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EDITORIAL

Science and Society

The ways in which science and society are governed are quite different and the difference causes friction when scientific progress is of societal concern. Science is dealing with the unexpected, the frontier, the search for a new path, not with the predictable, the established edifice, the walk down the well-paved road. In the aggregate, science is designed to make great progress on a wide front, but to predict which individual area will deliver a new discovery tomorrow is impossible. In general, this is well understood by both parties, science and society; but when science is asked to solve a problem, its instinct is to start from fundamentals and proceed on its slow but inexorable timetable. When society—through its agent government—says "I need the answer now," the two systems have serious misunderstandings. Science, trying to be accommodating, frequently says, "I'll give you a progress report, but understand that we need more data to get a definitive answer." The "but" clause soon gets forgotten, so science gives an educated guess as to whether saccharin is carcinogenic, or dioxin is deadly poisonous, or the climate is warming, and later revises the first estimate, bewildering the public and making it distrustful of science. A report on cholesterol in the diet needs volunteers and those at high risk are the most likely to volunteer, but scientists know that preliminary reports for a high-risk group are helpful but should not be overgeneralized until a more normal group (and the more difficult to study) becomes the focus of study. The subject is too interesting to prevent premature publication and premature conclusions, but the new facts require revisions which lead the public to say "the scientists should make up their minds." At the frontier, scientists are individualists, not consensus groups, and science adds more facts and voices until a full understanding is approached asymptotically. The final value can be the truth at some level of detail but in some cases may simply reflect the exhaustion or exasperation of some of the participants.

In the course of a debate, not only do different scientists enter with different ideas, but new data are continuously uncovered. So science is not failing the public by changing its mind. Nor is it being irresponsible in volunteering a progress report. To refuse to give an educated guess to those who are paying the bill would be irresponsible unless the progress report is presented as though it were a final opinion. In a number of recent debates a premature release of a tentative conclusion became a congressional excuse for a final judgment, for example, in the case of the carcinogenicity of saccharine despite the inconclusiveness of the data.

The great discoveries of science are the result of a range of discoveries in which an initial notion was suggested, but the final understanding required lots of work. The societal problems of climate change, public health, economic efficiency, and so forth are even more complicated than the related pure science problems, and it should be expected that they would be equally prone to revision and updating.

A good example of this revisionism is reflected in a special series that ran in *The New York Times* the week of 21 March 1993, which reports that environmentalism is now showing a new trend toward cost-benefit analysis. The story gives an excellent account of excessive costs of some highly publicized risks and the past tendency of the Environmental Protection Agency to follow publicity rather than science in its approach to the environment. The change in sentiment is occurring because the evidence is accumulating that a "to hell with the cost" approach is impossibly expensive and the data on risks are now more definitive and less scary. Solid evidence can change minds, but getting the data requires time. Some scientists had explained that the early data were dubious, but they were ignored.

Scientists must assist in producing and explaining preliminary findings on scientific problems even if their instincts are to say "go away until I've solved the problem." And politicians must understand that progress reports should not be used as laws that are not allowed to be modified. The alternatives are that government makes hasty decisions based on third-rate scientific advice and scientists refuse to give any opinions. Distrust between the partners arises when each forgets that the other is operating in an uncomfortable mode—scientists being forced to give premature conclusions, government being forced to delay decisions until evidence is acquired. This "odd couple" of science and government has produced an unparalleled standard of living for its people. It will produce even more if each partner seeks common ground and gives credit to its partner for willingness to compromise its normal operating procedures and to contribute toward a common goal.

Daniel E. Koshland, Jr.