David Lynch either has forgotten or never needed to use the pre-computer format for figures submitted to journals: They were either handmade India-ink drawings or glossy photographs of those drawings. Every author had to pay a drawing shop or personally master the art. Computers are easier and cheaper, but enable authors to submit unusable figures. My favorite, from my experience as editor of *Bioelectromagnetics*, is the black-and-white version of a false color map, with both extremes (red and blue) appearing as black and the intermediate yellow showing as white. No editor or publisher can fix that.

Ben Greenebaum
(greeneba@uwp.edu)
University of Wisconsin–Parkside
Kenosha

Lynch replies: I was struck by David Couzens's thoughtful comments on the inherent stumbling blocks of change. When he asks "Does electronic publishing save money?" he goes on to recognize that "Time is money." But whose time and whose money? A scientist can choose to labor over a paper as long as he likes to get it right, using whatever tools he chooses. But then he is slapped in the face and told that his pains are all for naught unless he spends a lot of time—money—conforming to the publisher's scientifically irrelevant submission requirements. "Sorry, your scientific best isn't good enough because your font is wrong."

Has physics unknowingly suffered because the author of a worthy paper didn't have the time or financial resources to meet the publisher's self-enforced, self-serving formatting and submission requirements?

I recently self-published a book. In the past I would have gone to a major scientific publisher. But if I am going to be forced to meet the publisher's onerous formatting and style requirements, I might as well self-publish and do it my way. My hero in this regard is Lawrence N. Mertz (1930–2002), who bypassed the journal requirements by publishing summaries of his scientific work as paid advertisements in the *Journal of the Optical Society of America.*

David K. Lynch
(thule@earthlink.net)
Thule Scientific
Topanga, California

Serving nontraditional graduate students

According to a report from the National Center for Education Statistics,[1] the percentage of undergraduate students who attended college part-time grew from 28% to 39% between 1970 and 1999. This suggests a need for nontraditional graduate study as well. Still, few physics programs actively work with nontraditional graduate students. As more students and universities become involved in lifelong learning, developing physics programs that cater to nontraditional students will become more important. Many master's programs in business administration are already beginning to focus on nontraditional students; it's time for physics programs to do the same.

Instead of following the traditional path in which graduate students are recruited exclusively from undergraduate physics programs and are expected to attend full-time, the University of Houston–Clear Lake (UHCL) developed a program that focuses on part-time, nontraditional students. As a result, we can educate students who would not normally be able to complete a graduate physics degree because of nonacademic obligations.

A nontraditional upper-level undergraduate and graduate university, UHCL was established as a commuter campus for the University of Houston system. About half of its students take classes part-time. The average age of students is 30 years for undergraduates, and 32 for graduate students. In the fall of 2002, we began to develop the university's first physics degree, an MS. The program began operations in fall of 2004 and currently has 40–50 graduate students; seven MS degrees were awarded in 2005. However, unlike most physics programs, almost all of our classes are offered in the evenings, and a majority of our students work full-time.

We developed the physics MS program based on community interest as determined by an online survey of employers and potential students in the local aerospace and petrochemical industries. Overall, the respondents wanted a program that could prepare students with engineering backgrounds for PhD study in physics, astronomy, or related areas while broadening the technical backgrounds of practicing engineers. The most difficult part of developing the curriculum was working within the restrictions of the part-time students. Almost all of our classes are taught in the evenings, and many involve group learning. Although we included both thesis and non-thesis options in the curriculum, the majority of students choose the non-thesis option. The capstone experience for those students consists of at least one semester of independent study research and a class in writing and publishing scientific papers and giving oral presentations. Our part-time students also seem to prefer theoretical and computational work that better allows them to schedule research time. Experimental work is typically done in collaboration with labs at the neighboring Johnson Space Center, where many of our students work full-time.

Because of the immediate popularity of this program among working students, we developed a professional physics sub-plan for the training of technical managers. The plan combines the physics core with business and organizational training from UHCL's systems engineering and management programs.

Overall, the response to the physics MS program has made it clear that a lot of people would love to pursue an advanced degree in physics but can only do so as nontraditional students. In physics we tend to follow an old model that expects students to work continuously from bachelor's degree through graduate school and postdoctoral study. Those who digress from the standard path are accused of leaving physics and are rarely welcomed back. In the wake of September 11, and as relative enrollments in science, mathematics, and engineering continue to decline nationwide, perhaps it's time to consider a new approach.

