Physicists Descend on the “Indy City” for 2002 APS March Meeting

by Richard M. Todaro

Approximately 5,000 physicists will descend on Indianapolis this month for the annual APS March Meeting, the largest conference sponsored by the Society. The APS last visited the city for its April meeting in 1996, and since then the Society has undergone a significant revitalization campaign that has resulted in a vibrant downtown, including an expanded convention center; several new, first-class hotels, as well as many new restaurants in all price ranges. Concentrating, as usual on condensed matter and materials physics, this year’s array of technical sessions will include such topics as superconductors, proteins, conjugated polymers, nanoclusters, semiconductors, multiferroics and magnetoactive oxides, among others. There will also be five sessions and more than 70 papers devoted to the latest research results on magnetoribbons, a newly discovered superconductor treated at length at last year’s March meeting in a mammoth all night session dubbed “Woodstock II.” (See APS News, May 2001.) There will also be numerous sessions on topics in applied physics, such as complex “small world” networks, the future of information technology, science policy, international cooperation, climate change mitigation, and science education. A sampling of session highlights is below. The complete program epitome and abstracts can be found online at http://www.aps.org, under meetings.

“Smart Paint” and Cellular Sensors
Nevolutionary advances in microelectronics are beginning to undercut some long-standing scientific assumptions about constructing and programming.

Lower Funding Shocks Education Advocates
by Richard M. Todaro

The decision by House and Senate conferees last December to fund a newly-established program to improve the quality of math and science education in elementary and secondary schools at just 5% of the amount spent last year by Congress for such improvements has been greeted with surprise and disappointment from math and science education advocates. But the head of one of the advocacy groups said he plans to work with a coalition of business, professional, and education groups for full funding of the new program in the years to come.

On December 18, 2001, House and Senate members of the appropriations committee overseeing fiscal year 2002 funding for the Departments of Labor, Health and Human Services, and Education appropriated $12.5 million for the Math and Science Partnerships program. Like its more generalized predecessor, the Eisenhower Professional Development program, the new Math and Science Partnerships program is the main vehicle by which the federal Department of Education provides money — either directly to nationwide pilot programs or through grants to individual state programs — to improve the quality of math and science education. Such improvements are made chiefly through teacher training programs that are designed to improve the knowledge and skills of teachers in math and science.

Advocates of such improvements were surprised and disappointed by the amount the conferees approved because it was just 5% of the $250 million spent by Congress in fiscal year 2003 for such improvements. They expressed concern that recent progress in math and science education may be jeopardized. “I’m very worried that the $12.5 million in this year’s appropriations will put an end to the strides we’ve made in the past decade in the area of teacher improvement,” said Fred Stiem, APS director of education and outreach.

In addition, advocates were disappointed because the amount appropriated accounted for less than 3% of the $450 million authorized for math and science education improvement under the provisions of the Elementary and Secondary Education Act (ESEA).

“IT was certainly not what we wanted or hoped we might get,” said Jack Hehn, director of education for the American Institute of Physics.

J. Patrick White is the executive director of the Triangle Coalition for Science and Technology Education (TCSTE), a Washington DC-based non-profit organization that supports math, science, and technology education at the kindergarten through 12th grade levels. “I was disappointed that it wasn’t funded at a higher level, but I was glad to see that there was strong support for professional development,” he said, referring to the $2.85 billion authorized by the conferees for a component of ESEA called the Teacher Quality Grant program. This program is designed to improve teacher quality in many different areas, including potentially in math and science education, through an assisted...
Austrian born theoretical physicist and mathematician, Stephen Hawking made profound contributions to quantum theory with the formulation of the wave equation that he co-discovered in 1965. Remarkably, his most famous work is a 1976 thought experiment that has piqued the interest of physicists around the world: the paradox of Schroedinger's cat.

