editorial

Physics through the 1990s

Physics Through the 1990s, the survey of physics issued this month by the National Research Council, attests to the enormous progress in physics since the last survey in the early seventies. Physicists can be proud of our progress in understanding the relation between the weak and electromagnetic forces, the quark nature of matter and the evolution of the universe, and in our ability to deal with problems of increasing complexity. Physics is also strongly influencing other fields of science and stimulating applications. Discoveries such as the laser, nuclear magnetic resonance, synchrotron radiation sources and tunneling microscopy have had or will have major impacts on fields such as chemistry and biology. In addition applications of physics discoveries underlie most of today's advanced technological industries—electronics, optical communications, medical instrumentation and national security.

Although physics looks healthy now, we are concerned about the future at all levels of endeavor, from the small-research-group activities typical of much university-based research up to the large-scale research characteristic of elementary-particle physics and plasma physics as it relates to fusion. The small science performed in our universities was of particular concern to the physics survey committee. The lack of instrumentation and machine shops, the increasing age of physics faculties, our apparent difficulty in attracting US citizens into physics and the unattractiveness of university positions to young physicists—especially experimentalists—all are symptoms of serious difficulties in university-based small research efforts. We must ensure that sufficient funding is available to support the most intellectually interesting and innovative research. But more is needed. Innovative action by our large universities is required to smooth retirement profiles, to create new bridges between disciplines, to sustain common facilities and, in general, to make universities more attractive to young researchers.

While we attempt to enhance small-scale research we must simultaneously recognize that our major national facilities are essential to much of the progress being made in physics. Synchrotron radiation facilities have revolutionized research using ultraviolet light or x rays by making possible completely new classes of experiments. Fusion machines continue to progress toward the goal of laboratory sustained-fusion reactions. New accelerators for nuclear physics will allow us to explore the quark–gluon nature of nuclei and to create a quark–gluon plasma. Our ability to observe the universe has continuously been enhanced by more powerful telescopes, radar arrays and x-ray observations. Discoveries in elementary-particle physics akin to those of the W and Z particles are possible only with large accelerators. The various panels of the survey committee have proposed a set of facilities to carry physics into the 1990s. Much planning, designing and engineering will be necessary to bring these facilities into existence. When completed they will offer many research opportunities.

The inevitable question is, can this country afford these facilities? In particular, can we afford to construct the Superconducting Super Collider? In response to such questions, I note that currently the United States devotes approximately 3.5% of its total research and development expenditures to basic research in the physical sciences. Both institutions I have been associated with—Bell Laboratories and Sandia National Laboratories—attempt to maintain a balance between development and research; both would consider the 3.5% figure too small—a more reasonable number would be 5 or 6%. I believe the United States should follow the example set by Bell Labs and Sandia. Although Congress and the President have clearly treated basic research reasonably well in recent years, the support is still not sufficient relative to the underlying needs of the total R&D community. With such a change in funding, SSC would become economically feasible and would not represent a drain on the other subfields of physics or on the other physical sciences.

Physics continues to play a vital role in the health of the scientific–technological structure of this country and we must assure that it continues to do so for the coming decade.

WILLIAM F. BRINKMAN
Chairman
Physics Survey Committee