

LETTERS

Physics First, Because the Atom Unlocks Science

Leon Lederman is engaged in a valiant campaign to renovate the teaching of physics in high school (PHYSICS TODAY, September 2001, page 11). At the center of his campaign is a modification of the order in which the different sciences are taught in the high-school curriculum: Instead of physics last, teach physics first.

The Europeans have cut this Gordian knot by teaching all sciences simultaneously. In France, for example, in the years that correspond to US middle school and high school, the schedule is approximately as follows: Math is taken four hours per week for all seven years; physics (with some chemistry), four hours per week the last six years; biology and natural sciences, three hours per week all seven years; and information science and technology, one hour per week for the first four years. Although student options are limited, the last three years will differ somewhat depending on whether the student chooses a more literary or scientific path.

Rather than start new pilot projects in the US that parallel the French schedule but will take at least 10 years to evaluate, one could perhaps obtain a more immediate evaluation by comparing US and European results in the 20- to 30-year-old groups. That is finally where differences will count, rather than in test results at the end of the school year.

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LEDERMAN REPLIES: The European system is better than our alphabetical system of biology, chemistry, and physics, but it is also mired in history and in the difficulty of

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change. The point was made by Richard Feynman, who pounded on the idea that the atom is key to 20th-century science. The learning of science involves exposure of students to phenomena, followed by explanation. Since 1930, the explanation of the periodic table or the ideal gas laws or the combination of elements to make compounds follows most beautifully from the properties of atoms. One doesn't need Schrödinger's equation to get a feeling for how atomic structure creates the rows in the periodic table, or the chemical activity of the columns, or the potential energy "well" that enables two atoms to make a molecule.

So the atom is the key to explaining much of chemistry. Study of physics concepts and methodology requires a full year, culminating in atomic structure. Imaging and simulation software can help to provide the overjoyed chemistry teacher with students who are comfortable with the physics of atoms.

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Teller 'Exiled' Himself for Science

In his review of Edward Teller's memoirs (PHYSICS TODAY, November 2001, page 55), Hans Bethe says that Teller left Hungary in 1926 to seek an education in Germany. Later in the review, he says that Teller was forced to leave Hungary (in 1926), then Germany (in 1933). This information creates the unfortunate impression that Teller left Hungary for the same reasons he left Germany when the Nazis came to power. He was not forced to leave Hungary; there was no anti-Semitism in Hungary at that time. Jewish Hungarians were doing quite well and were represented in outstanding numbers among top financiers and industrialists, professionals and artists. Nothing proves this point better than the synagogue in Budapest; built in the

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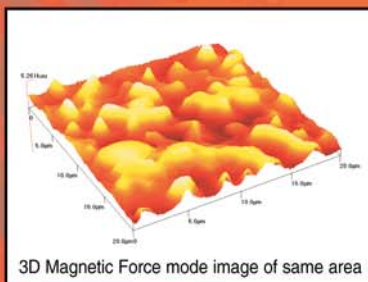
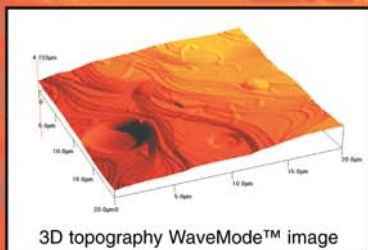
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BETHE REPLIES: Maria Ronay is correct. Edward Teller did not have to leave Hungary in 1926. He left voluntarily to get a science education in Germany. Jewish business was flourishing in Hungary at that time, and for many years thereafter. But a science career could only be had outside Hungary. In this sense, Teller felt (as he mentioned in his memoirs) that he was exiled from Hungary in 1926, and then, for quite different reasons, from Germany in 1933.

HANS A. BETHE
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'Pipeline' Provides Physicists with Flexibility

I read with interest the articles on careers for physicists in the April 2001 issue of PHYSICS TODAY, especially the article by Kate Kirby, Roman Czujko, and Patrick Mulvey (page 36). These authors interpret their fine research results in terms of the familiar concept of a "physics pipeline," a flow of physics students from high school through college, graduate school, and postdoctoral appointments. Students are often lured through this pipeline by such factors as the advertised prestige of physics faculty positions, promises of quality careers, and patriotism. I believe that the physics pipeline was a cold-war idea that emphasized the importance new physics research could have to national security. Unfortunately, the concept is also dehumanizing, comparing physics students and journeyman scientists to a commodity such as oil. Surely there are better ways to attract and justify the existence of students in physics.

I have a PhD, postdoctoral research experience, and more than 10 years' full-time university, college, and even high-school teaching experience. My observation is that today's students are wiser than students of the not-so-distant past, more cognizant of economic and political realities. For instance, I received the Society of Physics Students careers poster shown in Barrett Ripin's article in the same magazine (page 43, figure 2) when the poster first came out. I displayed it in the hall, and students

immediately told me that physics degree holders must be having trouble finding jobs. Within a week, one joker had penned in the career option of "fast food," so I had to take the poster down. Perhaps this cool reception occurred because students view blithe promises of quality careers as fostering a delusion to attract physics majors. Most of the careers listed on the poster have their own degree programs. Students realize this and may get the impression that physics is for people who don't know what they want to do.

My opinion is that the overarching reason to pursue a physics degree is interest in physics and the politics of physics research, although I realize that graduate programs in physics and other technical fields are attractive to foreign students who also wish to gain a foothold in the US. Physics educators encourage more undergraduate majors by emphasizing exciting teaching and research. Graduate programs with well-defined times for degree completion and a climate in which journeyman researchers believe that they can meet their career goals will improve both morale and enrollment numbers at higher educational levels. Insinuating that it takes a PhD in physics to solve certain challenging industrial and business problems is likely to be counterproductive.

We must do more to educate the American public about physics itself. People may link physics and national security far less tightly than in the past. For instance, in the community of my youth in the 1960s and 1970s, people thought that physics was hard and that physicists "learned to build better bombs." Now all that seems to remain is the thought that physics is hard. I believe that clearly defining physics to the public will, at the very least, boost high-school and undergraduate enrollments.

We saw in 2001 that a sudden economic bear market and layoffs in the technology sector make future job prospects uncertain at all times. I hope the physics community will steer away from tired concepts such as a bull market of jobs and a physics pipeline. I look forward to future articles in PHYSICS TODAY that point in new directions.

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KIRBY, CZUJKO, AND MULVEY
REPLY: We agree with many of the points that Kurt Bachmann made: the overarching reason to pur-