet, even after 15 years of looking. I, for one, hope this iceberg is just as deep."

Of course, the other key question is whether the compound might be amenable to technological applications. Although most scientists agree that it is too early to speculate about how the material might perform in devices, there are promising signs. Both magnesium and boron are common materials, inexpensive and easy to work with — in fact, MgB_2 is a commodity item that can be bought off the shelf from chemical companies. Its transition temperature greatly exceeds those of the conventional metallic superconductors, and studies on polycrystalline materials indicate that naturally occurring grain boundaries do not significantly inhibit current flow, another significant advantage over the cuprate superconductors.

The most promising potential application is the commercial production of superconducting wires out of MgB_2, which should be able to carry more current than the copper oxide superconductors, and could possibly be cooled by electric refrigerators rather than liquid helium because of the higher transition temperature. However, "A great deal of work remains to be done to develop wires of superconducting borides that are robust and cost-effective to manufacture," cautions Alex Malozemoff, chief technology officer of American Superconductor, which manufactures High-Temperature Superconducting (HTS) wires for electric power applications. "If these materials prove to be practical, it is likely that it will take five to ten years to get them out of the laboratory and into the marketplace." He points out that the HTS materials discovered in 1986 are just now in the early stages of commercialization.

Ultimately, though, the importance of the discovery and the special session is what they communicate to the general public about the noblest aspects of the scientific endeavor: the excitement of new discovery spurring a flurry of related research at laboratories around the world, culminating in a collegial gathering to interact and share results for the greater good. Most of those at the "Woodstock West" session echoed the sentiments of one observer in attendance, who enthused, "This is what physics is all about."

ANNOUNCEMENTS

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

2001 APKER AWARDS

For Outstanding Undergraduate Student Research in Physics

Endowed by Jean Dickey Apker, in memory of LeRoy Apker

DESCRIPTION

Two awards are normally made each year: One to a student attending an institution offering a Physics PhD and one to a student attending an institution not offering a Physics PhD

- Recipients receive a $5,000 award; finalists $2,000. They also receive an allowance for travel to the Award presentation.
- Recipients' and finalists' home institutions receive $5,000 and $1,000, respectively, to support undergraduate research.
- Recipients, finalists and their home physics departments will be presented with plaques or certificates of achievement. The student's home institution is prominently featured on all awards and news stories of the competition.
- Each nominee will be granted a free APS Student Membership for one year upon receipt of their completed application.

QUALIFICATIONS

- Students who have been enrolled as undergraduates at colleges and universities in the United States at least one quarter/semester during the year preceding the **JUNE 15, 2001** deadline.
- Students who have an excellent academic record and have demonstrated exceptional potential for scientific research through an original contribution to physics.
- Only one candidate may be nominated per department.

FURTHER INFORMATION

See **http://www.aps.org/praw/apker/descrip.html**

DEADLINE

Send name of proposed candidate and supporting information by **JUNE 15, 2001** to: Dr. Alan Chodos, Administrator, Apker Award Selection Committee; The American Physical Society; One Physics Ellipse, College Park, MD 20740-3844; Telephone: (301) 209-3268, Fax: (301) 209-3652, email: chodos@aps.org.

CALL FOR NOMINATIONS

THE GEORGE E. VALLEY JR. PRIZE OF THE APS

The George E. Valley Jr. Prize will be awarded for the first time in 2002. Nominations for the 2002 prize must be received by **July 2, 2001**. The prize will be awarded for outstanding research in any field of physics to an individual who is under the age of 30 at the time of nomination. The prize carries with it a cash award of $20,000. More details can be found on the APS web site at http://www.aps.org/praw/valley/descrip.html.

Five (5) copies of nominations and supporting documentation should be sent to: Laleña Lancaster; Attn: George E. Valley Prize; American Physical Society; One Physics Ellipse; College Park, MD 20740-3844; lancaste@aps.org.

CALL FOR NOMINATIONS

DANNIE HEINEMAN PRIZE FOR MATHEMATICAL PHYSICS

Purpose: To recognize outstanding publications in the field of mathematical physics.

Nature: The prize consists of $7,500 and a certificate citing the contributions made by the recipient plus travel expenses to attend the meeting at which the prize is bestowed. It will be presented annually.

