DIRECTIONS FOR LIBERATION SCIENCE

Brian Martin

The radical science movement developed in the ferment of the late 1960s, in response to abuses of science such as the design and manufacture of weapons.[1] The movement never had as much of a profile as other social movements that blossomed around the same time, such as the feminist movement and the environmental movement. Furthermore, some of the campaigning organisations and magazines of the radical science movement are now defunct.[2]

Nevertheless, it can be said that the movement had an impact. It fostered and reflected a change in citizens' attitudes to science that continues to have ramifications. It might be said that the movement itself was vital, or alternatively that the movement was simply the organisational face of deeper changes in society. In any case, what changes have occurred?

Many more people recognise that science is not neutral, but is inextricably linked to social values. Prior to the 1960s, technological change was widely seen as progress, so that campaigning against a new technology-especially an ostensibly civilian one such as supersonic transport aircraft or nuclear power-could be portrayed as something smacking of conservatism or a sticking-your-head-in-the-sand refusal to face the future. This is no longer the case. Proponents of new technologies, and expanded use of old ones, continue to portray critics as antiprogress, but this is far less likely to inhibit people than before, as indicated by campaigns against freeways and genetically modified organisms.

If science is linked to social values, then what values are they? When a corporation or government backs a product or a policy, often

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the product or policy is linked to vested interests of corporate or government elites, such as profit and social control. Drugs are promoted by pharmaceutical companies to make money, and much drug research is done at the behest of the companies. This sort of connection is more widely recognised.

If science is always linked to social values, then it makes sense that citizens should be involved in decision making about scientific issues, at least in as much as scientific issues also involve social issues. This is increasingly accepted. Campaigning is one manifestation of this. Another is the increasing use of opinion polls, public hearings, consensus panels, policy juries and other means for public input into decision making about science. Science is no longer considered so much an exception to politics, something that must be run by experts and exempted from democratic processes.

Dissent within science is more widely understood as expression of a valid point of view. Instead of scientific truth being the preserve of scientific authorities, members of the public are increasingly familiar with the possibility and potential validity of dissenting views, whether it is about the hazards of microwaves or the greenhouse effect. Being a dissenter is still risky, with many dissenters coming under attack.[3] Nevertheless, there is a greater public constituency for many types of dissenters.

Questioning of developments in science, although often effective, has been limited in one way: it is usually presented in negative fashion, namely as criticism of scientific developments. The radical science movement was very good at critique[4] but not so good at promoting alternatives. There is a good reason for this: governments and corporations have vast resources, including money, employees and the ability to use coercion, that they can use to promote developments of their choice. Citizens' movements do not have anything like these capacities.

Governments can fund missile research, build missiles and arrest antiwar protesters. Corporations can fund computer research, build

computers and take out patents and copyrights. The most obvious response for citizens is to oppose unwelcome developments. The result is many movements that are primarily against something, such as land mines, ozone-depleting chemicals or genetically engineered crops. Acting against undesirable developments and demanding citizen input into decision making are extremely important. But it is also important to go beyond opposition and to promote alternatives. The project of "liberation science" needs to set its own agenda.

One nice thing about promoting alternatives is that they include built-in critiques. The promoter of any technology is implicitly saying that it is worthwhile and more appropriate than other possibilities.

Energy is an area where there has been both powerful opposition and effective promotion of alternatives. There has been a potent movement against nuclear power due to its hazards and link with proliferation of nuclear weapons, among other factors. Coal and oil have also come under attack, most recently for their contribution to the greenhouse effect. But as well as opposition to fossil and nuclear energy, there has been promotion of soft energy alternatives, includ-ing energy efficiency, renewable energy sources and social changes to reduce energy requirements.

However, in some cases what is presented as an alternative is actually more like an adaptation to the current system. Recycling is an example. Undoubtedly it is better to recycle paper, bottles and cans than to simply dump them. But recycling-returning materials so that they can be melted down to make new products-is far short of reuse, namely using the same materials again, such as reusable milk bottles. There is ample technological capacity to produce reusable materials, but little economic incentive or political will. Beyond reuse is the option of designing systems so that no materials are needed in the first place. Examples are eliminating unnecessary packaging, promoting bicycle transport and compact community design (so that the need to manufacture cars is reduced) and local production of food (reducing packaging requirements).

In many areas the development of alternative directions for science has not made nearly so much headway as in the case of energy. Alternatives may not be promoted at all, or are restricted to adaptations within the current way of doing things, as in the case of recycling.