The paradox was first presented in 1935 by Erwin Schroedinger, who was developing a theory of quantum mechanics. The paradox states that a cat in a sealed box could exist in a superposition of states: it could be both alive and dead at the same time. This thought experiment illustrates the principle of superposition, which is a fundamental concept in quantum mechanics.

Hawking continued to develop this idea, and in 1980, he introduced the concept of Hawking radiation. This is a theoretical prediction that black holes emit energy over time, which is a consequence of the quantum nature of gravity. This idea was based on the work of physicist Roger Penrose, who had earlier proposed the idea of gravitational collapse leading to the formation of black holes.

Hawking's work on black holes and quantum mechanics has had a profound impact on the field of theoretical physics. His insights have led to the development of new ideas and theories, such as the information paradox, which explores the question of information loss in black holes. This paradox suggests that information about the matter that falls into a black hole is lost forever, which is at odds with the laws of quantum mechanics.

Hawking's contributions to physics have been recognized with numerous awards, including the Nobel Prize in Physics in 1979. He is considered one of the greatest theoretical physicists of the 20th century.
The APS is continuing its tradition of bringing together physicists from different fields to explore the severe under representation of women in physics and chemistry. Other organizations, such as the International Conference on Women in Physics (IUPAP), are holding conferences this spring. The first International Conference on Women in Physics (IUPAP) is sponsored by the International Union of Pure and Applied Physics (IUPAP), and will be held March 7-9 at UNESCO’s headquarters in Paris, France. It is intended to explore the severe under representation of women in physics in Europe and elsewhere in the world and to develop strategies and actions towards participation. And an International Conference on Medical Physics (ICMP) will be held April 8-10 in Bahamas. This conference, like all others, will provide input for those decisions, as well as opportunities for the scientific community to participate in Congressional visits.

The ICMP, which will be held April 8-10 in the Bahamas, will bring together physicists mostly, but not exclusively, women — to review data on women in physics, discuss barriers, share success stories, suggest ways to improve participation globally, and help develop appropriate strategies to improve the status of women in physics in their home countries. Teams of at least three people from each country will be participating, with a total of about 300 attendees expected. It is hoped that the conference will help establish a robust international women’s network that will work to boost the systemic change needed and reinforce the sense of isolation often felt by women physicists.

“We expect the conference to increase the awareness of the need for more women in physics, to improve the understanding of the problem through a comparative analysis of the causes, and to identify technical guidelines and measures that will be effective in different regions of the world,” says Judy Franz, APS Executive Officer and Associate Director for Organizational Effectiveness at IUPAP. “Existing and future local initiatives will gain strength from the support of a favorable international context and international networking.

According to APS Director of International Scientific Affairs Irving Lerch, the conference, which follows the latest in a series of APS efforts to expand interaction with the physics community in Cuba, despite continuing US embargo of the island country. The Conference was chosen as the.relence topic in order to work around US trade embargo, and a second similar conference on physics education is planned for 2003.

The ICMP’s conference theme is entitled “A large number of people in the science and math community, in particular the K-12 STEM Education community, will be working hard for this during the year, as a result of the emphasis on preparing and supporting science and math teachers.” The Conference will provide input for those decisions, as well as opportunities for the scientific community to participate in Congressional visits.

The conference will provide input for those decisions, as well as opportunities for the scientific community to participate in Congressional visits.
Good Marketing and Self-Delusion Won’t Do

A wide variety of articles discussing the relationship between the physics community and society, and the problem of APS News, the latest article by Bo Hammer which is summarized in APS News by this quote: “Our challenges are reduced to a marketing problem.” Another example of this trend.

The problem is that the most common view is dealing with facts and perceptions. The perception I have is that countless thousands of undergraduates take as graduate students prepared, or aren’t working to, or that better marketing must be done. It is rather simplistic to believe that poorly prepared students are forced to take courses that are poorly taught. This has gone on for decades, and as the population of Undergraduates expands, the problem gets worse. More and more people, who inevitably vote or run for Human Resource departments or become presidents of the country, endure this situation, and blame the “system” in general, and the physics community specifically. This leads to the myth that the physics community is long-lasting, because the education requirement more the marketing and self-delusion. The facts need to be understood first.