Establishment & Support: The prize was established in 1959 by the Heineman Foundation for Research, Educational, Charitable, and Scientific Purposes, Inc., and is administered jointly by the American Physical Society and the American Institute of Physics. For biographical information on Dannie Heineman, visit http://www.aps.org.

Rules & Eligibility: This prize is awarded solely for valuable published contributions made in the field of mathematical physics with no restrictions placed on a candidate's citizenship or country of residence. "Publication" is defined as either a single paper, a series of papers, a book, or any other communication which can be considered a publication. The prize may be awarded to more than one person on a shared basis when all recipients have contributed to the same accomplishments Nominations are active for three years.

Nomination Deadline: The deadline for submission of nominations for the 2002 Prize is: JULY 2, 2001

Five (5) copies of nominations and supporting documentation should be sent to the Chair of the 2002 selection Committee: Jonathan Bagger (Chair); Dept of Phys & Astron; Johns Hopkins Univ; 3400 N Charles St; Baltimore MD 21218; Phone (410) 516-5419; Fax (410) 516-7239; email bagger@jhu.edu

Visa, *from page 1*

evaluate between 50,000-60,000 visa applications annually, to issue 25,000-30,000 passports, to process 6,000-7,000 birth certificates, and to serve the needs of a US expatriate population in excess of 250,000 (mostly armed forces personnel and their families). This means that the 7 foreign service officers must make—on average—from 200 to 250 decisions on visas alone each day. "There is no time for extended deliberation," Lerch says, and adds that because the consular officer is held responsible for enforcing US law, it is just easier to deny an application that isn't letter perfect than to try to correct it.

Another factor is the increasing complexity of the law. The embargo required by the technology transfer provisions against nuclear proliferation (India and Pakistan), the economic embargo against Cuba, the "sensitive countries list" which requires special processing of visa requests from many countries, and a panoply of laws designed to prevent access to US technologies all obstruct scientific exchange.

APS has formed a partnership with other organizations (AAAS, American Chemical Society, National Academy) to try to help the State Department and the US scientific community deal with these problems in a more systematic way, and is also examining how best to bring the issues before Congress and the Administration.

Finally, APS stands ready to help at the individual level. A scientist in need can email international@aps.org or call any of the APS International Affairs staff: Irving A. Lerch (301) 209-3236; Michele Irwin (301) 209-3237; Jackie Beamon-Kiene (301) 209-3239.

Nanotech, *from page 1*

part of the scientific community to ensure continued strong funding in this area.

The Nanotechnology Initiative is intended to support long-term nanoscale R&D leading to potential breakthroughs in such diverse areas as materials and manufacturing, nanoelectronics, medicine, the environment, energy, chemicals, biotechnology, agriculture, information technology and national security. "The ability to work at the molecular level is leading to unprecedented understanding and control over the fundamental building blocks of all physical things," said Dresselhaus.

However, she emphasized that the nanoscale is not merely another step in the ongoing process of miniaturization; materials in that size range exhibit characteristics that traditional models and theories cannot explain, and hence, "Developments in these emerging fields are likely to change the way almost everything — from vaccines to computers to automobile tires — is designed and made," she said. Examples of specific applications include the use of giant magnetoresistance in magnetic storage applications; nanostructured catalysts; drug delivery systems; nanocomposites and nanoparticle reinforced polymers; molecular electronics; biodetection in the interests of national security; and water purification and desalinization.

The initiative includes a series of nanotechnology research centers, expected to play an important role in the development and use of specific tools, and in promoting partnership. Funding is also provided for measurement and instrumentation improvements, with the aim of developing a flexible infrastructure to enable US industry to commercialize the new discoveries and innovations as quickly as possible. And all this will be coordinated among several government agencies with strong traditional support for science and technology. "This is a multi-agency initiative," said Haworth. "It would not be as successful as it has been if it were focused on any one agency alone."

The DOE is planning five nanotechnology research centers at various national laboratories, and the NSF expects to fund additional centers. The DOE has already received funding for the preliminary design of the centers, and Dresselhaus reported that final design could begin as early as 2002 if new funding can be obtained, with construction expected to begin sometime in 2003. The NSF currently funds about 600 nano-related research projects, involving roughly 2500 faculty and students.

