

REFERENCE FRAME

Changing

Leo P. Kadanoff



Terms of employment for research physicists are changing rapidly. Over the last ten or fifteen years, basic research groups at, for example, AT&T, IBM, and the petroleum companies have mostly been dismantled to be replaced by more applied and directed efforts. Even product-related research groups have often shrunk. Scientists at all levels have been replaced, retired, terminated, moved, or fired—sometimes gracefully, sometimes not.

A different kind of dislocation has taken place at the large US government scientific laboratories. These institutions have been tossed one way and the other as they and society attempted to define their mission and goals. For a time, environmental work was in, then collaboration with industry, then the educational function, then this and that. Many friends of the laboratories began to wonder whether the labs could each sustain an overall scientific or technical purpose. And when their institutions lack purpose, scientists and other responsible workers become disoriented because they cannot see how to serve the institutions or themselves.

In the US, we have in the last decade, seen a rather large number of temporarily unemployed research scientists, with the biggest group coming from industry. Universities and government laboratories have absorbed some but not all of the resulting exodus. In parallel, the university system has absorbed large numbers of ex-Soviet bloc scientists and students, as well as a gradually increasing group of students from the technologically advanced Asian countries.

The US university system itself is in the process of major change. American society has more and more taken the view that the universities offer too little education at too high a price. Many people have become less and less happy about supporting scholarship and research, especially in fields in which the economic gain is long-term (most of physics) or problematical (literature). New models for

education have arisen. For example, the University of Phoenix offers an inexpensive education, with “library facilities”—mostly on line—and few full-time teachers. It is likely to be a strong competitor for the students and financial support that now go to our more conventional institutions.

These changes would have been unbearable for the physics community were it not for a parallel development in industry. New jobs opened in biotechnology, software, bioinformatics, and especially in the financial and management consulting industries. These jobs need flexible and intelligent people, well trained to ask and answer questions. And by some irony, many of these jobs—often the ones furthest from conventional science—provide first- and second-year salaries that are three or four or five times the usual starting salaries in the remainder of the profession. The newly extended job markets have absorbed most of the apparently redundant physicists, as well as many of the newly arrived Asian and Eastern European students and scientists. Without these partially foreign-educated scientists, it would have been difficult to find the technical knowledge and training needed for the US labor pool. Indeed universities and industry and government laboratories have all made very extensive use of people partially educated abroad and then further educated in the US. Especially in theoretical and computational fields, it is close to impossible to run a

state-of-the-art operation without recently arrived scientists.

Each generation of physicists has an opportunity to change the nature of physics, and redo the field's standards and goals. We are seeing a big change in the physics profession. A generation from now, a new group of people will have taken over, many with different aspirations and different standards from our own. They will try to define physics in a way that meets the needs of their times, their education and experience, and their cultural backgrounds.

We have already seen fifteen years of considerable change—and can expect more changes to come. These developments leave the individual scientist with a substantial problem in planning a career in science. This planning must be done in circumstances of very considerable uncertainty about the structure of the institutions that will employ scientists and the nature of the jobs within them. Change is certain. The direction is unclear.

These problems are not peculiar to scientists. They are shared by steel-

ALBERT EINSTEIN, IN HIS LATER YEARS, WAS UNABLE TO FIGURE OUT WHY, IF HE WAS SO SMART AND SO FAMOUS, HE WASN'T RICH



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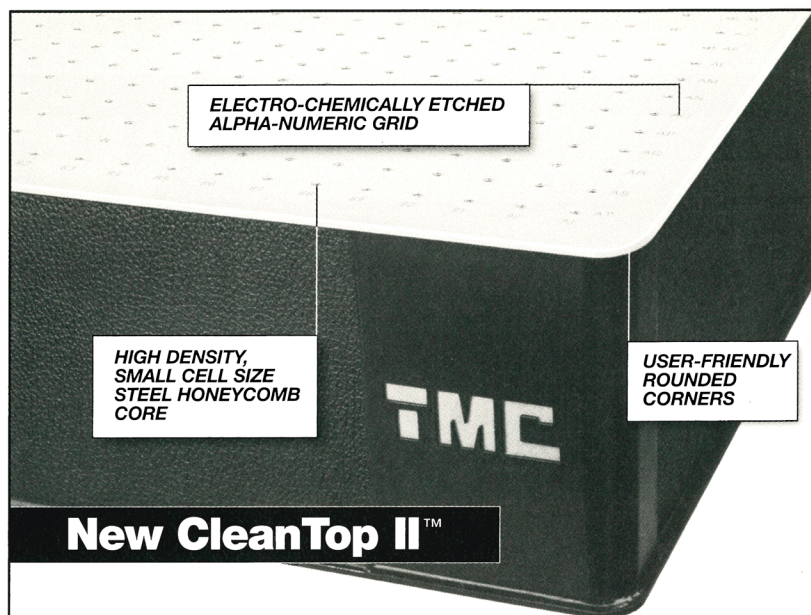
workers, bus drivers, physicians, politicians, and retirees. In a period of great growth in wealth, we have seen a big rise in insecurity. (Many believe, in fact, that the greater insecurity has helped cause the increase in wealth.) No longer is it true that one's job is one's most precious possession. A downsize here, a curriculum revision there, an outsourcing here, a reorganization there—and whole groups of jobs can disappear.

In many ways, physicists are particularly well suited to defend themselves against these gusts of adverse fortune. In practicing physics, we learn how to solve problems, and we expect the new problems to be different from the old ones. So must it be in our professional lives. We must be aware of and work within a rapidly changing job market. We must try to acquire skills that are both new (after all, we are particularly flexible) and also picked to be useful in potential future employment. Our market value is likely to be in our problem-solving skills and flexibility—and less likely to be in a particular process or technique.

Economic success or even survival will require each of us to invest less in a particular job and more in our own ability to do the next job. In plain fact, the right time to invest in new knowledge is while one is in the very middle of a solid, ongoing project. Soon enough, the present problem will get solved, or interest will turn away from the subject, or support will disappear. There are many possibilities but one end: Change will erode the ongoing project, and a replacement activity will be required.

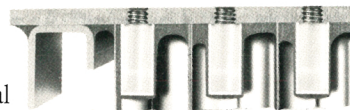
The replacement process requires investment in new problems, new techniques, new skills, and new fields. For many physicists, these investments will have to be made in the face of pressure to conform to the most conventional views of our scientific fields. Philip W. Anderson (PHYSICS TODAY, September, page 11) has described how short-term job pressures can work against novelty and creativity, thereby weakening the productivity of everyone.

In contrast, thoughtful responses to the pressures of change can perhaps help some individuals and institutions be more creative. But, as in the broader economy, many scientists are likely to be left behind by this process. And, perhaps the uncertainties and insecurities of our time will seriously erode all possibility of thoughtful study of the physical world. We don't know. Yet. ■



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