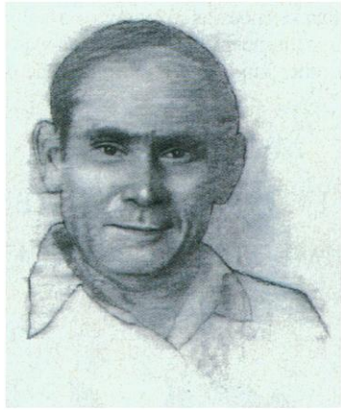
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

150 YEARS • 1848-1998

THE IMPACT OF SOCIETY ON SCIENCE



SYDNEY BRENNER

After earning his doctorate from Oxford in 1952, Sydney Brenner worked in the MRC Laboratory of Molecular Biology in Cambridge until 1987, serving as its director until 1992. During these years he collaborated in the discovery of the triplet code messenger RNA, established the importance of C. elegans *in the analysis of complex biological processes, and in the 1980s turned to the study of vertebrate genomics. He is currently director of the Molecular Science Institute in Berkeley, CA.*

At 72 I am almost half the age of the American Association for the Advancement of Science and belong to the generation that made the 20th-century revolution in biology. We have lived through a century of momentous changes, both in science and society, and more is still to come.

In the grim days of the Cold War, with the threat of global nuclear war hanging over us, who could have imagined that Communism would undergo a total collapse, that the Soviet Union would disintegrate, and that Russia would rapidly become a poor country controlled by gangsters. Our world now has an immediacy of contact never experienced before. Technology has brought all of humanity together, and nearly everything can be watched live—war in the Middle East, ethnic cleansing in Bosnia, and people dying of starvation and disease in Africa. Whereas it once took days or weeks for news to travel and a year for an influenza epidemic to spread, news can now be transmitted instantaneously and a new virus can spread all over the world in 24 hours.

All around I see evidence of the impact of science on society. This is so obvious and so well known that little more remains to be said about it. Science and the technologies it has spawned form the basis of all human activity, from the houses that we live in, the food that we eat, the cars that we drive, to the electronic gadgetry in almost every home that we use to remain informed and entertained.

Yet, despite these technological innovations, the paradoxes that I noticed when I was young are still with us: In advanced societies an increasing proportion of national wealth is now spent on health and recreation and large sums of money are devoted to military enterprises, while in the underdeveloped world famine and pointless wars still exact a terrible toll of human lives, malnutrition and disease are still rife, and even the basic necessities of life such as food and shelter cannot be provided for all. There is no doubt that great advances could be made in the treatment of malaria and other parasitic diseases that afflict more than half of the world's population, but the people who have these diseases also have another called MDD—money deficiency disease. There are many problems that science and technology, by themselves, are unable to solve given the economic structure of the world that we live in. So when we speak of the impact of science on society we are speaking about the more advanced countries, and when we speculate on the future, it usually concerns the same areas of the world.

Following the advent of molecular biology came the technologies and their applications. For many years it was widely held that molecular biology was a completely useless subject, a "fundamental" science of no interest to those working on practical matters. Then suddenly it came to be viewed as dangerous, and genetic engineering was considered an almost Satanic activity. Biological scientists became suspect and trust in this science diminished, as fantastical scenarios were played out to an increasingly terrified public. Our times are characterized by a view that we can accomplish everything in this generation, especially if we can find and apply the right technology. Thus when a newspaper journalist accused me of being one of the scientists who is going to make people in a test tube, I had to reply that I could think of a much more pleasant and cheaper way of making people than genetic engineering. The fixation on technology gives us a slanted view of human existence. For example, immortality may be a futile notion, yet some believe that through the use of high technology it might nevertheless be brought off.

The history of the last 25 years teaches us the profound lesson that it is necessary for scientists to communicate to society at large not only the content, use, and misuse of scientific discoveries, but also what their work tells us about the intrinsic limitations of our bodies and minds. This is not an easy task, especially in a science whose content becomes more complicated every day.

I do not know whether I want to speculate on what impact science will have on society in the next 150 years. I wish I could say that we will banish hunger and war, and I wish I could reassure readers that we will still have a planet to live on. As everybody knows, this does not depend on science alone but on economic forces and political wills, something that scientists do not control.

