Message to Congress: More Support, Not Less

'Twas the night after Congress came back here to spend
As little as possible before the year's end,
And all through the House and the Senate as well,
Research funds for tomorrow were felled by a spell.

Spending will increase for pensions and health,
But decrease for research that spurs national wealth.
Investments in education will wither away
Because public austerity is now here to stay.

I awoke with a start from this awful nightmare
To find that this tragedy was really out there.
Research and education can help give us the best,
But lacking either, we'll be less than the rest.

I threw open the window and yelled out below:
"This wounds our great nation! Which way will we go?
Will we build a great future with vision and verve,
Or shrink from the challenge and lose all our nerve?"

The answer, my friends, rests solely with you;
Don't watch it all happen, but act now and do
Whatever you can, and please take this vow:
"I will act with much vigor, and do it right now!"

It is good for us all to have self-reliance,
But now we must work to create an alliance.
Governors, executives, groups of any kind,
Must come together and be of one mind.

We must go to the House and forthrightly say:
"Support basic research without a delay!"
We must go to the Senate and forthrightly say:
"Support our universities with a much-needed yea!"

Let's get to the media, before it's too late,
To inform the public in every state.
Let's make sure our stakeholders are fully aware
Of all our good work, of how much we care.

University research helps the economy progress,
One percent of the budget is its total largesse.
Each buck invested yields 40 cents a year,
Nothing else in the budget returns as much, I declare.

For university research to remain so productive,
Action is needed that must be constructive.
What to use to tell Congress and have our full say?
Tomorrow's best labor-saving device—today!

MARTIN APPLE
Council of Scientific Society Presidents
Washington, DC

Physics Teaching in Context

Revising how we teach physics alters how people think about physics and that in turn changes physics itself. There is growing interest in changing the teaching of physics. But it is debatable as to what extent this movement is motivated by a desire to communicate information about truly wonderful new discoveries and to what extent it is due to recent threats to cut funding for basic science research. Nevertheless, some obvious changes in teaching have already begun to appear in new methods and new curricula—the innovative use of computers and the inclusion of modern physics, for example.

continued on page 114

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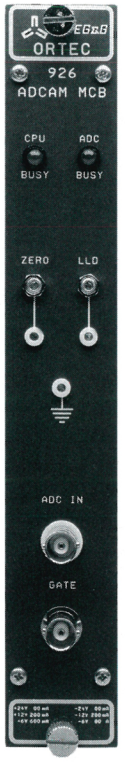

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[1]Ron Jenkins, R.W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp. 266–267.

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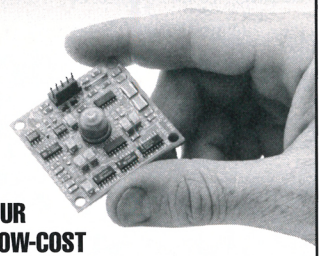

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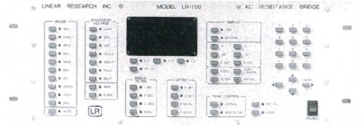

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LETTERS *(continued from page 15)*

Beneath these obvious technical changes, however, lie partially understood ideas that are beginning to shape the emerging new science. What is the role of modeling in physics? Is physics primarily conceptual or mathematical? Is truth unique? Some of our academic colleagues who are in the humanities and the history of science and have an interest in reconstructivism are beginning to press these questions.

The very suggestion that truth is not unique flies directly in the face of what most of us have been taught about the nature of physics, if not the nature of nature itself (or, more honestly, the limited ability of people to understand nature). If truth is not unique, then how do we determine what is true and what is the point of the natural sciences? This issue could be a Pandora's box: If we choose to look at the issue, we may be overwhelmed by the consequences that follow. The truth of physical law could become context dependent; the great pillars of scientific truth could be riddled with an openness of maybes.

The notion that truth is not unique neither invalidates nor weakens science. It does expand considerably the realm of possibility that scientists may wish to address. It does not diminish the concept of truth; it enlarges it. "Maybe" may be "may be."

Consider, for example, the common problem of throwing a small stone up into the air and trying to predict where it will land. We typically address this problem in physics using Newton's laws, which provide an exact way of predicting where the center of mass of the stone will go under the influence of the force of gravity. The position of this ideal point is described by a relatively simple mathematical equation that gives a unique answer.

But this answer is not always true. The assumptions we make in our modeling neglect the chaotic influence of the wind and the uncertain nature of the atoms in the stone itself. From this viewpoint the standard answer is not at all likely to be exactly true—although it is exact (that is, uniquely true).

The true answer is context sensitive. How large is the stone, how hard is the wind blowing? In principle, even the color of the stone could be significant if the absorption of light were to be considered.

New possibilities are opened by teaching and thinking about physics as being context sensitive, based on the use of flexible modeling (rather than rigid laws) and on the idea that physics may be more conceptual than mathematical. In this way, in principle, a broader, more realistic range of problems could be addressed. The notion of cause and effect may be measured by the degree of correlation between the cause and the effect. An exact description is the limit of perfect correlation of data with a given model. The absolute, but obviously absurd, determinism of Newton's laws may be sensibly softened.

Clearly there are dangers in softening science in this way. If science becomes unreliable, a great advantage is lost. Opening the question of the uniqueness of scientific truth is indeed risky. However, not all of the consequences of change are necessarily catastrophic. Intellectual fragmentation between the arts and the sciences has been of justifiably growing concern. By giving up a definition of truth that may be too narrow, we may open the door to some unification of a diverse spirit of the human intellect. We might also reach more people who do not understand science as we now teach it. We need them.

As Pascal noted three centuries ago, "There are two equally dangerous extremes—to shut reason out and to let nothing else in."

JIM MCGUIRE
Tulane University
New Orleans, Louisiana

Physics Teaching in Another Context

I feel compelled to comment on the "Reference Frame" article by Leon M. Lederman (April, page 11). I'm afraid that Dr. Lederman, with his impressive credentials and sweet smile, is living in an ivory-tower dream world.

Yes, physics is a disaster area in many, but certainly not all, American high schools. Yes, the sensible progression in science is physics first, then chemistry, followed by biology. Back in the mid-1970s, when I worked occasionally as a substitute teacher, I saw this sequence followed, apparently successfully, by the honors students at a high school.

There are two major reasons why physics education is what it is. One, correctly identified by Lederman, is that there are frightfully few teachers who are themselves comfortable enough with the subject matter to do an effective job of passing it along to students, with or without the mathematics.

More serious even than this, however, is the other reason: Too many high school students lack the mathematical skills to tackle even conceptual physics. Lederman presupposes a situ-