Careers Committee Convenes in College Park

Photo by Michael Lucibella

The APS Committee on Careers and Professional Development has the broad responsibility of coordinating affairs within the Society concerned with career and professional development in physics, and advising the Society on courses of action. The committee held its most recent meeting on March 16 at APS headquarters in College Park, MD. Shown in the photo are (l to r): Alice White, Sufi Zafar, Mark Holtz, Richard Berger, Committee Chair Gregory P. Meisner, Arnold Kritz (partially obscured), Committee Administrator Crystal Bailey, and APS Director of Education and Diversity Ted Hodapp.

Members in the Media

"Their approach is extremely powerful… This is at least a 10-year effort to make very tiny electrical wires and combine them with the placement of a phosphorus atom exactly where they want them."

Andreas Heinrich*, I.B.M., on research by physicists at Purdue and the University of New South Wales making single atom transistors,* The New York Times*, February 19, 2012.*

"I don't think I met anyone who said I bet it's going to be true. I think the people on the experiment worked as carefully as they could, and I think they ran out of ideas of what could be wrong and they decided to present it… Maybe they should have waited a few more months."

Edward Blucher*, University of Chicago, on OPERA's announcement that the faster than light neutrinos might be the result of loose cables,* MSNBC.com*, February 23, 2012.*

"The evidence is beginning to point towards the OPERA result being an artifact of the measurement,"

Sergio Bertolucci*, CERN, on the report by the ICARUS experiment that they measured neutrinos going at the speed of light,* Chicago Tribune*, March 16, 2012.*

"We've lost the motivation to make it (space) a priority… I think there's always been some background activities going on. The space shuttle has been going on for several decades. But my criticism of that was that we were boldly going where hundreds have gone before. If you want to actually advance the space frontier, what you want to do is move that frontier out. Every time you do that, a whole new level of interest and curiosity is stimulated, spawned for having done so."

Neil deGrasse Tyson*, American Museum of Natural History,* CBSNews.com*, February 27, 2012.*

"This very much smells like the Higgs boson."

Beate Heinemann*, University of California, Berkeley, on data coming out of the Tevatron's last run hinting at the Higgs boson,* The New York Times*, March 7, 2012.*

"Unfortunately, this hint is not significant enough to conclude that the Higgs boson exists,"

Rob Roser*, Fermilab on data coming out of the Tevatron's last*

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This Month in Physics History

April 23, 1762: Joseph Black and Latent Heat

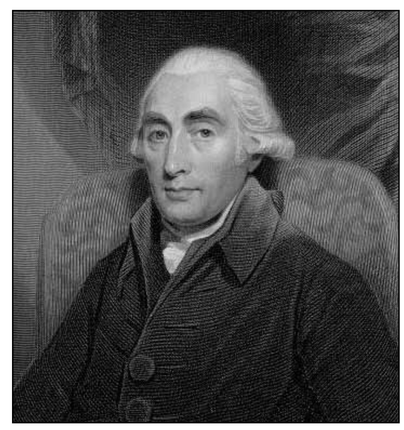
Disappearing heat and the dog that did not bark

Ed. Note: *This column has been contributed by guest writer Richard Williams.*

One of the most primitive human skills, known from ancient times, is our ability to tell whether an object is hot by touching it. It feels hot because of its energy content, "sensible heat." But there is a more subtle form of heat, recognized only more recently. We can't detect it by touch, yet evidence of its existence is all around us.

Melting ice, for example, absorbs a large amount of heat without any increase in temperature. The evaporation of water absorbs even more heat without a temperature change. When the process is reversed and water freezes, or the vapor condenses, this "latent heat" returns to the environment. The latent heat stored in ice and water vapor has a profound effect on weather and climate.

Early scientists were unable to grasp the concept of latent heat, which seemed to disappear and then reappear later, somewhere else. To make matters worse, at the time, the distinction between heat and temperature was poorly understood, and the instruments to measure them were crude and unreliable. Finally, however, in a brilliant leap of scientific intuition, the bizarre behavior of latent heat was unmasked by a modest Scottish scientist, Joseph Black, 1728-1799, who discerned a profound truth hidden in poorly understood and seemingly unrelated observations.