The following sections provide illustrations of how an emphasis on alternatives can provide directions for liberation science. I have selected four areas-nonviolent action, information, workers' control and women's liberation-as examples of how science can contribute to human welfare while providing an alternative to oppressive systems. These alternatives may seem quite radical, but then concepts such as appropriate technology and renewable energy were considered quite radical only a few decades ago (and still are for many purposes). This is inevitably a personal selection. Other ideas, including contrary ones, are welcome!

Nonviolent action

For many decades, a large proportion of global research and development has been devoted to military purposes, especially the design, testing, production and deployment of weapons. Hundreds of thousands of scientists and engineers have put their creative sparks and hard work to the service of military machines. The radical science movement, along with the peace movement, has decried this outrageous misdirection of scientific effort. To accompany this critique, what alternative direction is there for science?

Nonviolent action can be an alternative to military systems. Instead of defending (or attacking) a community using soldiers and weapons, a community can defend itself using rallies, strikes, boycotts, noncooperation, sit-ins and many other methods of nonviolent action. The basic aim of nonviolent resistance is to undermine the willingness of the opponent to continue with aggression or oppression. Some historical instances where nonviolent action has played a major role are the toppling of the Marcos dictatorship in the Philippines in 1986, the collapse of

Eastern European regimes in 1989, the failure of the 1991 Soviet coup and the ending of apartheid in South Africa.

Various theorists have analysed how a society could defend itself nonviolently.[5] However, no society has ever yet systematically prepared itself for nonviolent defence, so it remains to be seen how effective this alternative can be. While the most important aspects of nonviolent defence are social and psychological-factors such as morale, unity and will-science can certainly contribute. Possibilities include setting up communication systems for the resistance that cannot easily be shut down or spied upon, building factories that can be safely but definitively shut down when aggressors seek to take them over, and establishing self-reliant systems for energy, transport, agriculture and health that can enable a population to better survive in the face of destruction or a blockade.

The orientation of science to nonviolent struggle rather than military systems would have a dramatic transformative effect on research topics, disciplines and methods of inquiry.[6] Instead of developing computer systems for missile guidance, computer systems for fostering cross-cultural communication would have priority. Military-encouraged emphasis on fields such as aeronautics and meteorology would be replaced by emphasis on the sociology and psychology of community solidarity. Technological development by military labs would be replaced by community-based development and testing.

Information for all

With the rise of capitalism, land that had previously been used communally was "enclosed": landowners prevented traditional users from gaining access to the land. Large landowners already had control of more than their share of the land; the enclosure process further reduced what was available to the public. People who tried to use formerly public land were condemned as trespassers and treated like criminals.

In the past century, the new target for enclosure has been information. In the 1920s and 1930s, the broadcast spectrum was up for grabs. In principle, anyone could have used it, but governments claimed a monopoly over allocation and gave access only to them-selves and to licensed commercial broadcasters. Those who dared to challenge this government-imposed control were condemned as pirates and treated like criminals.

Designs, books, articles, films, recordings, paintings, drugs, software and genetic information have been subject to a similar process by being classified as "intellectual property." Copyrights and patents operate to prevent others from using intellectual products, with the contradictory justification of promoting intellectual production. Although society always contributes to the creation of intellectual products through education and the availability of prior ideas, the myth of the autonomous creator is used to justify treating intellectual products as property and restricting wider use. Most of this property, which can be bought and sold, is owned not by individual creators but by corporations and governments.[7]

The ownership of genetic information is an obvious case of enclosure. In some cases, species that have been found and selected by communities over a long period are patented by outside companies, which then claim the right to restrict local uses of the species.

Technical experts have played a key role in information enclosure, in designing radio and television broadcast systems, in writing proprietary software and in developing genetically modified organ-isms. Ironically, science itself is one of the last great areas where information is freely available. If formulas and scientific ideas could be copyrighted, with the normal copyright period lasting 50 to 70 years after the author's death, it would be impossible today to use the formula $E=mc^2$ without permission. The inhibiting effect of such an ownership regime can be imagined.

An alternative direction is to use science to promote information for all.[8] This is already occurring. Micropower broadcasting makes it possible for anyone to run a radio station.[9] The free software movement

is incredibly innovative and even beginning to challenge the corporate sector.[10] The internet is providing an enormous challenge to copyright, as did photocopiers a few decades ago.