Russell Youmann
Alexandria, Virginia

Upon Reflection, Spin is not Reversed

I enjoyed reading your article on the fall of parity conservation in the December 2001 issue of APS News. However, I must point out that both the Figure inserted at the bottom of the article and its caption contain a rather fundamental error, namely that the direction of spin is reversed by the parity operation. This is not correct. The nuclear (or electron) spin, as any nuclear (or electron) spin, as any other angular momentum, is a parity-even, time-odd axial vector. It is not reversed by the parity operation. The statistical distribution of particles and the accompanying error rates contain a rather fundamental error, namely that the direction of spin is reversed by the parity operation. This is not correct. The nuclear (or electron) spin, as any other angular momentum, is a parity-even, time-odd axial vector. It is not reversed by the parity operation.

The Comforting Linkage of Cause and Effect

The comforting linkage of cause and effect. Not everyone bought this. It threatened to panic, but no sweat, though—my theory permits us to find out for ourselves if we’re right or wrong. But quantum mechanics must answer, “Tough @#&!”

Dear Cecil:

Cecil, you’re my final hope!

Of finding a cure for this Straight Dope!

For I have been reading of Schroedinger’s cat but none of my cats are at all like that. This unusual animal (so it is said) is simultaneously alive and dead! What I don’t understand is just why he can’t be one or the other, unquestionably. My future now hangs in between eigenstates in one I’m enlightened, the other I’m not.

If you understand, Cecil, then show me the way

And rescue my psyche from quantum decay.

But if this queer thing has perplexed even you,

Then I will and won’t see you in Schroedinger’s zoo.

—Randy F, Chicago

Dear Randy:

Schroedinger, Erwin? Professor of physics!

Wrote “dancing squares!” Confounded his critics!

Not why? Don’t worry. This part of the verse starts off pretty good, but it gets a lot worse.

Win saw that the theory that Newton’d invented had been badly degraded.

What now? wailed his colleagues. Said Erwin, “Don’t panic,

No grease monkey I, but a quantum mechanic.

Considering electrons. Now, these twofear articles

Are sometimes like waves, and then sometimes like particles.

If you are not confusing, the nuclear dance

Of electrons and sleight is governed by chance!

Not, just teenagers—my theory permits us to join

Where of some of them is and the rest of ‘em was.

Not everyone bought this. It threatened to panic,

Though he doubted my theory, I’ll say of this saint:

Sweet Al was my buddy. I must make amends.

In vain—until fin’ly he more or less died.


We’ve just flipped a coin and we’ve learned he’s a

One vial prussic acid, one decaying ottom

Or atom—whatever—but when it emotes,

A trigger device blasts the vial into bits

Which sniff up our petty. The odds of this crime

Are 50 to 50 per hour each time.

The cylinder sealed. The hour’s passed away

Our pussy still purring—or pushing up daisies?

Now, you’d say the cat either lives or don’t it.

But quantum mechanics is stubborn and we

Statistically speaking, the cat (goes the joke),

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How Scientists Can Help With K-12 Education

by Diandra Leslie-Pelecky

Did you know that only 10% of Americans can explain what a molecule is? Or that over 50% of Americans believe that the Earth takes a year to circle the Sun, and only 75% realize that the Earth goes around the Sun and not the other way around? The National Science Foundation (NSF) from which these data are taken can be found at http://www.nsf.gov/sbe/srs/srch00.nsf. See especially Annex A-1. The image of the entire community usually treats these statistics as a sad curiosity, however, they represent a significant threat to our future. One need only look to one's elected representatives, college presidents and CEOs to realize that important decisions impacting science often are made by people who don't understand science. Even those with the resources to judge arguments on their scientific merit must justify their actions to a decisions science-illiterate public. If they don't address the general lack of science knowledge by the public, we are jeopardizing our own future.