However, "To make this initiative a success, we need the same level of funding increases that we've been seeing this past year," said Dresselhaus. APS Executive Officer Judy Franz, who moderated the session, praised the lobbying efforts of APS members last summer, who sent some 2000 letters to their Congressional representatives, joined by members of several other scientific and engineering societies. Their action was rewarded handsomely: the federal science budget increased about 15%, compared to an expected decrease before the letter-writing campaign began.

The Nanoscience Initiative increased from $270 million for FY2000 to $423 million in FY2001, according to Haworth. The NSF receives the largest share of the FY2001 budget for the initiative ($150 million), followed by the Department of Defense ($110 million) and the DOE ($93 million). Other agencies being funded at a lesser scale are NASA, the Department of Commerce, and the National Institutes of Health.

Unfortunately, the current outlook for federal science funding doesn't look quite so rosy. The change in Administration has brought a corresponding change in many major policies, and, said Franz, "The combination of massive tax cuts and substantially increased defense spending is going to put a squeeze on all other funding"—not just the Nanotechnology Initiative, but science funding across the board.

Web Session, *from page 1*

Talks from the APS Centennial meeting in 1999 had been posted on the Web, but the work had been contracted to an outside firm. Using APS resources to put talks from APS meetings on the web had been under active consideration, but the idea received a sudden shot in the arm when the MgB_2 session was scheduled. "We wanted to provide this service to the condensed matter and materials physics communities," said Jessica Clark, APS Public Outreach Specialist, who was in charge of getting the digital pictures of the transparencies.

The APS team had the enthusiastic support of the chairs of the session, John Clarke of Berkeley and George Crabtree of Argonne. "I'm glad the experiment has worked out," Crabtree said. "It is a great idea."

"Thanks to everybody at APS for all their efforts," added Clarke.

The next step will be to post the plenary talks from the just-concluded April Meeting, which should be a more typical exercise than the MgB_2 session. After that, it will be time to assess the experiment. According to Egan and Tracy Alinger, Director of Information Technology, when staff time and audio-visual costs are factored in, a half-hour talk should run about $150 to $200. This might be reduced for speakers who use power-point presentations.

What happens next will depend on whether the various units who participate in APS meetings want to see talks from their sessions on the web, and are willing to cover the cost. "It was an interesting experiment, but at this point we have to go to the units who organize the individual sessions and ask them whether they want this service to continue," concludes Alan Chodos, Associate Executive Officer of the APS.

Beltway, *from page 4*

$500 thousand or 4.2 percent.

Apart from the SNS, Basic Energy Sciences, as well as Fusion Energy Sciences, would have to live within budgets frozen at the FY 2001 levels. But as Secretary Spencer Abraham noted, his vociferous support for science could deliver no more, given the White House cap on discretionary spending.

Action now shifts to Capitol Hill, where science enjoys considerable support. Drawing on Bromley's critique of the presidential Blueprint, Republicans in both Houses have enlisted the support of Democrats in calling for 15 percent increases for DOE, NASA and NSF science.

Reversing the Administration's proposed cuts depends upon the science community. At the APS March Meeting, physicists sent more than 900 letters to members of Congress. But given the climate, thousands more will be necessary to get the job done.

THE BACK PAGE

APS Meetings Need Reform Now

By James S. Langer

As readers of *APS News* know, I've been taking every opportunity to stress the growing responsibilities of the American Physical Society. Simply stated, physics no longer sells itself: not to politicians, to future physicists, nor to the public at large. The entire US physics community, APS members and non-members alike, depends on the APS to make the case for our field.

The APS has been remarkably effective in this role. Its statements and advice are taken seriously by political leaders and the media. This effectiveness depends primarily on our reputation for wisdom and objectivity, but it also depends on the size and vitality of the community we represent – *i.e.*, our membership. Thus, membership in the APS is critical for maintaining the health of the physics community. I see a major problem emerging here. Our traditional mechanisms for maintaining the size and financial strength of the APS are changing just as dramatically as the political climate. And, unlike some other scientific societies the membership of the APS has not been growing in recent years.

Why do physicists join the APS? In the past, the answer was simple. We joined because we wanted to be part of and to support the larger physics community; and also because membership was essential to our professional careers. We needed ready access to the *Physical Review*, and we came to the regular APS meetings to exchange ideas and information. Today, however, neither of the latter motives is as compelling as they once seemed.

