
ENEMIES OF PROMISE

BY J. MICHAEL BISHOP

We live in an age of scientific triumph. Science has solved many of nature's puzzles and greatly enlarged human knowledge. And the fruits of scientific inquiry have vastly improved human welfare. Yet despite these proud achievements, science today is increasingly mistrusted and under attack.

Some of the opposition to science comes from familiar sources, including religious zealots who relentlessly press for the mandatory teaching of creationism in the public schools. It is discouraging to think that more than a century after the publication of Charles Darwin's *Origin of Species* (1859), and 70 years after the Scopes trial dramatized the issue, the same battles must still be fought. But fight them we must.

Other antagonists of science are less familiar. Strange though it may seem, there is within academe a school of thought that considers science to be wholly fraudulent as a way of knowing. According to these "postmodernists," the supposedly objective truths of science are in reality all "socially constructed fictions," no more than "useful myths," and science itself is "politics by other means." Anyone with a working knowledge of science, anyone who looks at the natural world with an honest eye, should recognize all of this for what it is: errant nonsense.

Science, of course, is not the exclusive source of knowledge about human existence. Literature, art, philosophy, history, and religion all have their insights to offer into the human condition. To deny that is

scientism—the belief that the methods of the natural sciences are the only means of obtaining knowledge. And to the extent that scientists have at times indulged in that belief, they must shoulder some of the blame for the misapprehensions that some people have about science.

But science does have something inimitable to offer humankind: it is, in the words of physician-author Lewis Thomas, "the best way to learn how the world works." A postmodernist poet of my acquaintance complains that it is in the nature of science to break things apart, thereby destroying the "mysterious whole." But we scientists take things apart in order to understand the whole, to solve the mystery—an enterprise that we regard as one of the great, ennobling tasks of humankind.

In the academic medical center where I work, the efficacy and benefits of science are a daily reality. So when I first encountered the postmodernist view of science some years ago, I dismissed it as either a strategy for advancement in parochial precincts of the academy or a display of ignorance. But now I am alarmed because the postmodernist cry has been joined, outside the academy, by other strong voices raised against science.

Consider these lines from Václav Havel, the widely admired Czech writer and statesman, who has vigorously expressed his disenchantment with the ethos of science: "Modern rationalism and modern science . . . now systematically leave [the natural world] behind, deny it, degrade and

defame it—and, of course, at the same time, colonize it.”

Those are angry words, even if their precise meaning is elusive. And anger is evident, too, in Havel’s main conclusion: “This era [of science and rationalism] has reached the end of its potential, the point beyond which the abyss begins.”

Even some influential men who know science well and who have been good friends to it in the past have joined in the chorus of criticism and doubt. Thanks in part to Havel’s ruminations, Representative George E. Brown, Jr. (D.-Calif.), who was trained as a physicist, reports that his faith in science has been shaken. He complains of what he calls a “knowledge paradox”: an expansion of fundamental knowledge accompanied by an increase in social problems. He implies that it shouldn’t be that way, that as science progresses, the problems of society should diminish. And he suggests that Congress and the “consumers” of scientific research may have to take more of a hand in determining how science is conducted, in what research gets funded.

A similar critique has been made by former Colorado governor Richard Lamm. He claims no longer to believe that biomedical research contributes to the improvement of human health—a truly astonishing stance. To validate his skepticism, he presents the example of the University of Colorado Medical Center. It has done “little or nothing,” he complains, about increasing primary care, expanding medical coverage to the uninsured, dealing with various addictions and dietary excesses, and controlling violence. As if biomedical research, or even academic medical centers, had either the resources or the capabilities to do what Lamm desires!

The source of these dissatisfactions appears to be an exaggerated view of what science can do. For example, agitation within Congress may induce the National Science Foundation to establish a center for research on violence, but only the naive would expect a quick fix for that momentous problem. Three-quarters of a century after the death of the great German sociologist Max Weber (1864–1920), the social and behavioral sciences have yet to produce an antidote for even one of the common social pathologies. The genesis of human behavior entails complexities that still lie beyond the grasp of human reason.

Critics such as Brown and Lamm blame science for what are actually the failures of individuals or society to use the knowledge that science has provided. The blame is misplaced. Science has produced the vaccines required to control many childhood infections in the United States, but our nation has failed to deploy properly those vaccines. Science has sounded the alarm about acid rain and its principal origins in automobile emissions, but our society has not found the political will to bridle the internal combustion engine. Science has documented the medical risks of addiction to tobacco, yet our federal government still spends large amounts of money subsidizing the tobacco industry.

These critics also fail to understand that success in science cannot be dictated. The progress of science is ultimately driven by feasibility. Science is the art of the possible, of the soluble, to recall a phrase from the late British immunologist and Nobel laureate Sir Peter Medawar. We seldom can force nature’s hand; usually, she must tip it for us.