One of the most effective approaches for improving public science literacy is to team with K-12 schools, teachers, and the parents of children to familiarize them with science. Less than 30% of high-school students take physics and, of the 1.2 million first-year college students, only about 320,000 (27%) take an introductory physics course. If we want until students reach college classrooms, we've already lost nearly three quarters of our potential audience. The one experience common to most people is that virtually all of them all pass through the 5th grade. Creating science-literate (and science-interested) students also broadens the pool from which to draw physics majors, which in turn creates future scientific and technical employees and graduate students.

The traditional involvement of scientists in the classroom is the discussion, in which scientists students with liquid nitrogen and beds of nails. These activities are great for stimulating kids' interest in science, but if we want to reach students who are not only interested and enthusiastic, but also who have the knowledge and skills necessary for understanding science. Once-a-semester visits from scientists addressing random topics is not enough. Common class material and activities must be sustained involvement, which means establishing long-term collaborations between scientists, teachers, schools, and colleges of Education.

My experience collaborating with Gayle Buck (a University of Nebraska High School teacher) and Suzanne Kirby (a 4th grade teacher with Lincoln Public Schools) has given me the benefit of the feedback and potential pitfalls of scientists' involvement in K-12 education. Our collaboration resulted in our current NSF-funded "Project Fukrum," which links science, math and engineering graduate students with an elementary or middle school for an entire year [See http://www.physics.uiuc.edu/]

I mention this explicitly to emphasize that the only way to bring about long-term change is to involve scientists, teachers and teacher educators as equal partners. Collaborations are not always easy. The disparity of cultures and vocabulary and the stereotypes we hold about each other can get in the way of accomplishing anything.

Collaborations are not always easy. The disparity of cultures and vocabulary and the stereotypes we hold about each other can get in the way of accomplishing anything.

Even the social conventions and styles of communication for different entities, one group can be alienating to another group. It is important to find collaborators you trust and whose work you respect.

For example, there is an assumption that placing scientists from underrepresented groups in the classroom will change student stereotypes. We analyzed interactions between physics graduate students, working on electric circuit and magnetics units with fourth graders. Our volunteer students, most of whom were female, introduced themselves as scientists, showed videos of their research labs, and described their research to the students. The graduate students worked with the fourth graders two hours a week over eight weeks before and after analyzing series and parallel circuits, and exploring the properties of magnets. We all were impressed by how much and how quickly the students learned, and especially by how they were able to suggest new experiments based on their observations.

About halfway through the project, Gayle pulled me aside to update me on the results of her student interviews. She said, “You know, the kids don't believe you're scientists.” The female graduate students didn't fit the fourth grade stereotypes of scientists, as expected. What I didn't expect was that, instead of rejecting their existing stereotypes, the students adopted the stereotypes and scientists students must not be scientists. (Sad!) Student stereotypes included not only that scientists wear lab coats, but also that 'real' scientists wouldn't be able to communicate with kids, and wouldn't be interested in whether the students were learning.

The teacher of this class interviewed parents of the students and found that one parent was under the impression that the scientists were the students' statuses. If I had executed this project by myself, I would not even have asked the students whether they believed that their visitors were scientists.

Many collaborations are short circuited by the assumptions scientists have about teachers (and vice-versa). Scientists who have visited K-12 classrooms sometimes complain that collaborating with teachers is impossible because the teachers 'don't know any science,' aren't smart enough to learn science or 'don't want to teach science.' The vast majority of teachers want to teach science and want to teach it well; however, many have need assistance in understanding content, using equipment and relating science to everyday life. Although scientists can assist with these missing elements, we need educators' expertise in how to deal with kids, parents, school district, state and federal rules and requirements, and the politics of K-12 education. Neither group can accomplish anything.

