

# SCIENCE

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# EDITORIAL

## The Crystal Ball and the Trumpet Call

In the 1860s Abraham Lincoln's commissioner of patents recommended that he plan to close the commission in a few years. The reason: the rate of discovery had become so great that everything that needed to be discovered would have been discovered by then. The patent commission would have no business.

In this issue of *Science* a number of scientists who are leaders in their disciplines were asked to cast off inhibitions and predict the future. They have done so in exemplary fashion. They clearly do not agree with that commissioner of patents of yesteryear. Great discoveries with great import for the future of science and the well-being of the citizen are in the offing. That we have come so far so fast is not an indication that we have saturated the discovery market, but rather that new discoveries will come even faster.

These scientists indicate areas, from room-temperature superconductors and rational drug design to whole new approaches to economics and social science, that are ripe for development in the future. They were not asked to be, and should not be judged on being, practical or conservative and safe, but rather were asked to be adventurous but sound—no perpetual motion machines, but plenty of extrapolations beyond the state of the art. This editor was personally disappointed that none of them predicted an "abolish sleep" pill. No one knows how much sleep we really need—some people sleep very little and are perfectly healthy, and a pill to get sleep over quickly and release many more hours per day for productive activity would seem a boon to harassed people. Despite this disappointment, the list of new ideas and vast new fields is impressive and reading it is enjoyable. It is a trumpet call to get on with the new challenges and surmount the new obstacles.

It could be asked, "Is this all pie in the sky—the unlikely guesses of some hallucinating scientists?" On the basis of past history, these guesses are very likely to be prophetic. On several occasions the National Academy of Sciences (NAS) has asked leading scientists of various disciplines to outline the futures of their professions. The Westheimer report of 1965, *Chemistry: Opportunities and Needs*, and the Pimentel report of 1970, *Opportunities in Chemistry*, predicted the progress of chemistry. Leading physicists speculated about advances in their discipline in the Pake report, *Physics: Survey and Outlook*, in 1966, and later in the Brinkman report of 1986, *Physics Through the 1990s*.<sup>\*</sup> In 1970, Philip Handler, chairman of the NAS Survey Committee on the Life Sciences, edited opinions of prominent biologists on future directions of research in *Biology and the Future of Man*.<sup>†</sup> The predictions made in these excellent volumes have, for the most part, been fulfilled—except that the most revolutionary and unexpected findings were not predicted. Physicists did not suggest the transistor and the laser, chemists missed buckyballs, biologists did not foresee recombinant DNA. Thus, history would suggest that scientists tend to understate the future.

The list in this issue was not designed and does not pretend to be comprehensive. It was an experiment to see if leaders in the field would be willing to go out on a limb of crystal ball gazing. Future issues can deal with other areas and other authors. For this moment, however, the responses show the enormous reach of modern science and its potential for improving the lot of humanity. Budget-cutters in the world's governments should look at this list and ask themselves whether they wish to be the person who prevented the development of a defense against drug-resistant bacteria or the building of superconducting medical machines, or closed the exploration of the interior of the Earth.

For the generation now carrying out research, it is worth acknowledging the altruism of their seniors who have, with great restraint, not solved all the problems, but have left a generous share for those who follow. We can expect that the new generation will act with the enthusiasm and resourcefulness of their predecessors and that those holding the power of the purse will allow them to do so.

Daniel E. Koshland Jr.

<sup>\*</sup>The Pimentel and Brinkman reports are available from the National Academy Press, 2101 Constitution Avenue, NW, Washington, DC 20418, USA. The Westheimer and Pake reports, published by the National Academy Press, are out of print. <sup>†</sup>P. Handler, Ed., *Biology and the Future of Man* (Oxford Univ. Press, New York, 1970).