The Selective Usefulness of Science

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There is increasing awareness that science is not independent of society, but is influenced by society as well as influencing it. Perhaps the easiest way to look at things from this perspective is to liken science to a tool.[1] A tool, such as a fork or an axe, is developed by humans for specific purposes. And once it is developed, a tool is useful more for some purposes than for others: it is possible to eat peas with an axe, but not especially convenient. Rather than science being intrinsically good, bad or neutral, the various aspects of science are each *selectively useful* for different purposes.

My argument here is that science as constituted at present is for the most part selectively useful for the interests of government and large corporations rather than the general community, and that this selective usefulness arises precisely because science is specifically developed in a way suited for the purposes of these groups.[2] There are a number of aspects of science which make it selectively useful for government and corporations. Here just two of these will be discussed: the type of research done and the organization of the scientific community. One of the best ways to highlight the selective usefulness of science is to point out possibilities for science serving different purposes and different groups. Examples of current science and possible alternative directions will be drawn from the areas of military research and environmental research.

Research Topics

The choice of a specific research problem out of the many potential research problems that might be investigated is a major factor in determining the purposes for which scientific results will be selectively useful. For example, there has been a large amount of research done on how to detect submarines through perturbations in the local magnetic field of the earth, and to establish means for a submerged submarine to pinpoint its exact location in the ocean. Research results on these sorts of topics are directly useful for military purposes and of relatively little use for any other purposes. The main reason for this selective usefulness is simply that the research has been done for specific military purposes, in these cases to track enemy strategic nuclear submarines as part of anti-submarine warfare and to improve the accuracy of strategic nuclear submarine missile systems.[3]

Military preparedness is only one way of approaching the problem of defending communities from repression, exploitation and violent aggression. Furthermore, military forces can be used to subjugate the people they are supposed to defend, as in the case of Poland and numerous other countries. Yet the bodies which fund scientific research devote many orders of magnitude more support to projects serving military approaches than to alternatives.

One promising alternative to military defense is social defense, which is nonviolent community resistance to aggression using techniques such as strikes, boycotts, refusal to cooperate, demonstrations, and setting up parallel institutions.[4] A look at the literature on this subject quickly shows innumerable possible topics for research. For example, instead of studying submarine communications, research might be done on communication systems which can be set up, operated and generally used by the community to coordinate nonviolent resistance to military aggression. In the Soviet invasion of Czechoslovakia in 1968, the nonviolent resistance was greatly strengthened by the maintenance of radio services for two weeks.[5] With a concentrated effort to develop technology specifically suited for such resistance, the potential for this alternative to violent defense would be greatly enhanced. Research for such purposes would be selectively useful for the goal of social defense.

Turning to environmental research, one highly studied topic is the mathematical modelling of pollutant gases in the atmosphere as they are spread about by winds and turbulence. For example, computer models have been set up to calculate the distribution of nitrogen oxides and ozone throughout a city as a function of emissions from traffic and industry and as affected by winds, turbulence, sunlight, and chemical reactions. Such research is mainly useful for planning bodies in making decisions about whether and what emission controls need to be implemented, or whether and where new developments contributing to total emissions may be allowed. Again, it is often for precisely such purposes that such atmospheric models are developed.

A prime use of environmental research of this kind is to justify decisions made mainly on political or economic grounds. Air pollution monitoring and modelling can be used to justify current practices, using claims such as "the problem is being studied" or "the experts have everything under control." Other types of environment-related research, such as on how to reduce industrial emissions, are eminently suited to help implement technical fixes. Corporations and governments can readily use such knowledge, whether to actually change the situation or for public relations.

Those who fundamentally question current purposes of urban planning or industrial production will find research related to technical fixes largely useless. From their perspective, environmental research of greater use to the community than atmospheric modelling would treat areas such as recycling, alternatives to automobile transport and production of goods designed for durability rather than obsolescence.