Before setting foot in a classroom, scientists must understand the constraints under which teachers teach. Teachers have very little latitude in the topics they teach due to the adoption of National and State Education Standards. Debating whether the standards are right or wrong is a moot point; they are in place and teachers are accountable for meeting them. The emphasis on standards is so high that teachers' raises (and sometimes jobs) can be strongly impacted by their students' performance on standardized tests.

Ignoring science is not an option for teachers. The stake are even higher because content, (students must be able to distinguish between reflection and refraction) and process standards, (students must be able to design and execute an experiment, and communicate the results) must be satisfied. Their students must not only be able to state that like poles repel, but must also be able to design an experiment that tests the assertion and graph the results. These goals are consistent with what physicists would like to see students hold: “Object-solution-solving, a decent base of knowledge on which to build, and a desire to learn science.”

Understanding science can be the most useful in teaching, problem-solving skills and building enthusiasm for science. One of our Project Fukrum fellows – a prospective scientist – accompa-

nied a group of fourth graders on a field trip to a restored prairie. She brought her field notebook and took notes. The students were fascinated by how carefully she observed, and how she recorded all of her observations.

Project Fukrum...
Plastic Electronics: Where Silicon Can’t Follow?

By Hendrik Schön, John Rogers, and Zhenan Bao

In order to define the critical device dimension of the OTFT, the channel length or distance between the source and drain electrodes, a current will switch and amplify electrical signals as needed for logic operations. Most of the early organic materials allowed only for p-channel devices, where holes are the major charge carriers, but careful syn- thetic, organic chemistry and molecular electronics research has demonstrated n-type transistor materials of similar performance. More recent studies of devices made of high-quality single crystals revealed that unintentional dopants and defects were mainly responsible for limiting OTFTs to one type of charge carrier mobility. Normally doped silicon materials have been shown to be capable of both p- and n-channel activity. This could be useful for the development of complementary logic circuits, similar to CMOS technology in silicon devices. The n-channel organic semiconductor film also has an important impact on the overall device performance, mainly by limiting the charge carrier mobility. However, by optimizing deposition techniques and making use of alignment layers and the self-organizing properties of molecular solids, mobilities in the range of 0.1 - 1 cm²/Vs have been obtained in various materials. This is already in the range of half of the targeted applications but more progress might be expected from investigations in material synthesis.

Besides the performance of the OTFT, the crucial point is also the choice of the gate insulator. That the display is only several millimeters thick and bendable reveals the unique capabilities of plastic electronics. With continued progress in materials engineering, processing, and ultra-low-cost fabrication techniques, commercial products may become possible and an evaluation of the full potential of plastic electronics would evolve.

The molecular nature of these carbon-based materials offers an intriguing final opportunity - molecular electronics in which logic circuits are based on single molecular or on a single layer of molecules! Recent results on carbon nanotubes and self-assembled monolayer-based devices show that transistor action and voltage gain can be achieved in single molecules with channel lengths as short as 1 or 2 nm. At these dimensions, the speed of the transistors and number of them per unit area might permit Moore’s Law to extend beyond its limits for silicon transistors. In one prototypical application of OTFTs, electronic paper (see Figure 2), plastic electronics are used to drive an electrophoretic display. This was first demonstrated by a collaboration of Bell Laboratories, Lucent Technologies, and Stanford University, which has been further developed by other companies. High voltages and rather low currents are needed to switch the electronic ink pixels, requirements that nicely match the characteristics of the organic transistors. That the display is also bendable and rollable reveals the unique capabilities of plastic electronics. So far, various companies have demonstrated the integration of a few thousand transistors in one prototype application of OTFTs, electronic paper (see Figure 2), plastic electronics are used to drive an electrophoretic display. This was first demonstrated by a collaboration of Bell Laboratories, Lucent Technologies, and Stanford University, which has been further developed by other companies. High voltages and rather low currents are needed to switch the electronic ink pixels, requirements that nicely match the characteristics of the organic transistors. That the display is also bendable and rollable reveals the unique capabilities of plastic electronics. So far, various companies have demonstrated the integration of a few thousand transistors in one prototype application of OTFTs, electronic paper (see Figure 2), plastic electronics are used to drive an electrophoretic display. This was first demonstrated by a collaboration of Bell Laboratories, Lucent Technologies, and Stanford University, which has been further developed by other companies. High voltages and rather low currents are needed to switch the electronic ink pixels, requirements that nicely match the characteristics of the organic transistors. That the display is also bendable and rollable reveals the unique capabilities of plastic electronics.
him with queries about the scienc
earth. He also provided reports for Radio Australia, an internatio
broadcast station.