Yet there are additional ways that science could be developed to foster a society without information enclosure. Possibilities include radio systems that help autonomous broadcasters to use the broadcast spectrum in a cooperative fashion, copy-friendly recording systems and research into nonpatentable drugs and crops.

Another aspect of information enclosure is the development of jargon and esoteric intellectual frameworks. "Science for the people" must include accessibility and understandability of research and its implications. As well as popularisation, this means a reconsideration of the way scientific knowledge is conceptualised and communicated. For example, every scientific paper might be accompanied by a summary designed for nonspecialists, or perhaps a web link to background material for those seeking to understand the field. Of course, there are limits to understandability: no one can expect to grasp a field without a fair bit of effort. The challenge is to see what can be done to reduce the barriers.

Workers' control

In workplaces, owners and managers typically are in a more powerful and privileged position than employees. One of the primary goals of employers is to maintain this inequality, and science has been deployed for this purpose. With the rise of capitalism, the factory system took workers out of their homes, the previous primary site of production, and subjected them to the control of capitalists, mediated through machinery. The factory system initially was no more efficient than the previous putting-out system, but it allowed greater exploitation of workers.[11]

Science has been repeatedly used to serve the interests of employers, for example, in designing production systems that remove skills or power from workers, in setting up workplace surveillance

schemes, and in developing social systems that inhibit militancy by workers. The globalisation of production, in which components of products may be assembled in different countries, limits the potential for resistance by workers. Globalisation could not be achieved without the assiduous efforts of corporate engineers and planners. Thus, in many ways science has been used to serve the interests of employers at the expense of the interests of workers.

An alternative direction is workers' control, in which workers collectively make all decisions about investment, products, work organisation and pay.[12] The workers may or may not appoint managers. The point is that all arrangements are under the direct control of the workers. Workers' control has developed in some enterprises by harmonious evolution, in some through direct takeover (usually short-lived) and in some in the wake of revolutionary transformation such as the Spanish revolution of 1936-1939.[13] Workers' control is also the guiding principle in many cooperatives.[14]

Science can be used to support workers' control. This was precisely the aim of the movement for sociotechnical design, in which workplace technology is designed around the collectively expressed needs of workers rather than workers being forced to adapt to preexisting slots.[15] Rather than an assembly line in which workers must carry out repetitive tasks at a pace determined by the speed of the line, products can be assembled in teams. Rather than quality control being implemented by a separate inspection, quality can be a responsibility of teams or individuals. In designing production systems, there is enormous scope for engineering creativity to bring out the most from workers who are themselves in control.

Workers have a range of skills, interests and potentials. In current systems this diversity is seen as a difficulty: if individuals cannot meet certain criteria, they are not employed in the first place; those with talents beyond what are required are bored rather than challenged. A production system designed around the workers would build on workers' skills, interests and potentials, providing a stimulating and educational

environment.[16] For example, systems can be designed to cater for individuals with particular disabilities, to use their skills and develop their capacities to the maximum extent.

As well as designing production systems that are adapted to the needs of workers, another aspect of workers' control is power to decide what is produced. In the famous case of Lucas Aerospace, workers proposed numerous ideas for products that would be socially useful, such as transport devices and medical equipment. This example suggests that workers in control would think of community needs as well as their own, for example taking into account environmental impacts of production. Workers certainly are more likely to respond to community concerns than are owners or managers. Workers' control opens enormous possibilities for the use of science for community benefit, both in converting harmful produc-tion to more beneficial uses and in designing products with a primary orientation to users.[17] For example, rather than designing goods that become obsolescent due to poor quality, changes in fashion or difficulty in making repairs, goods would be designed for durability and repairability.

Central to the imposition of capitalist frameworks on communities is the role of money. Far from being a neutral tool, the use of money introduces a set of values into relationships,[18] including the assumption that things can and should be bought and sold and that those with more money deserve the power associated with it. The free flow of capital throughout the world-while the mobility of labour is con-strained by national boundaries-gives power to bankers and big capitalists.

A vast amount of research is carried out into the operation of markets, with every effort made to understand problems and to fine-tune operations.[19] Relatively little study has been made of alternatives, such as local money systems and LETS (local employment and trading system), that give greater power to communities and prevent domination or exploitation by outside groups.[20] Much research and testing is needed to improve the operation of such systems, to ensure their smooth operation and protect them from outside domination. Systems of

electronic money are being developed. The challenge is to design them so that they can empower local communities.