To some extent individual scientists can take the initiative in pursuing research which is more useful to the community than to special interest groups. For example, in the last several years I have had the opportunity to do mathematical modelling of the incorporation of large-scale wind power into electricity grids, in collaboration with colleagues in the Commonwealth Scientific and Industrial Research Organization (CSIRO), the major Australian government scientific research body. This work has achieved considerable success scientifically, is of low cost, has generated public interest, and is of obvious relevance to Australia, which has several regions of high large-scale wind power potential. In spite of these points, continuation of the research is under threat due to top level CSIRO policy to wind down wind power research. The only public explanation given in relation to the modelling work, by a reporter relying on an unidentified CSIRO spokesperson, is that "the research was too far in advance of application." This claim is dubious in itself, and could be applied more appropriately to theoretical work in plasma physics in relation to fusion power, for example. A more plausible reason is that top science policy decision-makers, with their close links with government and industry leaders, strongly favor the present *de facto* Australian energy policy based on coal and oil, and prefer to downgrade research efforts that provide any fundamental challenge to this, including work on conservation, renewable energy sources and the possible climatic impacts of carbon dioxide from burning fossil fuels.

In many cases those who carry out research on sensitive environmental topics, or merely speak out about environmental or health hazards, and thereby threaten vested interests, are subjected to strong pressures from industry or government bodies or top university officials to cease their activities. Attempts at dismissal, blocking of appointment or promotion, blocking of publications, and withdrawal of funding are not unusual.[6]

Research which is more useful to the community can also be promoted in a collective manner. The Lucas Aerospace workers in Britain developed a Corporate Plan in which they proposed a switch from the production of aerospace equipment, especially for the military, to the manufacture of socially useful goods such as devices for firefighting and mining, alternative transport systems and aids for the handicapped.[7] Almost all the ideas for this switch to socially useful production came from the workers; an earlier appeal to 180 thinkers and writers on the subject (the "experts") had brought only four responses.[8] The Lucas workers' initiatives also have led to fruitful collaboration between workers and academics. But the management of Lucas Aerospace has resolutely resisted instituting any of the workers' proposals; acceptance would appear to challenge their managerial prerogatives.

Although often there is strong opposition to those who attempt to pursue socially relevant research or production, these attempts are not without effect. The net effect of many individual scientists doing what they can in this direction can be substantial; and certainly the Lucas workers' initiatives have had an enormous inspirational effect on workers around the world.

The Organization of the Scientific Community

The way the scientific community is organized has a major effect on the usefulness of scientific research for different purposes. Military research is done mostly in government institutes or contracted out to corporate or university research bodies. In many cases there is a fair degree of secrecy so that the results are primarily known and hence useful to military interests. Even unclassified work often is available only through internal reports or other difficult-to-obtain documents. Environmental research is done by scientists in government, universities and corporations. The scientists in these organizations have two primary orientations: the organizations in which they work and the wider scientific community. Not only do research problems arise from these two orientations, but communication channels, methods and styles are oriented to these groups. As a result most environmental research is primarily accessible to and understandable by other specialists in the same research area.

By the late 1950s there was considerable scientific research and communication concerning the impact of pesticides on ecosystems. These activities were mainly restricted to professional circles, and had a negligible impact on corporate and government policies, which were dominated by the immediate vested interests of pesticide-producing chemical corporations and their government and academic allies. It required Rachel Carson's *The Silent Spring* and other popularizations to stimulate widespread public interest and to prompt action on the problems in this area.[9]

There are many features of the organization of the scientific community:

writing style, journal content, appointments procedures, science syllabuses, and the like. A close look at almost any one of these features will show that the scientific community as organized at present serves primarily the purposes of its members and the purposes of organizational patrons of science, in particular government and corporations. For example, many scientists look down upon efforts to communicate or interact with the general public on issues with a scientific content, an attitude quite useful to those who employ scientists. In return, security and advancement are the rewards to scientists who shun public controversies.

There are two important ways in which the organization of the scientific community might be changed: introducing greater accountability by scientists to the community and making it easier for members of the community to engage in scientific research. Accountability can be increased in several ways, such as greatly augmenting the number of consumer and community group representatives on panels allocating money for government and university research, increasing incentives and pressures for researchers to publish and explain their results and methods in a manner accessible and understandable to a wider public, and allocation of research funds for research teams sponsored by local citizen groups. Engaging in scientific research can be made easier by reducing the formal requirements necessary to "qualify" to do scientific research, by lowering salaries for professional scientists and by providing research funds for independent individuals and teams which wish to do research.

