obtain, and advance in a job; how to make, invest, budget, and spend money; how to run a company; and how to start and operate a business. Conventional subjects of reading, writing, arithmetic, and science would be incorporated into the curriculum as they fit the overall structure. Students would be encouraged to get jobs as early as possible and integrate their practical experience into the course.

Chuck Gallo
(chuckgallo@comcast.net)
Superconix Inc
Lake Elmo, Minnesota

No simple cause and effect for glacial melt

The spectacular Back Scatter image "Black Soot and Tibetan Glaciers" (PHYSICS TODAY, February 2010, page 72) is accompanied by a commentary suggesting that black soot from industry on the surrounding subcontinent is warming the lower atmosphere, darkening the glaciers' surface, and dramatically increasing absorption of solar radiation and the rate of melting. The rate of accretion or ablation of mountain glaciers may be as much a result of precipitation as of surface temperature. Increasing the Himalayan massif's surface temperature would just as likely enhance the Southeast Asian monsoons and bring more snowfall to the glaciers, thus causing them to grow rather than decay. In considering the complex feedback processes linking the surface to the atmosphere, it is dangerous to speculate on the net result.

Michael Garstang
(mxg@swa.com)
University of Virginia
Charlottesville

Scientific declarations best left to scientists

Prestigious scientific societies, I have believed since my undergraduate days, exist to serve and promote science. But pronouncements concerning global warming issued by the Royal Society and the American Physical Society in 2007 indicate that some societies appear set on usurping science. To quote Thomas Huxley, "Belief, in the scientific sense of the word, is a serious matter, and needs strong foundation." That strong foundation can be provided only by the profound examination of nature by individual scientists and peer assessment of those examinations. For a committee, however distinguished its membership, to pontificate on scientific matters is not only hubris, it is dangerous. Let individual scientists speak and let committees be silent.

The Royal Society and the American Physical Society published endorsements in 2007 of the belief that there is global warming and that it is caused by human-generated carbon dioxide. Those pronouncements were made despite the scientific difficulties of obtaining a reliable quantitative measurement of global warming and of establishing a rigorous causal connection to man-made CO_2 in the atmosphere.

The media does not involve itself directly with scientific literature; it relies on the popular expositions of scientists and, mistakenly but understandably, on pronouncements of scientific societies. But those societies have no authority concerning scientific truth or falsehood. That is the business of individual scientists. It was not the Royal Society that gave the world its first account of gravity, it was Isaac Newton.

B. K. Ridley
(bkr@essex.ac.uk)
University of Essex
Essex, UK

Teaching amid the research obsession

In his review of Joseph Hermanowicz's book *Lives in Science: How Institutions Affect Academic Careers* (University of Chicago, 2009), Robert Hilborn remarks, "The most important lesson [of the book] is that the science community's obsession with research as the sole reason for recognition and reward leads to frustration and dissatisfaction when reality fails to match expectations. And that, as the sociologists would put it, 'leads to anomie' " (PHYSICS TODAY, January 2010, page 48). Although that statement essentially describes my career in physics, I still find it shocking. How can brilliant people be so stupid?

According to the *Random House Dictionary*, 2nd edition (1987), anomie—derived from the Greek word for lawlessness—is a sociological term meaning "a state or condition of individuals or a society characterized by a breakdown or absence of social norms and values, as in the case of uprooted people." Uprooted people have an understandable excuse. What excuse can the physics community offer?

The obsession with research as the sole measure of an educator's worth came close to ruining my career but for the intercession of a few farsighted colleagues in the University of Minnesota physics department who came to my aid and helped me get some recognition and at least some improvement in salary. Today, after decades of work and dedication on my part, and after 10 years of retirement, I am considered a master volunteer teacher in the Osher Lifelong Learning Institute, and I had a similar reputation throughout most of my tenure at the university.

The research obsession is both self-reinforcing and self-destructive. The eroding state of science and science education in the US today is at least partly due to that misguided and harmful attitude in our universities. It has disfigured the humanities into useless imitations of some kind of quantitative science and has made the exact sciences a shadow of what they ought to be as part of liberal education and knowledge. It's tragic that at a time when science should be setting the standard for truth and understanding, science academics and administrators are too preoccupied with their own self-advancement to play the valuable and important leadership role.

My case is a small example of the problem. My department didn't recognize the value of my talents and skills, which it could have used in "selling" physics to the lay community. I could have been a central player in efforts to popularize, explain, and spread understanding of physics.

Teaching physics has been so undervalued for so many years that its denigration has become a serious, even self-destructive problem for science and society. Now, when we need science and scientists most, the populace has little understanding of the value of either, and even ridicules science on a regular basis. What have we wrought?

Roger S. Jones
(jones001@umn.edu)
University of Minnesota
Minneapolis

Notes on *Strangest Man*

I had just finished reading Graham Farmelo's biography, *The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom* (Basic Books, 2009), when the December 2009 issue of PHYSICS TODAY arrived, with the interesting review by Babak Ashrafi on page 52. Although I

quite agree with Ashrafi that Farmelo's book is "fascinating" and "thoroughly researched," since I counted 1494 reference notes distributed across its prologue and 31 chapters, I was consequently astonished to find two significant errors concerning the history of relativistic cosmology in the 1920s.