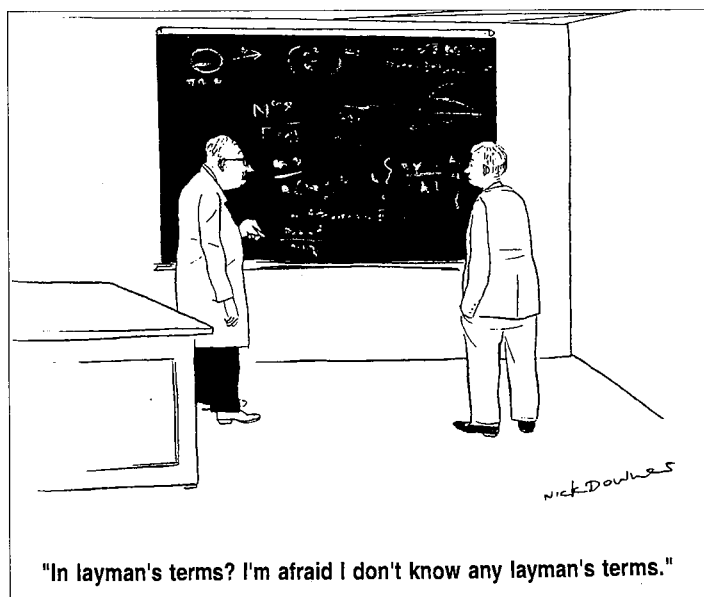
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Nor is it possible, especially in the early stages of research, to anticipate what benefits are likely to result. My own experience is a case in point. In 1911, Peyton Rous at the Rockefeller Institute in New York City discovered a virus that causes cancer in chickens, a seemingly obscure observation. Yet 65 years later, that chicken virus was the vehicle by which Harold Varmus and I, and our colleagues, were able to uncover genes that are involved in the genesis of human cancer. The lesson of history is clear: the lines of inquiry that may prove most fruitful to science are generally unpredictable.

Biologist John Tyler Bonner has whimsically recalled an exchange he had some decades ago with the National Science Foundation, which had given him a grant for a research project. "After the first year, I wrote that things had not worked out very well—I had tried this, that, and the other thing, and nothing had really happened. [The foundation] wrote back, saying, 'Don't worry about it—that is the way research goes sometimes. Maybe next year you will have better luck.'" Alas, no scientist today would think of writing such a report, and no scientist today could imagine receiving such a reply.

The great successes of science have helped to create the exaggerated expectations about what science can accomplish. Why has malaria not been eradicated by now? Why is there still no cure for AIDS? Why is there not a more effective vaccine for influenza? When will there be a final remedy for the common cold? When will we be able to produce energy without waste? When will alchemy at last convert quartz to gold?

When scientists fail to meet unrealistic



Even for educated members of the public, science is largely a mystery.

expectations, they are condemned by critics who do not recognize the limits of science. Thus, playwright and AIDS activist Larry Kramer bitterly complains that science has yet to produce a remedy for AIDS, placing much of the blame on the National Institutes of Health (NIH)—“a research system that by law demands compromise, rewards mediocrity and actually punishes initiative and originality.”

I cannot imagine what law Kramer has in mind, and I cannot agree with his description of what the NIH expects from its sponsored research. I have assisted the NIH with peer review for more than 20 years. Its standards have always been the same: it seeks work of the highest originality and demands rigor as well. I, for one, have never knowingly punished initiative or originality, and I have never seen the agencies of the NIH do so. I realize with sorrow that Mr. Kramer is unlikely to believe me.

Biomedical research is one of the great triumphs of human endeavor. It has unearthed usable knowledge at a remarkable

rate. It has brought us international leadership in the battle against disease and the search for understanding. I wonder how all this could have been accomplished if we scientists did business in the way that Kramer and critics like him claim that we do.

The bitter outcry from AIDS activists over the past decade was echoed in the 1992 film *Lorenzo's Oil*, which portrays medical scientists as insensitive, close-minded, and self-serving, and dismisses controlled studies of potential remedies as a waste of precious time. The film is based on a true story, the case of Lorenzo Odone, a child who suffers from a rare hereditary disease that cripples many neurological functions and leads at an agonizing pace to death.

Offered no hope by conventional medical science, Lorenzo's desperate parents scoured the medical literature and turned up a possible remedy: the administration of two natural oils known as erucic and oleic acid. In the face of the skepticism of physicians and research specialists, Lorenzo was given the oils and, in the estimation of his parents, ceased to decline—perhaps even improved marginally. It was a courageous, determined, and even reasoned effort by the parents. (Mr. Odone has since received an honorary degree from at least one university.) Whether it was effective is another matter.