Joseph Black

Black's attention was drawn to the latent heat puzzle by an observation on supercooled water, made by physicist Gabriel Daniel Fahrenheit, [of the Fahrenheit temperature scale.] Fahrenheit reported the now well-known fact that water can be supercooled, or chilled below the freezing point, without turning to ice. When shaken, however, the supercooled water turns instantly to ice, and the temperature rises to the freezing point.

Black meditated on Fahrenheit's experiment, and on his own observations of the slow melting of ice. Taken together, the two suggested that a large quantity of heat was absorbed as ice melts, and a corresponding quantity released by the freezing of water. Starting from this simple insight, he soon realized that a form of heat must exist that mysteriously disappears and reappears as water changes phases. Black based his reasoning in part on the fact that something expected to happen did not. [Sherlock Holmes used similar logic to solve a puzzling case by noting that a dog at the crime scene had not barked, though it was expected to.]

Before Black's work, scientists expected that if one warmed a cold piece of ice to the freezing point, a minute quantity of additional heat would melt the ice entirely. Black showed that the expected thing did not happen. In lecture demonstrations he showed that equal weights of ice and water, both at 0° C, warmed equally by the air of the lecture hall, behaved very differently. Over a period of time, the water warmed by many degrees. The ice did not melt as expected, but most remained, along with a little water, at 0° C. He used the absence of an expected effect, "the dog that did not bark", to argue the case.

He pointed out an important effect of latent heat on the melting of snow and ice in nature. "If the complete change of ice and snow into water required only the further addition of a very small quantity of heat, the mass, though of considerable size, ought all to be melted in a few minutes or seconds more. Were this really the case, the consequences would be dreadful. Even as things are at present, the melting of great quantities of snow and ice occasions violent torrents. But were the ice and snow to melt... suddenly ... the torrents would be incomparably more dreadful." The latent heat that Black discovered greatly slows the melting of snow and ice. He gave the first account of this work on April 23, 1762 at the University of Glasgow.

Having established the existence of latent heat in the melting of ice, Black turned to the vaporization of water. From his lecture notes: if a small quantity of heat added to boiling water could convert it all to vapor, "the undeniable consequence of this would be an explosion of all the water with a violence equal to that of gunpowder." Since this does not happen, he concluded that a large quantity of heat must be added, even though there is no change in temperature, "and I gave it the name, *latent heat*."

The concept of latent heat was soon applied to industrial practice. James Watt was a student of Black and cooperated with him in his work. Watt's early knowledge of latent heat enabled him to manage heat in the steam engine, improving it from a crude and inefficient machine into the powerful driver of the industrial age. With ice, recognition of latent heat allowed one to design ways to use heat insulation, so that ice could be stored for months without melting, even in the warmest climates. An industry arose in the US, shipping ice cut from northern lakes in winter to Cuba, India and other warm countries. In the early 19th century, ice was one of the most important US exports, exceeded only by cotton. Writer Henry David Thoreau, a relentless critic of technology, in 1854 expressed his disdain for both the ice export and the steam engine in a single sentence; "Men think it necessary that the Nation have commerce, and export ice... and ride thirty miles an hour; ... if railroads are not built how will we get to heaven?"

Joseph Black was born on April 16, 1728, one of twelve children. Pressed by his father to study medicine, he enrolled at the University of Glasgow, then went on to receive his medical degree in 1754

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Focus on Advocacy

Ed. Note: *With this contribution,* APS News *begins an occasional series highlighting members' activities in public advocacy.*

John Mergo

John Mergo is a PhD student at Cornell University, where he investigates colloidal micron spheres used to model atomic systems. Although his research in soft matter is his priority, he finds time to participate in outreach and advocacy to impact science policy. A native of southern Ohio, he grew up with a passion for science. But he recognizes that not everyone understands the relationship between innovations such as the iPad and GPS and basic scientific research. His goal is to help people comprehend the connection. In addition to participating in Congressional Visit Days, he recently wrote an op-ed that appeared in the Chillicothe Gazette (Ohio) detailing the choices young scientists face when considering whether to stay in the United States as they advance their careers. "I've been happily surprised by the positive feedback that my op-ed has generated in the community," says Mergo.

Read the op-ed: http://www.aps.org/policy/resources/opeds/index.cfm.

For more information about getting involved in outreach and advocacy, contact Tyler Glembo, government relations specialist at glembo@aps.org or 202-662-8714.

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implemented for other reasons."