These suggestions imply a basic questioning of the monopoly over science now exercized by full-time professional scientists who work for large organizations. This monopoly, often taken for granted today, has existed for less than half a century, and is certainly not the only way to organize scientific research.

The Australian debate over uranium mining and nuclear power illustrates some of the effects of the monopoly exercized by professional scientists. A large fraction of money for scientific research and development in Australia is allocated to the Australian Atomic Energy Commission and to other nuclear research bodies, and very little to environmental studies. But even the environmental research carried out by professional scientists has been of limited value to the community. Some research which has been done, such as monitoring the environmental conditions in Australia's Northern Territory to establish a baseline for judging the environmental effects of uranium mining, is mainly useful to mining companies. Very little has come out of all the environmental research establishments that is readily available and useful to the community in terms of understanding and evaluating the issues of nuclear power and uranium mining. Most of the valuable contributions in this area have come from individuals isolated in places such as philosophy departments, medical research institutes or environmental activist groups. There are quite a number of talented researchers who have not had the opportunity or funds to engage in significant studies directly related to the uranium issues as they concern the community. Some of these researchers attempt to continue their efforts while surviving on unemployment payments.

In stark contrast to the limitations of professional science is the success in Japan of small largely volunteer research groups formed for studying specific environmental problems and made up of academics, students, citizens, and school teachers.[10] The studies made by these groups have been simple and inexpensive but ecologically sound, and have involved, for example, observing the effects of pollutants on plants and talking to sufferers from diseases caused by industrial emissions. Heavily funded groups of professional scientists have studied some of the same problems using sophisticated chemical analyses, wind tunnels, elaborate mathematical simulations, and the like. But the professionals have often failed to touch the real problems, due to specialization, bureaucratic procedures, the influence of funding bodies, and the isolation of the research effort in laboratories and offices away from the location of the pollution and the experience of the people affected. In many instances, as in the case of Minimata disease caused by mercury poisoning, the simple methods used by the people's volunteer research groups gave more reliable results than the "modern scientific methods" used by professional scientists supported by government and industry.

Promoting Science for the Community

Can anything be done about the present situation? First, members of the community can make their voices heard on what research topics should be investigated by professional scientists. Most scientists live in an isolated environment where the main influences are other scientists and the imperatives of government and corporations as translated into the form of scientific problems. Input from the community provides both a threat and a challenge. And community concern does have an impact. For example, environmental studies programs were set up in US universities only *after* the environment had become a major public issue.[11]

Second, citizens can work through various channels to attempt to obtain greater say over the funding of science. This will be strongly and loudly opposed by scientists and those who most greatly benefit from their work, but such opposition is to be expected from those who are privileged and have little formal responsibility to the community.

Third, citizens can promote and participate in their own research efforts, especially in areas which establishment science ignores. Along with this there would need to be new procedures and standards for communicating the results of research. The Japanese volunteer research groups provide one example.

Fourth, members of the community can be much more skeptical about the claims of "experts" and about the scientific studies used to support these claims. Such skepticism is often stigmatized as being a symptom of irrationality or an anti-scientific attitude, but actually it is a quite reasonable response to the failures of many "experts" defending government or industry positions in public controversies over the past decade.[12] The questions to be asked about scientific studies are, what are the values underlying the research and its interpretation and use, and what groups stand to benefit and lose from this research?

Actually, in my experience many non-scientists are very skeptical about the orientations and value of much scientific work. But there is often a worry beneath this skepticism that perhaps those scientists know something that the non-scientists don't. My experience as a scientist leads me to conclude that there is no need to worry. Citizens are quite capable of meeting scientists on equal terms regarding the values embodied in scientific work.

And what can scientists do to promote science for the community? Efforts by scientists in this direction have been strongly hampered in two ways. First, the organizational location of most scientists, namely as employees in large organizations, leads them to think and act mainly through bureaucratic channels rather than encouraging community involvement. And second, the intellectual training and day-to-day experience of most scientists lead them to believe in the power of ideas and to discount the reality and potential of political and social action.

