Science at the Margins—The Impact of Multidisciplinary Research on the Vitality of Research

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As the nation confronts continuing pressures to reduce federal spending, the science community should recognize two important things. One is that science is continuing to receive high priority in the budget; the other is that science is in a relatively healthy position today. The extraordinary rates of growth in the first part of the decade permitted us to inject new vitality and strength into our science institutions and capabilities, and even with slowed growth now, we are operating on a much more vigorous base. We have drawn good, new people into the most exciting fields, we have upgraded facilities for research, and we have made public policy that clearly says science is important.

Science, in response, has exceeded our expectations for progress. Within virtually all the disciplines, knowledge is advancing at extraordinary rates. Unlike the earlier part of the century when a few fields surged as others idled, today almost all fields are pushing at their boundaries. This disciplinary flowering is, in fact, the expected return on the investments we made in basic research in the post-war years.

But something important is happening over and above that—the unpredicted acceleration in progress today. That results partly from the ease with which one field uses the tools and insights of another (not the least of which is our ability to handle massive amounts of data), and partly from the synergism of distinct disciplines approaching similar or even the same problems from different perspectives. Consequently, we can be bold about attacking far more complex problems than we would have predicted only a few years ago.

As a result, we now have the happy choice of being able to pursue knowledge not only in depth, but in breadth as well. An obvious example is the expansion in materials science as we begin to exploit our ability to tailor-make surfaces and structures with specific performance characteristics and to develop wholly new kinds of composites, ceramics, thermoplastics, and rapidly solidified alloys that defy the traditional tyranny of the phase rule. All of a sudden materials scientists are all over the map, and they are bumping into physicists, chemists, computer scientists, and neurobiologists, all of whom are simply pursuing interests that naturally cross over into what had once been either someone else's territory, or terra incognita.

This broad synergism of mutually reinforcing disciplines is the most important trend in science of this decade, the thing that makes research in the 1980s so qualitatively different from research in decades before. And that synergism has been extended by increasing interactions not only among scientists from different disciplines, but also from different realms—from universities, from federal labs, and from industry. It occurs not because it is socially desirable or because it meets someone's notion of how the research world ought to be structured, but because that turns out to be the way research is moving. The kinds of problems that command interest and excitement are not necessarily confined to a single stratum of research.

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This significantly greater dimension of multidisciplinarity offers us a way to achieve powerful leverage within the modest growth possibilities for science in coming years. One of the most important mechanisms for that leverage is the development and evolution of multidisciplinary university/industry centers for research. These got their impetus three years ago in the National Science Foundation's Engineering Research Centers, but what has been so fascinating about the ERCs is how quickly they seem to be growing beyond engineering. It appears that the same kinds of mutual interests that first attracted the engineering community to this idea are present in most fields of science as well.

The centers are distinct organizations on university campuses where the research is centered around some problem area, such as composite materials manufacturing or biotechnology process engineering, where faculty and graduate students are drawn from perhaps half a dozen different disciplines, and where they may be complemented by counterparts from industry who may become something like research fellows in the center. The center itself may be loosely guided by an advisory board composed of both university and industry representatives. NSF started six of the centers last year, with funding for each of several million dollars per year, and it will begin another four or five this year.

In all, this is only a tiny portion of the federal R&D budget, but its leverage comes from the fact that it is the fastest growing portion. I would argue that those centers are the single most important research initiative undertaken over the past five years, because the centers are not simply one more program—they are the vanguard of a profound change in the way we do research. In fact, university/industry research centers are starting to appear, in various forms, as part of research being supported in most of the federal R&D agencies, but they are also emerging independently as a consequence of productive collaborations between academic and industrial researchers drawn to common problems.

What we should see in coming years is an interesting and mutually supportive interplay between these multidisciplinary efforts and the ongoing disciplinary research projects that form the backbone of American science. The net result is certain to invigorate U.S. science and should go a long way to improving its coupling to the problem-solving process.

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