

Grid initiatives. (A list of project URLs can be found at <http://www.mcs.anl.gov/~foster/grid-projects>.) I would also have discussed the various virtual observatory projects (see *PHYSICS TODAY*, February 2002, page 20), and environmental data Grid efforts. I hope that Jacob's letter and my response will clarify that physics problems and physicists are indeed central to the emergence and evolution of Grid computing.

We must all hope, as Jacob suggests, that physics will continue to have the opportunity to pose IT challenges of the magnitude associated with the LHC.

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Sprites and Elves Are Seen but Seldom Quantified

I believe Earle R. Williams's article "Sprites, Elves, and Glow Discharge Tubes" in the November 2001 issue of *PHYSICS TODAY* (page 41) requires additional historical background. For decades, pilots have reported observations of auroralike flashes of light immediately above very large thunderstorm cells; such reports have come particularly from commercial and military pilots who have flown routes along the coast of Central America, home to some of the most severe electrical storms on the planet. Scientists have consistently dismissed these observations as everything from glare on the inside of cockpit windows to tricks played by the minds of sleep-deprived pilots on long-distance flights. Perhaps in the light of this article, some members of the scientific community will not be so quick to dismiss observations made by laypeople.

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WILLIAMS REPLIES: Eyewitness accounts often provide valuable input to scientific progress. If greater attention had been paid to eyewitness reports of transient luminosity in the middle atmosphere, progress in sprites research would no doubt have been quicker. This expectation seems particularly true given greater awareness of C. T. R. Wilson's early predictions on sprites (ref. 1 in my article).

Capps's characterization of quick dismissal by the scientific community is perhaps unjust. Many scientists simply find little to say about qualitative observations. As Lord Kelvin said, "When you measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, . . . your knowledge is of a meager and unsatisfactory kind." Ball lightning is another area in atmospheric electricity in which relatively little progress has been made, largely because good quantitative measurements are scarce.

Given the limitations on article length, I chose to concentrate on aspects of sprites research for which numbers are available and where observations agree and disagree. The earlier historical background Capps mentioned was addressed in the review article by Craig Rodger (ref. 4 in my article). Further discussion of historical observations was given in an older paper that W. A. Lyons and I wrote for the American Meteorological Society's Conference on Atmospheric Electricity in 1993.

I look forward to further discussions with Capps about the eyewitness accounts he mentions, which may not be generally available to other scientists.

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Edward Condon Remembered

In her interesting article "Edward Condon and the Cold War Politics of Loyalty" (*PHYSICS TODAY*, December 2001, page 35), Jessica Wang summarizes the remarkable career and political tragedies of this accomplished physicist. One of his last contributions to science and society, though, is missing.

Between 1966 and 1968, Condon headed the Colorado Project, also known as "The Scientific Study of Unidentified Flying Objects" [and Project Blue Book]. The published results of that work became known as the "Condon Report," and its most famous conclusion was: "Careful consideration of the record as it is available to us leads us to conclude that further extensive study of UFOs probably cannot be justified in the expectation that science will be advanced thereby." Much of the gen-

eral public may still believe that UFOs are piloted spacecraft from alien worlds, but Condon's thorough analysis at least liberated American science from the task of pursuing this illusion.

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The article on Ed Condon taught me much I should have known about the endurance of a scientific leader in the face of political attacks. Condon was kind to me—in a completely different field—when I was the youngest assistant professor in the physics department at the University of Colorado in the mid-1960s. His legacy is the present excellence of the department and of JILA. I miss his puckish humor.

Ed used to offer me a ride in his huge Cadillac; he could barely see over the steering wheel. The first time he offered, I was reluctant, because of his reputation as a terrible driver. He explained that, since he drove a Cadillac (though admittedly secondhand), he could never be accused of being a Communist.

When he was appointed chief scientist on Project Blue Book (a US Air Force-sponsored review of evidence for UFOs), he said that he was chosen because of his history—no one could say that he was automatically biased on the side of the government.

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Jessica Wang's excellent article on Edward Condon's career and trials inspired this letter. He had an ability that may not be fully recognized but that should be mentioned in any evaluation of his career.

Condon was my adviser in graduate school. Early one morning, I entered his office to be greeted with "Bob, what's on your mind that you can admit?" I referred to an article that I did not fully understand in the latest *Physical Review*. He took his unopened copy of the *Review*, turned to the article, scanned it with amazing speed, went to the blackboard, and said, "Are you taking Robertson's course in methods of mathematical physics?" After I said "yes," he explained the article at my level of mathematics.

As we sat and talked, a senior in physics entered and apologized for

interrupting. Condon greeted him with "Join the fun, we're just shooting the breeze. What's on your mind?" The same article was bothering the senior. As Condon erased the board, he asked, "Are you taking advanced calculus?" The student said he was, and Condon explained the article in advanced calculus.

The next visitor was Fred Seitz, at the time an advanced graduate student, who was puzzled by the same article. Condon again went to the board and explained the article in math I didn't know. These three explanations spanned 45 minutes. I was privileged to study under many brilliant people, but Condon was the only one who could, without a shadow of a doubt, teach calculus to a six-year-old.

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Physics Fills the Gap for Java Man

Ervan Garrison wrote a very thoughtful article that brings the field of archaeology to the attention of physicists (PHYSICS TODAY, October 2001, page 32). Certainly both fields could benefit from more interactions. Garrison covered a lot of material in a short article, and so couldn't be thorough with every subject. I noticed some important omissions, and would like to point out that the field of radioisotopic dating is far more advanced than his article suggests.

Contrary to Garrison's suggestion, radiocarbon dating is not the only discovery to truly revolutionize archaeology or archaeological dating. Accelerator mass spectrometry,¹ which was covered in the Garrison article (see also the article by Richard A. Muller in PHYSICS TODAY, February 1979, page 23), increased the sensitivity of carbon-14 methods by a factor of 1000, enabling their use on much smaller samples. The invention of potassium-40/argon-40 dating (and its modern equivalent, $^{40}\text{Ar}/^{39}\text{Ar}$) was equally important for the field of archaeology and, as Garrison mentioned, has enabled us to date most hominid remains. The $^{40}\text{Ar}/^{39}\text{Ar}$ method has also been used to help determine the provenance of building stones, such as those in ancient Rome.²

Garrison suggests that there is an age "gap" from 0.05 Ma (million years ago) to 0.5 Ma between the effective

age ranges covered by radiocarbon and ^{40}K -decay dating methods. This is false. While 0.05 Ma is the approximate range to which radiocarbon dating can be used, the $^{40}\text{Ar}/^{39}\text{Ar}$ method is being used all the way down to the historical realm, where it has been used to date the 79 AD (that is, 0.002 Ma) Mount Vesuvius eruption.³ Thus, the lower limit of 0.5 Ma for $^{40}\text{K}/^{40}\text{Ar}$ dating mentioned by Garrison is incorrect, and the gap does not exist. Additionally, uranium-series decay methods are also ideally suited for dating materials of this gap age, including volcanic rocks, soil

carbonate, and animal teeth.

Garrison points out that other dating methods have been used to date materials of the gap age. While it is true that other methods (thermoluminescence, optical-stimulated luminescence, and electron-spin resonance) are being used to date certain types of samples of that age (and, in many cases, samples that cannot be dated by radioisotopic means), the uncertainties associated with those methods (10% suggested by Garrison) are significantly larger than those associated with radioisotopic dating techniques (routinely 1–2%