Having written extensively online, Harris has been employed as About, Inc's physics specialist since 2000. He still manages one of the most read physics blogs on the web at physics.com.

When a commercial television network was planning a children's science program, Harris was called on to research, write and co-produce the 65-episode series 17, now in its fourth series. Recently, he has been working as a journalist and public information officer for the University of Queensland identifying, reporting and alerting the science press to science stories for the Australian and international media.

He has been an elected member of the national committee of Aus-
talian Science Communicators, the professional science communica-
tion body, and was Director of the 2001 inaugural Australian Science Wit-
ters Festival.

"David came for an interview at APS on September 11, and was stranded for several days until he could get a flight back home," said Alan Chodos, APS Associate Executive Officer. "We were afraid that after that experience he might just decide to stay in Australia. We're delighted that he accepted our offer, because, with his back-
ground and his skills, he's the perfect person for the job."

Harris focuses at the APS will be to foster physics coverage in na-
tional and international media, extending the usual reach of phys-
ics stories. He will also contribute to APS's education, outreach and policy activities.

"There is great public interest in physics research despite its spe-
cial nature. Most people think a physicist has a long story in front of
him need to be open to new possibili-
ties for communicating our work to new audiences," said Harris. He has already had some success in convincing publications that have no regular science content to include physics-related stories.

Harris sees his work as that of an intermediary who can make commu-
nication between physicists and the media simpler and more efficient.

One of the greatest impediments to communication between physi-
cists and journalists is lack of time. Journalists often don't have the time to learn all the background to a story and physicists often don't have time to walk a journalist through a new result. A key function of media rela-
tions is to equip them with sufficient information to communi-
cate in an appropriate manner without the process getting bogged down in unnecessary details.

In some cases, communication difficulties arise from the very dif-
erent ways in which physicists and journalists work. Having been in both situations, Harris is in a good position to ensure that everyone involved in reporting a story gets the assistance they need in the manner best suited to them.

Harris will work closely with the APS Media and Government Rela-
tions team to engineer broad and effective coverage of all types of physics and physical science stories.

APS members seeking help or advice in dealing with the media can contact Harris at 301-209-3238, or at harris@aps.org.

EDUCATION, from page 3

there is a catch," White said. "At $100 million, they become state-
project. We want funding for fiscal year 2003 at a minimum level of $100 million. How could you call that a mid size project?" "Any-
thing under $100 million is administered by the De-
partment of Education," said Executive Officer. "They typically reach far more people than small, federally-run pilot pro-
grams. "It is expected that P5 will observe and monitor the progress of each proposal as it moves through the agency reviews (and) will provide advice on how to fit the best mid size projects into the current portfolio of projects. "It is expected that P5 will observe and monitor the progress of each proposal as it moves through the:

