HARD TIMES

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In recent years, physics has seen much of its support base disappear. In Eastern Europe the decline of governments and the changes in the economy have moved interest away from all activities with long-range payoffs. For different reasons, a short-term focus has begun to dominate American life also. Here, all the prods for science have begun to weaken. Government has become unpopular. The military has started to shrink. Corporations are concerned with tomorrow's stock value and the next quarterly income statement, and have lost interest in promoting applied research. Antiscientific threads have become evident in many parts of popular thinking. Congress enjoys exposing the misbehavior of some of the leading figures in the biological sciences. Both the animal rights movement and the environmental movement have considerable antiscientific components. Science is in low regard.

These fundamental difficulties arose first. Now more specific symptoms are beginning to appear. All branches of activity in US physics have insufficient support. It looks as if experimental particle physics will have to accept a postponement of its latest accelerator project, the SSC; a substantial cut in the support given to the science in the field; or both. Plasma physics has put all its eggs in a fusion-engineering basket, and fusion does not appear to be economical in any reasonable time frame. Condensed matter cannot support 50% of its researchers. Space research must contend with a NASA that has lost its way. The National Science Foundation has begun to move away from science.

As our support becomes weaker, our demands and claims become more strident. Very often the expected benefits of any given scientific advance are auctioned to many times their real value. Think of cold fusion (or hot), of the statements coming from the Texas Congressional delegation about the SSC, or of the more recent history of high-temperature superconductivity. We are fast approaching a situation in which nobody will believe anything we say in any matter that touches upon our self-interest.

Nothing we do is likely to arrest our decline in numbers, support or social value. Too much of our real base depends on events that are now becoming ancient history: nuclear weapons and radar during World War II, silicon and laser technology thereafter, American optimism and industrial hegemony, socialist belief in rationality as a way of improving the world. Now China and much of Eastern Europe have moved away from science. America's problems cannot be given a quick fix by science or technology. For the world's corporations, "high tech" now tends to mean not the applications of the physical sciences but instead of computer sciences or biology or of the innovative use of financial instruments. Most important is science's loss of reputation. Einstein and Sakharov caught the popular imagination, for excellent reasons. But today when the public thinks of the products of science it is likely to think about environmental problems, an unproductive armament industry, careless or dishonest "scientific" reports. Livermore cheers for "nukes forever" and a huge amount of self-serving noise on every subject from global warming to "the face of God." At this point, we must ask ourselves how we should proceed in a time of declining financial and social support for all of science and especially for physics. We must face up to two types of difficulties:

First, individual difficulties. Many excellent students now in the pipeline will not be able to find careers in the mainstream of science. Some older scientists will be forced into early retirement or other forms of enforced unproductivity. Other physicists will continue to follow our profession but with greatly reduced possibilities for productivity or appreciation from society. We can only do a little to help our colleagues in trouble. We can try to make all of them feel that they remain part of our professional world. We all can realize that individual success or failure is in part a product of market forces and might not be an indicator of individual worth.

In the past, a career in science has served as a mechanism for social mobility. Now, this mechanism is likely to work less well. Many trained scientists will have to look for new kinds of employment in fields of activity that reward socialization better than technical or intellectual accomplishments. My own field of condensed matter will have to downsize itself considerably. Industry's interests have turned elsewhere, and support continues to shrink across the board. In the US we shall have to help people from Eastern Europe and China, as well as the native crop, in relocating their interests.

Second, problems in the social and economic fabric of our science. There is no doubt that the world of science and scientists will change as resources become scarcer. But we can help by asking what portion of what we hold in common is really worth preserving, and what strategy will best work to save the valuable elements for future generations. Let me try to define what is truly valuable:

First and foremost is a rational view of the world. Things happen because of laws, and are in that sense knowable and predictable. One should oppose this view to that of Dan Quayle's grandmother, who said one could do anything one truly wanted. We should and must communicate to our students and to the world at large a belief that rational study can delineate between what is feasible and

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unfeasible and provide methods of accomplishing the former.

- Second, our reputation as reliable observers. The public has demanded that our politicians say things that are untrue, and then feels shocked that it is not well served by its leaders. Science should be better. If society is to entrust to us the testing of advanced technological systems, we should say when they do not work. When did we ever report that any activity in which we were involved had failed? With supercomputers? (Most of us have noticed that personal computers and workstations are more economical for most tasks at hand.) Or high-temperature superconductivity theory? (Its contact with experiment is often problematical or worse.) Who points out to the public that in particle physics, the imaginations of experimentalists and of theorists have been focused upon almost entirely different topics?

- Third, we have a set of techniques that should be passed on to future generations. As physics contracts, we should try to preserve in reduced form the main elements of our culture. These include the capability for careful and thoughtful design of experiments, an insightful and intelligent use of mathematics, and a creative use of gadgets and technology. The last two are not in terrible danger. However, small-scale experiments must be explicitly protected lest the siren calls for big science, beautiful technology or "deep" mathematical developments absorb all attention and resources.

We shall see many wrenching dislocations in our field. But we can do some things to help. Those of us who are in relatively secure positions should, in our own self-interest, broaden the reach of our society. Every person trained in physics and everyone who wants to be associated with us should be made to feel a part of the world of physics. APS meetings should include more activities for teachers, students and just interested individuals. Universities and governments should sponsor more outreach programs for informing citizens of all ages about science and engineering.

Also, we should communicate a realistic view of the future to people trying to join our profession. We can try to be helpful by finding and using all the possible outlets for talent and training, for example, by supporting teaching and by taking a very broad view of technology. In a period of decreasing support of science throughout the world, no nation can expect to be a leader in all fields of research. To help each nation maintain its technological base, we should encourage governments to provide additional sponsorship for undergraduate, graduate and postdoctoral study abroad. For similar reasons, there should be government sponsorship for individuals at mid-career to pursue a year of training or study at home or abroad in industrial, university or government laboratories. But we should not expect too much from these efforts.

Looking for truth may be expected to be lonely and outwardly unrewarding. In recent decades, science has had high rewards and has been at the center of social interest and concern. We should not be surprised if this anomaly disappears. We will all be disappointed and hurt by this likely development. But if we can back away and look at the situation with some perspective, all of us in science can say that we have been lucky to be part of a worthwhile enterprise.