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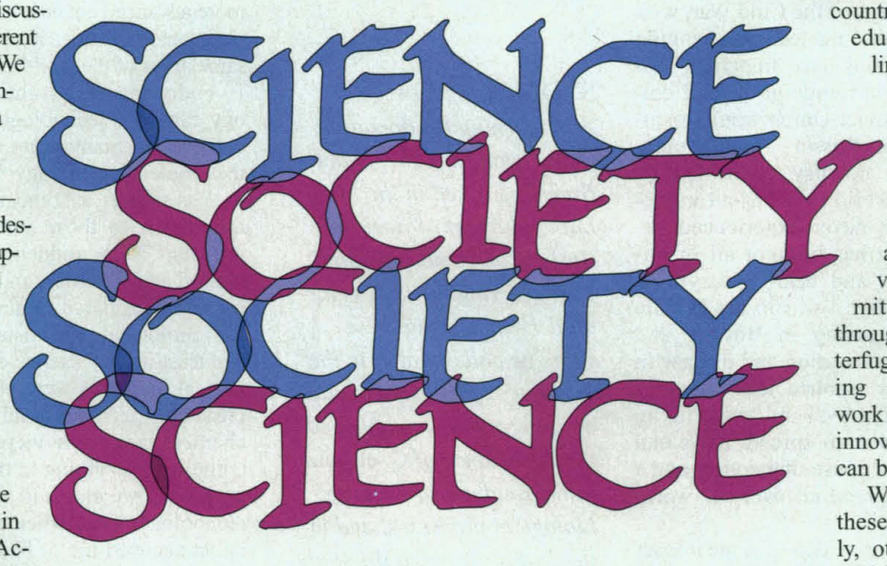
ILLUSTRATION: ALLAN M. BURCH

However, there is another subject that is not often discussed in this context: the impact of society on science, the inverse of the general theme of this essay series. Much like the evidence for the impact of science on society, the evidence for the impact of society on science is all around for everyone to see, mainly in the form of the large (but never sufficient) funding that science enjoys in the more advanced countries. Society and its arm of action, government, understands that science has developed powerful methods for solving a large number of problems. What distinguishes science from all other kinds of problem-solving activities is the demand that the answers it discovers work in the real world. It is why rulers gave up slaughtering animals to examine their entrails: Magic does not exist in any world at all. However, in stimulating and supporting science, society, as the paymaster, has taken a much shorter term view of research than most scientists would like. There has been much discussion about the different kinds of science. We call one pure, another applied, and a possible third, strategic—it could also be called "apploid"—that is pure but destined to become applied. Then there is mission-directed as opposed to curiosity-driven research, a distinction that I find particularly obnoxious because one can almost see the word "idle" in front of curiosity. Actually, the answer to the question of which type of science to fund is quite simple: Since all science is problem driven, it should be judged by the quality of the problems posed, and the quality of the solutions provided.

Governments support research because its findings contribute greatly to social ends such as the health and wealth of citizens, causes that get politicians re-elected and for which people pay taxes. Of course governments indulge in other activities that cost much more than scientific research, and one can always find military expenditures that could keep a lot of labs going for a long time. The increased funding for scientific research in recent years, especially in the health fields, has resulted in a great expansion of the number of scientists and thus in increased competition for academic and research funds. We have established an elaborate system of peer reviews to deal with this competition, and a similar process is in force for the publication of scientific results. All of this has subtle consequences for the scientific enterprise. If you know what sort of research is wanted by a committee you write your grant to satisfy these expectations, and if you know what the oligarchy believes is the correct view of a subject, you give your paper that slant. Ironically, all of this was originally introduced to ensure fairness and to eliminate the older system where powerful people got all the money, appointed who they liked to their laboratories, and published only papers written by their friends. Both the old feudal system and the new bureaucracy have consequences for scientific innovation; the former narrowed its pursuit to only a few, while the latter discourages its pursuit by all. But there are also more insidious effects because in most countries research and education are now linked almost exclusively to universities: Postdocs learn from professors, students learn from postdocs, and the art of surviving is very quickly transmitted. It is only through the use of subterfuge such as applying for money for work already done that innovative research can be freely pursued.

MUCH LIKE THE EVIDENCE FOR THE IMPACT OF SCIENCE ON SOCIETY,



THE EVIDENCE FOR THE IMPACT OF SOCIETY ON SCIENCE IS ALL AROUND FOR EVERYONE TO SEE, MAINLY IN THE FORM OF THE LARGE (BUT NEVER SUFFICIENT) FUNDING THAT SCIENCE ENJOYS IN THE MORE ADVANCED COUNTRIES.

We need to take these matters seriously, otherwise science will lose the independence of thought required for innovation that it has cherished for centuries. In my own subjects, genetics and molecular biology, research has become so directed toward medical problems and the needs of the pharmaceutical companies that most people do not recognize that the most challenging intellectual problem of all time, the reconstruction of our biological past, can now be tackled with some hope of success. I hope it is not too much to ask that rich societies provide more support for this and other fundamental fields of biology. We need to assure the future of biological research and prevent it from becoming stilted and boring. We can only do this by attracting new young minds to our science and offer them problems as challenging as those that excited my generation.

ILLUSTRATION: TERESE WINSLOW