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EDUCATION, from page 3

there is a catch," White said. "At $100 million, they become state-
project. We want funding for fiscal year 2003 at a minimum level of $100 million. How could you call that a mid size project?" "Any-
thing under $100 million is administered by the De-
partment of Education," said Executive Officer. "They typically reach far more people than small, federally-run pilot pro-
gams. "It is expected that P5 will observe and monitor the progress of each proposal as it moves through the agency reviews (and) will provide advice on how to fit the best mid size projects into the current portfolio of projects. "It is expected that P5 will observe and monitor the progress of each proposal as it moves through the:
Recently there have been murmurings in the scientific community about the Bush Administration’s choice of spending more money on science, and the value it places on federal investment in science and technology. This has created a palpable unease among the American academy in the wake of the tragic events of the September 11 terrorist attacks. I can assure you that this administration is determined not to let terrorism deflect America from its focus on world leadership in science. Our national prowess in technology, especially information technology and instrumentation, has helped shape the world in ways we could scarcely have imagined even a few years ago. It has made it possible to visualize and manipulate matter on the atomic scale, leading to a profound reordering of our understanding of the processes of life, as well as of manmade matters. It has produced the means for great strides to be made in health care and food safety. Through the conventional mechanisms of research and development, we can transform potential technologies into improved foodstuffs, health care, and energy systems. The single greatest leverage for military operations is to strengthen the infrastructure of the nation. The single greatest readiness is needed less now than a generation ago. The analogy is wrong-headed. Cleverly concealing innovations including a single device. Potential technologies range from dusty laboratories to a common language to assess the detection of our Homeland and the security of the way we live less terrorism and the fear of terrorism cover multiple dimensions. How can we detect an unpredictable threat to an indefinable complex territory? How do we measure progress? We need an ability to detect weapons of terror, develop these detection technologies for rapid deployment, and think carefully how to integrate the ones adopted, as a coherent package, into air and sea routines. We must do this in a way that they create not unpleasant delays and unfordable expenses, but do enhance both security and passenger convenience. Potential technologies range from dogs that can sniff explosives to computer-based biomarkers to resonant gamma imaging of concealed explosives, and laser interrogations of trace compounds. Fire was critical in the collapse of the World Trade Center buildings and contributed to damage to the Pentagon buildings, but current building design practices do not consider fire as a design requirement. Current emergency response procedures could not adequately cope with the events in those buildings. Buildings today are not immune from chemical, biological, and radiological threats. Efforts are underway to protect military buildings through DARPAs “immunize building” program, but there are no standards and practices or civilian buildings. Prior to 9/11 the Corps of Engineers helped design several modern high-rise buildings. The Pentagon is part of a completed renovation. Analysis of past attacks, the use of computer simulations and detonations and super computer simulations led to structural hardening innovations including a strong steel support matrix, a keel wrap to contain shrapnel-like frag- ments, and blast resistant windows. That work saved many lives. Let me turn now to the more direct question of how the war on terrorism, and the threat of terrorism, may impact the conduct of science. Increased security mea- sures are, of course, helpful if they actually decrease the chances that unauthorized people will gain ac- cess to classified material, and they do not adversely impact the mis- sions of those implementing the measures. Security measures implemented without adequate forethought can backfire if they do not significantly improve security and have a negative impact on sci- ence and agency missions. We need to identify systematically where additional security measures are needed and develop thoughtful re- sponses sensitive to the importance of activities they might impede. Many people come from around the world to study in US under- graduate and graduate programs. Some come from the same coun- tries that we believe generate terrorists. It is important that inter- national students continue to come to the US to study and contribute to our science and technology en- terprise. They are a major factor in our nation’s world scientific lead- ership. They also learn to appreciate the advantages of our educational system and acquire skills that will enable them to con- tribute quality of life in their own countries. But we do need better ways of identifying the few that might contribute to terrorism. We are currently grappling with what new measures should be introduced, both to iden- tify terrorists before they receive visas, and to identify potential ter- rorists by their activities after they come to the US. Finally, our nation today is a sci- entific superpower. The scope of our scientific activity, both basic and applied, is breathtaking and un- matched. We are not, however, a science monopoly, and we have much to learn from colleagues else- where in the world. Science thrives on open discourse. Measures that inhibit discourse will impede our efforts to enhance their effectiveness and interactions with other nations without paying a scientific price.

John Marburger is the newly ap- pointed presidential science advisor and head of the White House Office of Science and Technology Policy. The above is adapted from his speech at a December 18, 2001 symposium on the war on terrorism sponsored by the American Association for the Advance- ment of Science.