Women's liberation

The collective domination of men over women, called patriarchy, seems primarily to be a social phenomenon. Nevertheless, science has in various ways served to support patriarchy. At the ideological level, scientific findings about women's bodies and minds-brain size, spatial abilities, brain lateralisation-have been used to justify women's subordination. Medical technologies have been developed that take childbirth out of the hands of women (including midwives) and put it in the hands of doctors, drug companies and designers of hospital equipment. In some workplaces, equipment is designed for people of a certain size and strength, making the job difficult or impossible for many women (and some men).

Within the scientific community itself, women have long been a minority due to exclusion, direct discrimination, sexual harassment, work demands and career structures that discriminate against people with responsibility for children, and cold and alienating intellectual and collegial styles that are less than appealing to women.

Science could be used to give much greater power to women. Reproductive technologies could be developed and designed so that women, rather than medical specialists, have direct control.[21] Production systems and goods could be designed around women's skills and needs.

Male domination is not just a question of personal prejudice. It is also built into social arrangements. Home appliances are designed, produced and marketed under the assumption that cooking, cleaning and child rearing take place in the home, usually a women's responsibility. Another possibility is collective provision of goods and services. For example, housing can be designed so that cooking and child care are centralised for a group of families while retaining individual and family privacy. Alternatively, meals could be delivered on a regular basis. The technological infrastructure for such alternatives would be considerably different than what is available at present.[22]

Table: Some areas where science contributes to social problems but can also contribute to alternatives

Area	Problem	Alternative
Defence	War, dictatorship, repression	Nonviolent struggle
Information	Domination, propaganda, inequality	Network communication, information for collective use
Work	Domination by employers, exploitation, inequality	Workers' control, production for social use
Gender	Male domination	Self-help reproductive technology, collective provision
Energy	Domination by governments and corporations, environmental impact	Energy efficiency, town planning to reduce energy requirements, renewable energy
Health	Hightech corporate medicine, curative approach, neglect of the disadvantaged	Prevention, technologies and drugs for self-help
Education	Credentialism, dependence on experts, social inequality	Learning as part of life experience, learning for liberation
Food	Corporate domination	Community self-reliance
Housing	Inequality, homelessness, dependence on specialists	Technologies for community self-reliance
Animals	Suffering and killing for food production and research	Vegetarianism, veganism, drug testing without animals
Politics	Domination by politicians and vested interests, lack of participation	Participatory democracy

Conclusion

The table lists the four areas discussed above plus a number of other areas where science can contribute to alternatives as well as being used to challenge problems.

This table-which is far from exhaustive-suggests the scale of the

problems as well as the scope for alternatives. Currently, the bulk of research and development is being funded by and is largely in service to groups with the greatest power, especially governments and corporations. There is vast expenditure on weapons and little on nonviolent struggle. There is vast expenditure on proprietary drugs and little on nutritional healing. There is vast expenditure on corporate-designed manufacturing systems and little on worker-designed systems. And so on.

Nevertheless, there are many committed individuals pushing for alternatives. Some of them operate on the margins, directly helping those in greatest need. Others work in the heart of the system but seek to move it in more humane directions. Efforts in all locations are needed.

Nicholas Maxwell has argued that most science is based on the "philosophy of knowledge," assuming that knowledge is a value in itself. That is a prescription for amoral investigations at the service of whoever can pay for research. Maxwell advocates replacing the philosophy of knowledge by a "philosophy of wisdom" in which science is explicitly oriented to solve the world's most pressing problems, such as war and poverty.[23] The philosophy of wisdom is an appropriate intellectual foundation for the practical task of developing science for liberation.

