China is not a democracy, and the political situation is more uncertain than usual because of the impending change in leadership. The committee's position was and is unreasonable. The APS delegation did transmit a unilateral statement on the human rights situation on behalf of the APS. That statement was, as expected, transmitted without comment to higher levels of the Chinese government by our Chinese colleagues.

There will always be legitimate differences of opinion on how to act when values conflict, as they did here. The majority of the council of the APS agreed that the memorandum of understanding was the best that could be done at that time. It should, of course, be reviewed in a few years to see if it is still appropriate.

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Altering the Academy in Industry's Interests

I write you concerning Werner Wolf's article "Is Physics Education Adapting to a Changing World?" (October 1994, page 48). We in industry—I work for a major military and commercial semiconductor device and components manufacturer—have learned that, except for a few exceptional people, most new graduates face a significant learning curve in industry. It can take them a considerable amount of time (six months to a year minimum) to become fully productive. I feel that most of the reasons for this lie in the different needs of universities and industry. At universities, students work independently on highly specialized problems with little regard to manufacturability, time pressure or budgetary constraint. The opposite is true in industry: Teamwork (an acquired skill), versatility, manufacturability, tight time schedules and cost containment are paramount.

Things were not always this way. In the past we mostly hired new graduates and trained them on the job. Times were prosperous and we could afford to invest in on-the-job training. Much to my frustration, times have changed. The corporate environment is much more demanding and intolerant. Downsizing has increased the need for employee productivity, and competition and profit pressures are fierce. We generally cannot afford the time and money to train new graduates. Rather, we seek experienced individuals with proven ability, good references and the specific experience that we need for the position. Typically, we now want five years of relevant industrial experience for the PhD positions we seek to fill.

I feel sorry for the many excellent students whose resumés I must reject. I hope that universities and the outside world can cooperate to find ways to improve their employment prospects.

If you decide to publish this letter, please withhold my name. My employer is paranoid about individuals speaking publicly on corporate policy, and I could get in a great deal of trouble if they found out. The company currently is downsizing and consolidating operations. Need I say more?

NAME WITHHELD

Werner P. Wolf's timely article "Is Physics Education Adapting to a Changing World?" dealt primarily with undergraduate programs in physics. However, current opinion appears to have it that the problems in unemployment and underemployment of physicists are mainly at the PhD level. While it is not well known, there is a 30-year-old program involving the University of California, Davis, and Lawrence Livermore National Laboratory that attacks those problems through "hands on" training, with a great deal of success.

In 1963 Edward Teller persuaded the regents of the University of California and the Davis campus of the university to support a purely graduate program—the Department of Applied Science—making use of the people and physical facilities of LLNL. His concept was that students with undergraduate degrees in physics, chemistry, mathematics or engineering would come to Livermore and be exposed to "applied science" (defined as large-scale projects that involve teams of people from various disciplines), learning in an apprentice mode. In contrast to the common situation where a new graduate student is tolerated until he or she can be trained to carry a fair share of the research work, at Livermore the students are expected to carry their weight from the start.

In the 31 years since the program started, 252 men and women have earned their PhDs. The majority of them have found nonacademic jobs as their first post-PhD positions. Even today, in what we all recognize to be a tight job market, recent graduates of the Department of Applied Science have for several years been able to find technical positions, although some have spent a year or two in postdocs before finding permanent spots. This success may be due to the cultural milieu of their work at LLNL. The environment at Livermore is more akin to what existed at several technical universities and institutions during the late 1940s and early '50s than to most current graduate education: Important problems with practical applications are posed and are expected to be solved in real time and within budget. This is an attitude that strikes a responsive chord in industry recruiters!

In addition to the national laboratories of the Department of Energy, the Department of Defense has many research facilities scattered about the nation. Any of these could be approached by a major research university and possible joint programs explored. There are also excellent private research facilities, some of which are already open to graduate students on an informal basis. We suggest a vetting of the best staff at these laboratories by the faculty of a school so that the staff can act both as instructors in formal courses on site and as research advisers—the model at LLNL.

If students are immersed in PhD research outside the academic setting, we believe that they will more easily appreciate the breadth of career opportunities that await them. It is recognized that half of those graduating from our law schools do not practice law; it is less well known that for years at least half of those trained as scientists and engineers have found jobs other than as scientists and engineers.

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The Sky is Falling! (Well, Part of It)

Regarding the three letters by Moti Segal and Rodney Kubesh, Michael Kelly and John Kepros on how an increase in the greenhouse effect might alter the heights of atmospheric layers (December 1994, page 15): Back in 1989 Ray Roble and Bob Dickinson of the National Center for Atmospheric Research, in Boulder, Colorado, investigated "global cooling" in the upper atmosphere.[1] They predicted that a doubling of the CO_2 and CH_4 concentrations at 60 km height (as expected within the next 50 years) would cool the mesosphere by up to 10 K. In the thermosphere the predicted cooling is greater, about 50 K. The resulting thermal contraction would reduce the air density at 300 km by about 40%, leading to increased orbital lifetimes of satellites.

Using simple physics, I estimated that the cooling would cause a drop of 15–20 km in the height of the ionospheric F2 layer (the layer that has the greatest electron concentration and is the most important for radio communications).[2] Better calculations with the NCAR thermospheric global circulation model gave similar results.[3]

These predictions are theoretical: What of the data? The ionospheric layers have been routinely sounded since 1931, though precise measurement of the height of the F2 peak is difficult. At middle latitudes by day, the peak typically lies at about 250 km at solar minimum and 350 km at solar maximum, though its height may vary by up to 100 km with time of day, latitude, and solar and geomagnetic activity. Given this variability, detecting a progressive decrease of the layer height would be difficult, but it should be possible. In Germany, Jürgen Bremer[4] has detected a drop of 8 km in 33 years, consistent with my theoretical prediction.

Of course more observations over longer time scales are needed to confirm the trend, together with further studies of whether global cooling in the upper atmosphere is indeed a reliable indicator of "global warming" lower down.

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Was PT's Environment Issue Misaddressed?

The November 1994 PHYSICS TODAY special issue on physics and the environment arrived, and I was delighted to find we were addressing one of the most important issues facing our survival. Now I was to learn what the world of physics, my field, had to say. First I learned that we were not even going to mention nuclear power: Fuel cells are the future. Then I get a dissertation on the nitrogen cycle, which, if it goes unchecked, will be a major problem in a few thousand years. Well, if the

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