In chapter 19, after describing Georges Lemaître's commencing his studies with Arthur Eddington in 1923 and his cosmology work of 1927, Farmelo says, "Quite independently, the Russian mathematician Alexander Friedmann had applied Einstein's general theory of relativity to the universe as a whole and demonstrated that some mathematical solutions of the equations correspond to an expanding universe, though his work was published only in Russian and at first went unnoticed." No reference note is given, perhaps because the latter two assertions about Friedmann's work are incorrect and, in absence of date of publication, possibly misleading with respect to priority of publication.

Friedmann's first published paper on the subject[1] was written in German and titled "Über die Krümmung des Raumes" ("On the Curvature of Space"). It was not only noticed but criticized later that year by Einstein, who thought Friedmann had made a mistake.[2] Following a visit by Friedmann's colleague Yuri Krutkov and a letter from Friedmann himself, Einstein withdrew his criticism the following year and accepted Friedmann's work as "both correct and clarifying."[3] Although those historical errors have no bearing on Dirac's life, nevertheless, as he would have emphasized, it is important to get it right.

References

1. A. Friedmann, *Z. Phys.* **10**, 377 (1922).
2. A. Einstein, *Z. Phys.* **11**, 326 (1922).
3. A. Einstein, *Z. Phys.* **16**, 228 (1923).

Frank R. Tangherlini
(frtan96@sbcglobal.net)
San Diego, California

The need for nondestructive sampling

In their gathering of data, scientists need to be careful that they don't irrevocably pollute the object or area they seek to study. We are particularly concerned about a NASA Moon mission in 2009.

It is fairly common knowledge that the Antarctic and Greenland ice caps are the archives of Earth's climatic history of the past million years. As the ice formed, it trapped air bubbles. From ice cores drilled today, researchers can use refined analysis techniques to recover information about past atmospheric composition, world temperature, ice extent, winds, volcanic eruptions, and other topics.

In the future, even more advanced techniques will allow the extraction of additional information that is archived in the ice. That discovery will be possible because the drilling of ice cores now does not destroy the ice caps.

In interplanetary space, water molecules have existed for millennia. Dust particles varying greatly in size and composition travel in circumsolar orbits together with molecules of both inorganic and organic material. A small fraction of those objects fall on planetary surfaces, including Earth's and the Moon's. Most of those that land on Earth are diluted in the atmosphere, in the oceans, and on the planet's surface. The search for such extraterrestrial objects here is therefore hopeless, except for a few special cases.

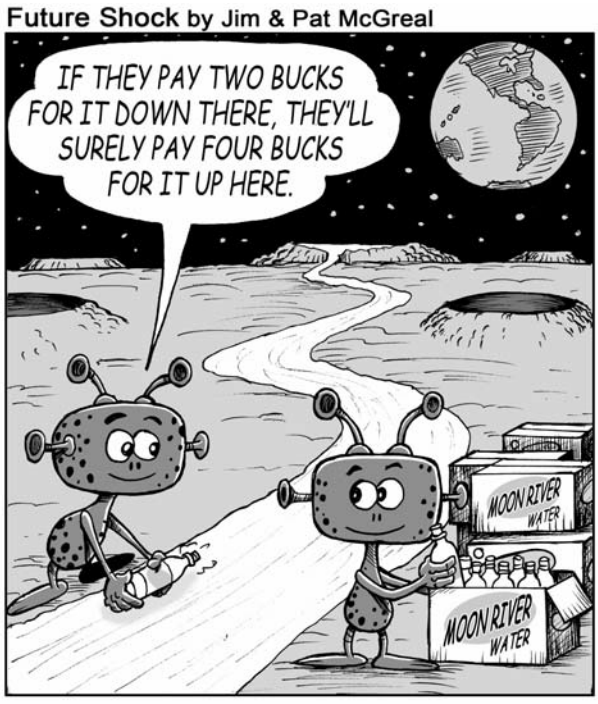
Objects falling on the Moon have a different fate. They are unimpeded by atmosphere, winds, or oceans. Water molecules will be absorbed on the rocky and sandy surface, to be desorbed later by solar radiation. Due to the Moon's low gravity, the escape velocity of water molecules is low enough to allow a continuous loss into space. With such conditions, one would not expect to find many water molecules on the lunar surface.

Nevertheless, there are exceptions. Molecules hitting inside small craters near the poles may find a good, protected location; there are certainly small spots that solar radiation will never reach. In those spots there may be interplanetary dust particles and organic or inorganic molecules glued together by frozen water, having accumulated possibly since the Moon was first formed. Those tiny spots are an archive of solar-system history.

In October 2009 NASA's Lunar Crater Observation and Sensing Satellite team carried out a new Moon mission whose main objective was to confirm the presence of water ice in a permanently shadowed crater (http://www.nasa.gov/mission_pages/LCROSS/main/prelim_water_results.html). Unfortunately, that fascinating research question was addressed by dropping a 2366-kg "bullet" that destroyed the crater and polluted the impact site. We understand that the damage is a small price to pay for science, but we wonder if NASA considered that future generations of scientists might not want to find those explosives in the Moon's archives.

From the very basic viewpoint of site preservation, NASA's experiment was quite primitive; it destroyed the historical record in that location. Scientists over the next few hundred years will develop new analysis techniques. They would, we are sure, be glad to find at least part of the natural archive left intact. Subsequent lunar water experiments should be planned as nondestructive site samplings.

Antonio Zecca
(zecca@science.unitn.it)
Luca Chiari
(chiari@science.unitn.it)
University of Trento
Trento, Italy



Correction

June 2010, page 60—References 2 and 3 in Robert J. Burke's letter were inadvertently reversed. ■