

LETTERS

The Intrinsic Value of Basic Research

The difficult economic situation in Mexico has put pressure on our politicians to trim and tighten the budget, so scientists and policy makers have been forced to answer the question: What is basic research good for? Some months ago, a new law for science and technology was proposed; it has been discussed in many forums. The final text of that law lists the guidelines for deciding which scientific and technological activities should be supported. Such activities should contribute to solving the country's problems and should demonstrate a strong sense of social responsibility. That is, the country needs the kind of applied research that will have a short-term local impact on education, environment, and the quality of life of the population.

Such a view sounds reasonable, at least in principle. Applied research is indeed needed, but what about basic research? The budget for science and technology is limited, and the new guidelines seem to imply that, if the results of basic research can be shown to be useful in the future for specific applied research, the chances of funding increase.

Talking to colleagues who work in fundamental areas, I often hear: "This is the way things are now. If we must adapt our research program to fulfill the new requirements, we will. Anyway, we can also apply to other, more productive areas the techniques we are developing and using to solve our problems." The list of projects accepted for funding last year by the National Council of Science and Technology Research (CONACYT), the main Mexican research funding agency, includes several in fundamental research as it relates to some specific productive application.

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Basic research has, in many ways, led to important advances in applied research. For example, I wrote this letter using a computer, which in my view wonderfully illustrates what basic research has to say about its own usefulness. Furthermore, many examples exist of successful collaboration between pure and applied scientists, like the application of mathematical theories in economics or the use of techniques from elementary particle physics to develop medical instrumentation. Such collaborative successes are not new; basic research has been incredibly useful in the past and has given us reason to expect that it will continue to be so.

Researchers, then, have a drive to make basic research useful. There is nothing wrong with that. Applied research by any definition has its roots and sustenance in pure research. One form could not exist without the other. So basic science is useful in that it is the origin of applied science, and it has contributed to many technological advances.

In my opinion, though, the question of the usefulness of basic research should not be asked, and certainly not in the context of funding. The examples above notwithstanding, the question makes no sense. Basic research does not have to be useful. Its *raison d'être* is not to serve or be productive. Those are welcome side effects, but even if no examples existed of applications that have had a profound positive impact on society, basic research would still be worthwhile. It simply is. Along with other creative human activities, like the ability to communicate or to write music, basic scientific research forms one of the cornerstones that define our being human. The point is not whether fundamental research is useful, but that it is, like other forms of creative expression, part of the definition of human society.

People who have never had real contact with science are likely to be unaware of its essence, which goes beyond any application. And, when faced with the pressing needs of society and a limited budget, politicians

may fail to give pure science the priority it deserves.

I believe the solution is education—letting people, beginning with ourselves, know what we scientists really do and why we do it, without trying to put makeup on our work to make it more acceptable. If we cannot face and cherish the truth about ourselves and our work, how can we expect other people, including policy makers and funding agencies, to do so?

Some scientists have compared the usefulness of basic research to the usefulness of a child. One interpretation of that analogy is that we hope a child will grow up to be someone great. Another interpretation is that, without children, there would be no adults, the majority of whom are useful to society. These answers parallel those given as examples for the usefulness of basic research. But children and basic research both have value just by what they are, independent of what they will become.

I cannot understand why people, including some scientists, do not realize that the name we have given to these activities is no coincidence. Indeed there is, and should always be, research that is basic, fundamental, and pure.

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Energy Possibilities: Windows, Windmills, and Satellites

The special Energy Challenge issue of PHYSICS TODAY (April 2002) contained a number of articles that focused strongly on energy production, whereas the possibilities of energy savings were given small attention. So it bears repeating, as mentioned in the article by Arthur Rosenfeld, Tina Kaarsberg, and Joseph Romm (PHYSICS TODAY, November 2000, page 29), that energy efficiency is a vital part of meeting the energy challenge.

The well-known correlation between the Human Development