1. In this article, science is taken to include technology.
2. Examples are the British Society for Social Responsibility in Science and its magazine Science for People and, in the US, Scientists and Engineers for Social and Political Action and its magazine Science for the People.
3. See, for example, Brian Martin, "Suppression of dissent in science," Research in Social Problems and Public Policy, Vol. 7, 1999, pp. 105-135. On responding to attack, see Brian Martin, "Strategies for dissenting scientists," Journal of Scientific Exploration, Vol. 12, No. 4, 1998, pp. 605-616.
4. Rita Arditti, Pat Brennan and Steve Cavrak (eds.), Science and Liberation (Boston: South End Press, 1980).
5. Anders Boserup and Andrew Mack, War Without Weapons: Nonviolence in National Defence (London: Frances Pinter, 1974); Robert J. Burrowes, The Strategy of Nonviolent Defense: A Gandhian Approach (Albany: State University of New York Press, 1996); Gustaaf Geeraerts (ed.), Possibilities of Civilian Defence in Western Europe (Amsterdam: Swets and Zeitlinger, 1977); Stephen King-Hall, Defence in the Nuclear Age (London: Victor Gollancz, 1958); Brian Martin, Social Defence, Social Change (London: Freedom Press, 1993); Michael Randle, Civil Resistance (London: Fontana, 1994); Adam Roberts (ed.), The Strategy of Civilian Defence: Nonviolent Resistance to Aggression (London: Faber and Faber, 1967); Gene Sharp with the assistance of Bruce Jenkins, Civilian-Based Defense: A Post-Military Weapons System (Princeton: Princeton University Press, 1990).

6. Brian Martin, "Science, technology and nonviolent action: the case for a utopian dimension in the social analysis of science and technology," Social Studies of Science, Vol. 27, 1997, pp. 439-463.
7. Debora J. Halbert, Intellectual Property in the Information Age: The Politics of Expanding Ownership Rights (Westport, CT: Quorum Books, 1999); Seth Shulman, Owning the Future (Boston: Houghton Mifflin, 1999).
8. Brian Martin, Information Liberation (London: Freedom Press, 1998).
9. Ron Sakolsky and Stephen Dunifer (eds.), Seizing the Airwaves: A Free Radio Handbook (Edinburgh: AK Press, 1998); Lawrence Soley, Free Radio: Electronic Civil Disobedience (Boulder, CO: Westview Press, 1999)
10. Free Software Foundation, 59 Temple Place, Suite 330, Boston MA 02111-1307, USA; gnu@prep.ai.mit.edu; http://www.gnu.org/.
11. Stephen Marglin, "What do bosses do? The origins and functions of hierarchy in capitalist production," Review of Radical Political Economics, Vol. 6, No. 2, Summer 1974, pp. 60-112.
12. This is also called workers' self-management. Another term, industrial democracy, often is used to refer to limited forms of worker participation such as representation on boards of management.
13. Gerry Hunnius, G. David Garson and John Case (eds.), Workers' Control: A Reader on Labor and Social Change, (New York: Vintage, 1973); Ernie Roberts, Workers' Control, (London: Allen & Unwin, 1973); Daniel Zwerdling, Workplace Democracy: A Guide to Workplace Ownership, Participation and Self-Management in the United States and Europe (New York: Harper and Row, 1979).
14. George Melnyk, The Search for Community: From Utopia to a Cooperative Society (Montreal: Black Rose Books, 1985); Jenny Thornley, Workers' Cooperatives: Jobs and Dreams (London: Heinemann, 1981).
15. P. G. Herbst, Socio-Technical Design: Strategies in Multidisciplinary Research (London: Tavistock, 1974).
16. Hilary Wainwright and Dave Elliott, The Lucas Plan: A New Trade Unionism in the Making? (London: Allison and Busby, 1982).
17. Victor Papanek, Design for the Real World: Human Ecology and Social Change (London: Thames and Hudson, 1985).
18. Nigel Dodd, The Sociology of Money: Economics, Reason and Contemporary Society (London: Polity, 1994).
19. That the capitalist system is still subject to recurrent crises is important, but not the topic here.
20. Richard Douthwaite, Short Circuit: Strengthening Local Economies for Security in an Unstable World (Totnes, Devon: Green Books, 1996).
21. Liz A. Highleyman, "Reproductive freedom in everyday life," Love & Rage, vol. 3, no. 2, February 1992, p. 6; Lisa Loving, "The abortion underground," Kick It Over, #29, Summer 1992, pp. 15-18; Julius A. Roth, "A sour note on Roe vs. Wade," Research in the Sociology of Health Care, vol. 9, 1991, pp. 3-8. Providing technologies for women to easily and safely prevent pregnancy and have abortions has long been a goal of many feminists. Opponents of abortion would see this in a different light.
22. Ruth Schwartz Cowan, More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave (New York: Basic Books, 1983).
23. Nicholas Maxwell, From Knowledge to Wisdom: A Revolution in the Aims and Methods of Science (Oxford: Basil Blackwell, 1984); Nicholas Maxwell, "What kind of inquiry can best help us create a good world?', Science, Technology, and Human Values, Vol. 17, 1992, pp. 205-227.