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EDITORIAL

Science in the Stationary Phase

Much of what we know about the mechanisms of catalysis and the regulation of biochemical processes has been learned from study of the growth and survival of microbes. After an interval of rapid growth, microbial cultures respond to impending stringencies in the environment. They sense that the feasting is over and that a major reordering of priorities is needed to survive in what is called the stationary phase. Hundreds of genes are turned on and others off, which, along with adaptive mutations, ensures the survival of the colony during the stationary phase and the colony's reemergence under more favorable conditions. What we learn from microbes in the stationary phase will, it seems to me, have profound significance for how we as scientists cope with diminished support for science.

Modern science began in Europe about 300 years ago. As shown in a graph prepared by David Goodstein of the California Institute of Technology, the growth of science (as measured by the number of scientific journals) has been exponential, expanding by a factor of 10 every 50 years. If continued, this trend would extrapolate to 1 million journals by the year 2000, but fortunately it has tapered off to a mere 40,000. However, in the past decade, as more drastic reductions in support for the research enterprise have been made, U.S. science has entered its stationary phase. With sufficient effort, we may produce brief bursts of growth here or there, as microbial cultures do. But to ensure the continued survival of science, we must be resourceful in adapting to the stringencies of the stationary phase.

In the biomedical sciences, we have become increasingly vulnerable to the prospect of severe cuts in federal support. We must not let anyone be deluded into thinking that these cuts will be replaced to any significant extent by private and industrial sources of funding. In the period after World War II, over 90% of the support for the revolutionary advances made in the biomedical sciences came from the National Institutes of Health (NIH). No industrial organization would have invested or ever will invest millions of dollars annually, for decades, in projects that have no direct relevance to marketable products.

We are urged: Do strategic basic research! Do targeted basic research! How can we make clear the oxymoronic nature of these terms? It may seem impractical even to scientists to solve an urgent problem, such as developing treatment for a disease, by pursuing apparently unrelated questions in basic biology or chemistry. Yet it is a fact that throughout the history of medical science the pursuit of basic research has been the most practical and cost-effective route to the development of successful drugs and devices. Investigations that seemed irrelevant to the attainment of any practical objective have yielded most of the major discoveries of medicine. For example, x-rays were discovered by a physicist observing discharges in vacuum tubes; penicillin was isolated during enzyme studies of bacterial lysis; and genetic engineering and recombinant DNA were developed from the study of reagents used to explore DNA biochemistry.

As scientists, we lack the skills to make our case effectively. Universities, research foundations, professional societies, and pharmaceutical companies should band together to organize their resources and employ media professionals to convey to citizens and legislators the essential message that basic research is the lifeline of medicine. If the National Rifle Association can be so effective in delivering its message, why can't we do at least as well with a far better one?

In the face of so much uncertainty, would I recommend a career in science to my grandchildren? Emphatically yes! Science is unique among all human activities—unlike law, business, art, or religion—in its identification with progress. Regarding the means to do science, I think back to 1943 when I was studying rat nutrition at NIH and decided that research was more attractive than the clinical medicine I had chosen as a career. There were no grants then, laboratory resources were meager, and academic jobs were almost nonexistent. Those were not the good old days. But rich or poor, science is great! To frame a question and arrive at an answer that opens a window to yet another question, and to do this in the company of like-minded people with whom one can share the thrill of unanticipated and extended vistas, is what science is all about. That is what will sustain us in the days and years ahead.

Arthur Kornberg

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