The movie portrays the treatment of Lorenzo as a success, with the heroic parents triumphant over the obstructionism of medical scientists. The film ends with a collage of parents testifying that the oils had been used successfully to treat Lorenzo's disease in their children. But it fails to present any of the parents who have tried the oils with bitter disappointment. And, of course, all of this is only anecdotal information. Properly controlled studies are still in progress. To date, they have not given much cause for hope.

Meanwhile, as if on cue, medical scientists have since succeeded in isolating the

damaged gene responsible for the rare disease. Thus, the stage is set for the development of decisive clinical testing and effective therapy (although the latter may be long in coming).

If misapprehensions abound about what science can and cannot do, so do misplaced fears of its hazards. For more than five years now, my employer, the University of California, San Francisco, has waged a costly battle for the right to perform biomedical research in a residential area. For all intents and purposes, the university has lost. The opponents were our neighbors, who argued that we are dangerous beyond tolerance; that we exude toxic wastes, infectious pathogens, and radioactivity; that we put at risk the lives and limbs of all who come within reach—our own lives and limbs included, I suppose, a nuance that seems lost on the opposition. One agitated citizen suggested in a public forum that the manipulation of recombinant DNA at the university had engendered the AIDS virus; another declared on television her outrage that “those people are bringing DNA into my neighborhood.”

Resistance to science is born of fear. Fear, in turn, is bred by ignorance. And it is ignorance that is our deepest malady. The late literary critic Lionel Trilling described the difficulty well, in words that are even more apposite now than when he wrote them: “Science in our day lies beyond the intellectual grasp of most [people]. . . . This exclusion . . . from the mode of thought which is habitually said to be the characteristic achievement of the modern age . . . is a wound . . . to our intellectual self-esteem . . . a diminution of national possibility . . . a lessening of the social hope.”

The mass ignorance of science confronts us daily. In recent international testing, U.S. high school students finished ninth in physics among the top 12 nations, 11th in chemistry, and dead last in biology. Science is

poorly taught in most of our elementary and secondary schools, when it is taught at all. Surveys of adult Americans indicate that only a minority accepts evolution as an explanation for the origin of the human species. Many do not even know that the Earth circles the Sun. In a recent committee hearing, a prominent member of Congress betrayed his ignorance of how the prostate gland differs from the testes. Accountants, laborers, lawyers, poets, politicians, and even many physicians look upon science with bewilderment.

Do even we scientists understand one another? A few years ago, I read of a Russian satellite that gathers solar light to provide constant illumination of large areas of Siberia. "They are taking away the night," I thought. "They are taking away the last moments of mystery. Is nothing sacred?" But then I wondered what physicists must think of biologists' hopes to decipher the entire human genome and perhaps recraft it, ostensibly for the better.

Writing an article about cancer genes for *Scientific American* some years ago, I labored mightily to make the text universally accessible. I consulted students, journalists, laity of every stripe. When these consultants all had approved, I sent the manuscript to a solid-state physicist of considerable merit. A week later, the manuscript came back with this comment: "I have read your paper and shown it around the staff here. No one understands much of it. What exactly is a gene?"

Robert M. Hazen and James Trefil, authors of *The Sciences: An Integrated Approach* (1994), tell of 23 geophysicists who could not distinguish between DNA and RNA, and of a Nobel Prize-winning chemist who had never heard of plate tectonics. I have encountered biologists who thought string theory had something to do with pasta. We may be amused by these examples; we should also be troubled. If science is no

longer a common culture, what can we rightfully expect of the laity by way of understanding?

Lionel Trilling knew where the problem lay in his time: "No successful method of instruction has been found . . . which can give a comprehension of science . . . to those students who are not professionally committed to its mastery and especially endowed to achieve it." And there the problem lies today: perplexing to our educators, ignored by all but the most public-minded of scientists, bewildering and vaguely disquieting to the general public.

We scientists can no longer leave the problem to others. Indeed, it has always been ours to solve, and all of society is now paying for our neglect. As physicist and historian of science Gerald Holton has said, modern men and women "who do not know the basic facts that determine their very existence, functioning, and surroundings are living in a dream world . . . are, in a very real sense, not sane. We [scientists] . . . should do what we can, or we shall be pushed out of the common culture. The lab remains our workplace, but it must not become our hiding place."

The enterprise of science embodies a great adventure: the quest for understanding in a universe that the mathematician Freeman Dyson once characterized as "infinite in all directions, not only above us in the large but also below us in the small." We of science have begun the quest well, by building a method of ever-increasing power, a method that can illuminate all that is in the natural world. In consequence, we are admired but also feared, mistrusted, even despised. We offer hope for the future but also moral conflict and ambiguous choice. The price of science seems large, but to reject science is to deny the future.