Reference

1. National Center for Education Statistics, http://nces.ed.gov/programs/coe/2002/analyses/nontraditional/index.asp.

David Garrison
(garrison@uhcl.edu)
University of Houston–Clear Lake
Houston, Texas

Why no Einstein's laws?

Since my undergraduate days, I have been puzzled by the fact that we have Newton's laws of motion but only Einstein's theory of special relativity. We have finished celebrating the 100th anniversary of the publication of the theory of special relativity, and it seems to me that after a century of validation, it's time to rename it as more than just a theory.

I propose that we, as physicists, define a set of Einstein's laws, just as we have Newton's laws, Coulomb's law, or Faraday's law. I begin the discussion by offering the following three laws:

- The laws of physics are identical in

all non-accelerating (that is, inertial) frames.

▶ The vacuum speed of light, c, is the same for all inertial frames.

▶ The total energy E of a body of mass m and momentum p is given by $E = \sqrt{m^2c^4 + p^2c^2}$. In particular, the energy of a body measured in its own rest frame is given by $E = mc^2$, and the energy of a massless body is $E = pc$.

Collectively, these laws should, in my opinion, be called Einstein's laws of special relativity. Others may prefer slightly different wording, or more lawyerly definitions; with that I have no quibble. Time dilation, length contraction, and the relativity of simultaneity could be considered corollaries of these laws.

Some may ask what is the consequence of renaming a "theory" to a "law"; obviously Nature does not care. To my way of thinking a theory is speculation based on incomplete knowledge, and a law is valid in all cases where the appropriate circumstances apply. I believe that the special theory of relativity falls into the latter category equally with Newton's laws, Coulomb's law, or Faraday's law. If nothing else, this change would help us impress upon students and nonscientists (a) the importance of special relativity to our understanding of nature and (b) the multitude of advances in science made possible as a consequence of its formulation.

Richard W. Kadel
(rwkadel@lbl.gov)
Lawrence Berkeley National Laboratory
Berkeley, California

Nuclear power's costs and perils

In "Stronger Future for Nuclear Power" (PHYSICS TODAY, February 2006, page 19), Paul Guinnessy surveys plans for refurbishing, expanding, and building new civilian nuclear power reactor facilities in numerous countries. In the US, passage of the 2005 energy bill marks the federal government's readiness to put the national credit card behind the nuclear industry. Tax credits worth \$3.1 billion and the renewal of legislation mandating that the US taxpayer assume all corporate nuclear liability in excess of about \$9.3 billion[1] represent a nice vote of confidence.

Some observers attribute these ambitious plans, after 25 years of drought in investment in nuclear power, to a gradual dissipation of the fear that followed the 1979 Three Mile Island accident. Arguably the more important factor in the drought was that when all costs are accounted, nuclear energy is not cost-competitive with fossil energy.

The reason that well-informed and intelligent people are still talking about Three Mile Island emerges clearly from two major new scholarly works published in 2004. The first, by J. Samuel Walker,[2] was sponsored by the US Nuclear Regulatory Commission. The authors of the second book, Bonnie A. Osif, Anthony J. Baratta, and Thomas W. Conkling,[3] chose the 25th anniversary of the accident as an occasion to evaluate its impact.

Both books describe the TMI accident as a watershed event. The story of how that accident happened—how it could possibly have happened—emerges not so much as a technological who-done-it as a loss of the public's confidence in the people who own, operate, regulate, and oversee the nuclear power enterprise.

Woven throughout the technical details is the unmistakable thread of facts manipulated and people misinformed. The 1979 *Report of the President's Commission on the Accident at Three Mile Island* documents that what the technical people knew minute by minute had been concealed from the media and public officials. Repeated assurances of "no danger," continued even after TMI station manager Gary Miller had declared a "general emergency," which includes in its official definition "the potential for serious radiological consequences to the health and safety of the general public."

Osif and coauthors remind us that before the accident, the nuclear industry believed it had designed "accident-proof plants . . . thanks to the many safety features engineered into each reactor" (page 32). Now, 25 years later, as those same assurances are being repeated, perhaps they are losing credibility.

What went wrong at TMI was not primarily a technology fiasco but a character flaw in management and regulation. Lessons learned from the technical failings may well have led to some technical improvements. However, one could easily suspect that the character flaw is intrinsic to the political–industrial complex; consider, for example, the sequence last year that started with the coal-mining industry's lobbying for and obtaining a lowering of national safety standards and ended with the needless deaths of 17 coal miners.

The TMI accident happened not because a pump failed, but because the management—staffing, training, main-