With all this inside knowledge about the aviation and airline industry, do these physicists still enjoy flying? Nathaniel, who was an airline instructor for 10 years before becoming a commercial pilot in 2006, clearly loves it–he does it every weekend as he manages his dual-career. When Ng flies, he likes to listen in on the conversations between flight crew and controllers using the airlines' onboard entertainment system to hear what's happening in the cockpit. He declares "I very much enjoy flying," in part because he understands what the pilots are talking about. Listening to the pilots' chatter helps him make decisions about his own personal travel arrangements and stay relaxed on delayed flights. "I know when and where to fly," he says, with a wink.

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from the University of Edinburgh. He joined the faculty at Glasgow and made most of his discoveries there. He published very little of his works. What is known about them comes from occasional public lectures and from careful lecture notes made by his students. In addition to the discovery of latent heat, he first clarified the concept of specific heat, and showed how it varied from one material to another. He also discovered carbon dioxide, and showed how it was related to other gases and to mineral carbonates. Finally, he joined the faculty at the more prestigious University of Edinburgh. His lecturing skills were legendary, models of order and precision, with demonstration experiments, always successful, attracting many students from different fields.

He died peacefully in 1799.

Uncertainty Looms Over Federal Science Spending

By Michael Lucibella

In the Obama administration's proposal for the fiscal year 2013 budget, science and engineering overall received a modest bump in spending; however, there are areas with potentially painful cuts. Overshadowing the proposed budget are looming partisan battles in Congress, a presidential election and possible across-the-board spending cuts, casting a great deal of uncertainty over the future of federal science funding levels.

According to the President's budget, funding for research and development is up about 1.2 percent. This puts the increase below the expected rate of inflation over the next year, but dramatically better than the proposed 2.4 percent cut in federal discretionary spending overall. Nondefense research and development will be getting a 5.1 percent boost while defense R&D, which usually makes up about half of the total R&D expenditures in the federal government, will shrink by $1.5 billion or 1.9 percent.

"This administration has over the years been a pretty strong supporter of science and innovation…given the budget constraints, the budget caps, the budget control acts, the looming sequestration… I think they probably did as well as they could have," said Matt Hourihan, director of the R&D Budget and Policy Program at the American Association for the Advancement of Science. "However just as there are a number of signs of continuing support, there are a number of signs of the limitations they're facing."

Energy research is one of the big winners for research dollars, while high energy physics, nuclear physics and domestic fusion research are taking a hit. Overall the Department of Energy's Office of Science got a 2.6 percent boost in its budget, with programs working on energy research getting the biggest increases. The Advanced Research Projects Agency, ARPA-E, which focuses on developing energy technology, is getting an extra $75 million, or 27.3 percent increase. Basic Energy Science, Advanced Scientific Computing and Biological and Environmental research are slated to grow by 6.6 percent, 3.3 percent and 2.6 percent respectively. Fusion Energy Sciences, High Energy Physics and Nuclear Physics are all contracting, with budgets declining 0.7 percent, 1.8 percent and 3.7 percent respectively.

"Budget issues are very real. We'd love to have larger budgets for the field we represent, but we have to live with what we can orchestrate through Congress and the administration," said William Brinkman, head of the DOE Office of Science at a recent meeting of the High Energy Physics Advisory Panel.

Under the current budget, the development of Fermilab's new flagship experiment, the Long Baseline Neutrino Experiment has been reduced and the project will likely be further stalled and possibly even canceled. In addition the Relativistic Heavy Ion Collider at Brookhaven would run for 10 weeks, down from a planned 20 this year.

The US contribution to ITER, the major fusion reactor under construction in France, is increasing by about $45 million while the overall budget for fusion research is cut, resulting in the shuttering of the Alcator C-Mod Tokamak at MIT.

NASA is getting a 3.3 percent cut overall, including a 3.2 percent cut in its science program. The James Webb Space Telescope is being supported, but at the cost of deep cuts to the planetary sciences which has already resulted in the likely end to the joint Mars exploration missions with the European Space Agency.

The National Science Foundation is set to receive a 4.8 percent increase, and NIST's scientific and technical research services would get a 13.8 percent boost.

How much of the proposed budget makes it through Congress is an open question. Budget proposals reflect an administration's policy priorities, and can be dramatically altered by Congress during the appropriations process. This administration and the current leadership of the House of Representatives have had a particularly acrimonious relationship over federal spending; however scientific research has generally received bipartisan support.

