Policy Forum

This new feature for the exchange of opinion on issues of importance to the scientific community will appear from time to time. This first exchange resulted from a response to an editorial on the hazards of budget cutting ("Let Us Meander," 4 April).

Science Must Grow

LEON M. LEDERMAN

SCIENTISTS SHARE THE VERY HUMAN TRAIT OF REACTING TO austerity by trying to edge out the competition. One of the terrible consequences of the Gramm-Rudman-Hollings act is that it is beginning to set scientist against scientist. Recall the cartoon whose caption reads, "There is no meat, and we are fighting over the bones." I have witnessed the internecine warfare in Britain where fund-starved scientists bayed at one another over national television. The tone of the competition suggests the questions, How do we evaluate "big projects" versus "medium projects" versus "little projects"? How do we become more efficient? Implied is the additional contest, Social relevance versus abstract research. In his essay, Frank Press (Perspective, 21 March) suggests more peer review to increase the amount of science per dollar, which is fine, but his message is essentially pessimistic.

I, for one, feel no guilt at contributing to the national deficit—I wish I could do more. I would obviously be happier if there were no deficit, and I share with other citizens a respect for the awesome political problems of controlling the federal budget. However, if deficit reduction produces so destructive a result as now seems to hang over science, then we are clearly doing it wrong, and we must improve the procedure.

My field, high energy physics, is as remote from applications as you can get; nevertheless, it too contributes to a conclusion that science has always, and will always, be the best possible investment, next to education, that this nation can make in its future. I include here the social and humanistic sciences because when science creates new world views or the capacity for new technologies and new lifestyles, we will continue to need the wisdom these disciplines can contribute.

My suggested strategy is not to meander, as Koshland proposed, but to attack. What we need is a grand unification of science and scientists armed with the conviction that what is good for science is good for the nation. We scientists should marshal our forces, link arms, raise banners, and insist that science may be the last hope of humanity. The cycle of budget increases, slides, increases, and new preparations for drastic retrenchment is irresponsible. I will not catalog the tragedies of frustrated personal commitments. After all, these are hard times for all. I do feel outraged at the waste of economic and human resources, at the expenditure of huge sums to build new facilities, only to discover that we are too poor to use them. This kind of governmental bungling is inexcusable.

Efficiency? I believe that we are fantastically efficient already.

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Fight the Edifice Complex

STUART A. RICE

AMERICANS HAVE ALWAYS BEEN FASCINATED BY "BIGNESS," whether it takes the form of the biggest cattle ranch, the largest corporation, the tallest building, or the fastest airplane. American scientists are no exception: some fantasize about placing large manned space stations into permanent Earth orbit; others dream of building ever larger particle accelerators to smash matter into ever smaller pieces; still others yearn for commercial aircraft that can whisk them to Tokyo in 2 hours. When the pursuit of "bigness" becomes inordinate, when the costs of a particular project begin to defy a rational analysis of goals and priorities, when the value of an undertaking seems to lie principally in the size of its budget, one can be certain that an Edifice Complex has set in.

Senior officials of the federal agencies that support scientific and engineering research seem to be particularly affected by the Edifice Complex. They act as if funding increases and budgetary success for their programs can only be ensured by advocating massive projects or large machines. Yet, much of the creative research that is being done today—research producing discoveries of practical importance to societal needs—is being carried out in small university research groups that are victimized by the Edifice Complex.

In the small research group—typically composed of a professor, and students, and postdoctoral fellows or of a staff scientist and several technical assistants—individual initiative and creativity are highlighted. Students are given the opportunity to direct their own work and, more importantly, to take responsibility for the development of new ideas. The entire research group can change direction in the course of work without incurring large costs, thus providing greater flexibility and freedom for all members of the group. Healthy competition among and within groups confers the freedom and opportunity to break the bounds of limiting intellectual paradigms. In sum, the entire atmosphere of the small research group encourages new discovery.

The intellectual excitement and societal payoff of the discoveries made in small research groups are clearly illustrated in the recent report from the National Academy of Sciences, *Opportunities in Chemistry*. The intellectual vigor of chemistry, the quintessential small-group science, has never been greater. In the last two decades we have seen major advances in the synthesis of new substances and materials, including ultrapure semiconductors, pharmaceuticals, and advanced polymer composites; in the measurement and basic theory of molecular-level interactions; and in the unraveling of the fundamental steps of biological processes. Chemistry has become the

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