To overcome these limitations, I suggest that socially concerned scientists involve themselves as members of social action groups, whether these be environmental groups, workers groups, feminist groups, consumer groups, or peace groups. The aim in this is not to make such groups more "scientific," though technical advice is often useful. Rather, scientists can in such groups get a direct feel for political realities at a grassroots level. If some of the understanding generated this way can be used to reform or challenge the business-as-usual mentality in the scientific community, this may help in a small way to make science more useful to all the community.

1 Barry Barnes, *Scientific Knowledge and Sociological Theory* (London: Routledge & Kegan Paul, 1974).

2 For a fuller exposition of these basic arguments, see Brian Martin, *The Bias of Science* (Canberra: Society for Social Responsibility in Science [ACT], 1979; North American distributor: International Scholarly Book Services; British distributor: Southern Distribution). Other critiques along this line are David Dickson, *Alternative Technology and the Politics of Technical Change* (London: Fontana, 1974); Hilary Rose and Steven Rose, eds., *The Political Economy of Science* and *The Radicalisation of Science* (London: Macmillan, 1976); Rita Arditti, Pat Brennan and Steve Cavrak, eds., *Science and Liberation* (Boston: South End Press, 1980); and the journals *Science for the People* (897 Main Street, Boston MA 02139), *Science for People* and *Radical Science Journal* (both at 9 Poland Street, London W1V 3DG, UK). Excellent case studies which illustrate the role of values in science are Ian I. Mitroff, *The Subjective Side of Science* (Amsterdam: Elsevier, 1974); Joel Primack and Frank von Hippel, *Advice and Dissent: Scientists in the Public Arena* (New York: Basic Books, 1974); and Phillip M. Boffey, *The Brain Bank of America* (New York: McGraw-Hill, 1975).

3 Robin Clarke, *The Science of War and Peace* (London: Jonathan Cape, 1971).

4 Stephen King-Hall, *Defence in the Nuclear Age* (London: Victor Gollancz, 1958); American Friends Service Committee, *In Place of War* (New York: Grossman, 1967); Adam Roberts, ed., *The Strategy of Civilian Defence* (London: Faber and Faber, 1967); Gene Sharp, *Exploring Nonviolent Alternatives* (Boston: Porter Sargent, 1970); Anders Boserup and Andrew Mack, *War Without Weapons* (London: Frances Pinter, 1974); Johan Galtung, *Peace, War and Defense. Essays in Peace Research, Vol Two* (Copenhagen: Christian Ejlers, 1976); Gustaaf Geeraerts, ed., *Possibilities of Civilian Defence in Western Europe* (Amsterdam: Swets and Zeitlinger, 1977).

5 Gene Sharp, *The Politics of Nonviolent Action* (Boston: Porter Sargent, 1973), pp. 99–100.

6 Brian Martin, "The Scientific Straightjacket: The Power Structure of Science and the Suppression of Environmental Scholarship," *Ecologist*, 11, 1 (January–February 1981), 33–43.

7 Hilary Wainwright and Dave Elliott, *The Lucas Plan* (London: Allison & Busby, 1982).

8 Mike Cooley, *Architect or Bee? The Human/Technology Relationship* (Slough: Langley Technical Services, n.d.).

9 Frank Graham, Jr, *Since Silent Spring* (Boston: Houghton Mifflin, 1970).

10 Jun Ui, "The Interdisciplinary Study of Environmental Problems," *Kogai – The Newsletter from Polluted Japan*, 5, 2 (1977), 12–24. (Published by Jishu-Koza, c/o Jun Ui, Faculty of Urban Engineering, University of Tokyo, Hongo, Bunkyo-ku, Tokyo, Japan.)

11 David J. Rose, "New Laboratories for Old," in Gerald Holton and William A. Blanpied, eds., *Scienec and Its Public* (Dordrecht: D. Reidel, 1976), pp. 143–55.

12 Frank von Hippel, "The Emperor's New Clothes – 1981," *Physics Today*, July 1981, 34–41.