"The House Republicans are not even going to accept the bare bones of [the proposed budget]. They're going to pull this thing apart completely," said Michael Lubell, APS Director of Public Affairs. "I don't believe there is going to be any budget whatsoever until at least after the election."

If no budget is passed by Congress, it is likely that they will pass some kind of continuing resolution, keeping the government operating at 2012 spending levels until a final budget is passed.

The fallout from the Budget Control Act of 2011 is the biggest wildcard facing federal budgets at all agencies. According to the act, after the failure last Fall of the so-called "Super Committee" to come up with a plan to reduce the deficit, significant across-the-board cuts, called sequestration, would set in starting January 2nd of 2013. The cuts include 8 percent reductions in non-defense discretionary spending, and 11 percent reductions in defense spending.

"Sequestration–that is an absolutely open question," Hourihan said. "There are real risks for science and engineering funding."

As it stands, the President's budget does not factor in the cuts, and it is unclear how and where cuts will be introduced. It's also possible that Congress can opt to ignore its own mandate for cuts.

"If it comes to pass, I think people will be shocked," Lubell said. "They [Congress] can do whatever they want."

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diences up-to-date on research being conducted by the Alpha Magnetic Spectrometer onboard the International Space Station.

Nobel Session

Monday morning's Nobel session promises to be engaging and enlightening. Two of the winners of the 2011 physics prize, Saul Perlmutter from the University of California, Berkeley and Adam Reiss from Johns Hopkins have both been invited to speak about their discovery that the expansion of the universe is accelerating. One of the 2004 Nobel laureates, Frank Wilczek of MIT, will discuss the implications that a potentially low-mass Higgs boson will have for theories of supersymmetry (Session P1).

Plenary Session

The third plenary session of the meeting, on Tuesday morning, features a range of topics. Krishna Rajagopal from MIT will describe how string theory is being used to describe the properties of hot quark soup at RHIC and the LHC. Zheng-Tian Lu from Argonne National Laboratory will highlight how laser-based atom traps are being used for Atom Trap Trace Analysis which could enable researchers to develop an effective method of krypton-dating groundwater and ancient ice. Judith Curry from the Georgia Institute of Technology will talk about how the Berkeley Earth Surface Temperature Project has brought together more than a billion historical temperature readings from around the world to produce a method to more accurately calculate the history of global climate.

Neutrino Research

New neutrino results are big at this year's meeting. Bradford Benson from the University of Chicago will present the first evidence of a 4th generation of neutrino discovered by the South Pole Telescope (Session W3.02). Recent results from the Daya Bay Experiment which uncovered the value of the theta one-three mixing-angle of neutrino oscillations will be presented in session G10.

Gravitational Waves

The hunt for gravitational waves continues, and session L6 will bring focus on new developments in the various searches as well as efforts to further refine general relativity. Nicolas Yunes of Montana State University will give an overview of his work developing new devices to look for evidence of gravitational waves around binary star systems. Later, John Conklin from Stanford University will present the latest results from the Gravity Probe B mission, launched in 2004.

Energy for the Developing World

As renewable and green energy becomes more affordable, physicists have been working on ways to bring cleaner energy to the world's poorest billions. Ashok Gadgil from the University of California Berkeley will share his work developing a cheap, energy efficient and low carbon emission biomass stove for use by displaced people around the world. Kurt Kornbluth from the University of California at Davis has been developing inexpensive solar powered lights for unelectrified houses and huts. Jeffrey Nelson and his colleagues at Sandia National Laboratories have developed what they call "solar glitter," a new way of creating photovoltaics made from crystalline silicon that uses much less semiconductor material, but maintains its efficiency (Session H6). The second session of the series looks at power generation at an industrial scale. Chris Lyons from Solar Turbines Incorporated will talk about how to generate electricity using already existing biomass and other wastes. Trudy Forsyth from the National Renewable Energy Laboratory will show the promise that wind power holds for developing nations (Session J12).

Nuclear Detection

Warren Stern from the Department of Homeland Security will highlight some of the recent developments in radiation detection technology. Michael Kuliasha from the Defense Threat Reduction Agency will focus on overarching strategies being employed by the United States to reduce the threat of nuclear terrorism and proliferation. Michael Larson will describe the history of the Nuclear Emergency Support Team, a team trained to respond to any kind of nuclear incident in the country (Session Q5).