The APS is by far the world's leading publisher of scholarly physics journals, and publishing remains one of its very most important responsibilities. However, individual subscriptions to the *Physical Review* no longer make sense for most of us. We count on our home institutions to buy "site licenses" that give us access, via our computers, to a huge database of scientific literature. Thus, access to the APS journals has been disconnected from membership in APS.

That leaves the APS meetings as our single most important membership benefit. There are other benefits, of course: free subscriptions to *Physics Today*, participation in APS educational and public outreach activities or in human rights advocacy. Our established purpose, however, is to "advance and diffuse the knowledge of physics," and our core competence is as a scientific society. Therefore, our core rationale for membership had better be science, not public affairs. If future generations of physicists join the APS primarily because they agree with our positions on issues of public policy, then we will be known primarily for those positions rather than for our scientific objectivity, and we will become less effective in both science and public outreach.

What's worrying me is that our meetings — our primary scientific membership activity — seem to be in serious trouble.

"What's worrying me is that our meetings – our primary scientific membership activity – seem to be in serious trouble."

The major bright spot in this picture is the March Meeting, which focuses on condensed-matter and materials physics and related subjects, and is attended by about 5,000 people every year. There are roughly that number of invited plus contributed talks, presented in about 30 parallel sessions spread over five days. The meeting is organized jointly by a group of APS units whose leaders get together each year in the fall to select invited speakers and symposia. Throughout my career, although my research interests have shifted over the years, the APS March Meeting has remained a fixed point on my professional calendar. I know that a large fraction of the most active people in my areas of interest will be there, and that the speakers will bring me up to date, not just in my current specialty, but in many other areas where relevant ideas may be emerging.

The March Meeting is big, but it may not yet be big enough. I think we need to bring back more industrial physics; FIAP and other units and topical groups are working hard to do so. I'd also like to see more active participation by the Division of Fluid Dynamics and, more generally, more aggressive efforts by many units to include sessions in far-flung interdisciplinary areas of soft condensed-matter physics, biology, complex systems, and the like. If our units continue to work together constructively in these efforts, we'll be in very good shape.

Now for the bad news.

The only other general APS meeting is the one we hold in April. I seldom went to the April Meeting until I joined the presidential line. In the spring of 2000, however, I had official responsibilities at the meeting in Long Beach; and my concern about what I saw there is a major part of my reason for writing this article. The April Meeting has declined to less than one quarter the size of the March Meeting. Most of the APS divisions that participate in organizing it hold their own separate meetings elsewhere and at other times. Few, if any, of my colleagues that I saw last April seemed to use this meeting as a principal professional activity in the way that many of us use the March Meeting. Prominent physicists came to give their invited talks or receive prizes and then left as soon as possible. There were essentially no commercial exhibitors. There were some excellent special symposia; the organizers had made heroic efforts to schedule plenary sessions as well as other invited sessions of general interest. I listened, for example, to accelerator physicists talking about new ideas involving lasers and plasmas, but was keenly aware that there were hardly any laser or plasma physicists present to participate in the discussions. The audiences seemed small compared to what I would have expected for comparable sessions in March.

As bad as it may seem, the possible demise of the April meeting isn't nearly so serious a threat to the APS as the centrifugal forces that are afflicting many of our units. Not only have many APS units been holding separate meetings but, in some cases, the barriers between these units appear to be growing despite clear needs for bringing people together. Last year, for example, the Division of Laser Science (DLS) expressed interest in combining its meeting with the Division of Atomic, Molecular, and Optical Physics (DAMOP); but, so far as I know, nothing has happened. Similarly, the Division of Plasma Physics (DPP) declined a proposal to merge with the April meeting and move the whole event to the fall. Plasma physics, a field of wide-ranging importance, is under stress because of funding crises in its key area of fusion energy. I think it might be enormously important for the DPP to take advantage of the strengths of the APS in broadening its horizons.

For some years, the Division of Computational Physics (DCOMP) has met in conjunction with the March Meeting. I have gone to their sessions quite often, not just out of idle curiosity, but because some talks were directly relevant to my current research and I needed to know what was happening. This year, DCOMP has decided to hold a stand-alone meeting because, I am told, they want to emphasize that computation is just as relevant to particle and astrophysics as it is to condensed matter. That's absolutely true. But why, then, deprive all but the specialists of the chance to attend their sessions?

I fully realize that small, independent unit meetings are a long-standing APS tradition. In many ways, they can be more comfortable than big general meetings, and the organizers have a better sense of being in control of the program and extracurricular activities such as banquets and award ceremonies. But small meetings do not take best advantage of the strengths of the Society as a whole. Larger meetings are much more natural mechanisms for providing interactive, cross-disciplinary opportunities, and it is relatively easy for a large society like the APS to organize them efficiently. In contrast, neither the APS nor its units have any natural advantage — as compared to, say, the Institute for Theoretical Physics in Santa Barbara or the Aspen Center – in organizing innovative special-topics workshops or other small, focused events. I think that our unit meetings will have a much harder time keeping themselves relevant to the rapidly changing natures of their fields if they remain separate instead of combining with other units.

By far the most compelling advantage of big meetings, in my opinion, is their special importance for young physicists. We take great pride in the fact that an education in physics is an excellent preparation for a wide variety of careers. Only a fraction of the graduate students who specialize in experimental high-energy physics, for example, expect to continue in that field for the rest of their lives. In addition to their knowledge of particle phenomenology and their problem-solving abilities, many of these students are skilled in scientific instrumentation and data analysis, and are prepared to use those skills in a wide variety of careers in science or technology. They need exposure to fields beyond their areas of specialization, and they also need opportunities to talk with people who might offer them jobs. That's what happens at the March Meeting, where recently I have been seeing not just large numbers of young people, but also large numbers of employers competing for their services. I think that all our units ought to be providing the same opportunities for young physicists.

"By far the most compelling advantage of big meetings is their special importance for young physicists."

There are yet other advantages of large meetings. The March Meeting is big enough to attract substantial numbers of commercial exhibitors, whose presence adds greatly to the professional content of the meeting. The March Meeting is also big enough to provide an effective forum for discussing general issues such as federal science funding, electronic publication, or trends in education. A year ago in Minneapolis, about 2,000 people attended a special session on the proposed federal initiative in nanoscale science and technology. The speakers — all key players in the field — found this a useful forum for engaging a large fraction of the relevant scientific community in the national debate.

I belong to two other scientific societies that are in many ways comparable to the APS: the American Geophysical Union, and the Materials Research Society. Both are growing organizations that are providing important leadership for their fields. Like the APS, both publish research journals. Unlike the APS, however, both use large general meetings as their principal membership activities. The AGU and MRS meetings and memberships are large and growing; ours is not.

James S. Langer

In short, the APS has a serious problem. I think that the solution is obvious: we must move toward consolidating our meetings. At the very least, we should move in the directions that we started but aborted last year, shifting the April meeting to the fall and adding other units to it, *i.e.*, DAMOP, DLS, DPP, etc. We also should encourage all of the units that participate in this new general meeting to make it their principal event, including their most urgent special symposia.

It's already too late to make these changes quickly; we have had to book facilities three or more years in advance for all APS meetings and cannot reasonably change those commitments. Given that lead time, however, large-scale changes are feasible. We have a highly professional meetings department, led by Donna Baudrau, that has gained valuable experience in organizing large events such as the Centennial celebration in Atlanta and the increasingly complex March Meeting. With a competent and well-staffed meetings department, we shall find it much easier and more economical to organize unit meetings as components of general meetings rather than as stand-alone events. And, the more our meetings business grows, the better the service we'll be able to provide.

I don't think that we can wait much longer to reform the APS meetings. Like any competitive business whose success depends on building and maintaining customer loyalty, our meetings business is intrinsically unstable. The APS meetings must be visibly the most important and exciting events of their kind, attractive especially to young scientists who are moving into new areas of physics and related fields. The alternative is that we shall lose some of these meetings, perhaps quickly and suddenly, and then the very future of our Society will be in jeopardy. We cannot continue to be influential in public affairs, or even to remain a major, non-profit, publisher of scientific journals, unless we maintain our unique identity as a broadly representative, membership-based scientific organization.

James S. Langer was President of APS in 2000.

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