Technology for nonviolent struggle

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Technology for Nonviolent Struggle

Organised nonviolent struggle, using methods such as strikes, boycotts and noncooperation, is a possible alternative to military methods. However, compared to military funding, there has been hardly any financial and organisational support for nonviolent struggle. Putting a priority on nonviolent struggle would lead to significant differences in technological development and scientific method. Research and development relevant to a number of areas—especially communication and survival—are assessed in terms of their relevance to nonviolent struggle. The findings are used to suggest how science and technology used for the purposes of war and repression can be converted most effectively to serve the purposes of nonviolent struggle.

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Contents

Prologue. The vision of Aldous Huxley *1*
1. Introduction *4*
2. Militarised technology *8*
3. Nonviolent struggle *26*
4. Priorities for research and development *34*
5. Communication *42*
6. Survival *59*
7. The built environment *68*
8. Countering attack *71*
9. Research methods *75*
10. Technology policy for nonviolent struggle *80*
Appendix. Theories of technology *91*

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Prologue

The vision of Aldous Huxley

In 1946, a remarkable essay by Aldous Huxley entitled *Science, Liberty and Peace* was published.[1] Huxley (1894-1963) is widely known as a novelist whose most famous work, *Brave New World*, was published in 1932. He was also a prolific and eloquent essayist in diverse fields. *Science, Liberty and Peace* is filled with insights about the connections between science, violence and nonviolence. Considering how far in advance of others Huxley was on this issue, it seems worthwhile examining how he arrived at his conclusions.

Huxley's essay begins with the point—quoting Leo Tolstoy from around the turn of the century—that if power in society is mostly in the hands of a few people, then control over nature through science and technology will serve to increase power inequalities. Huxley points out that in the 1800s, armed liberation might have seemed a reasonable prospect: barricades and sporting rifles could be used to resist the government's cavalry and cannon. But with the development of weapons of mass destruction, people's weapons were no longer a match for the violence controlled by the state. Similarly, modern methods of mass persuasion—notably the press and the radio—become tools for oppressors because they allow the few to manipulate the many.

Mass production, the very foundation of industrial society, has aided this process, Huxley argues. Centralised production is favoured by both governments and big business, and they put every obstacle possible in the face of decentralised production. In each of these developments—weapons, media and industry—science and technology have played a crucial role. The main thrust of science and technology thus has served oppressors and hindered the expansion of peace and freedom.

Huxley's analysis of society and science can be traced back to one guiding principle: that power is corrupting. Huxley refers to Lord Acton, whose views on power are best known through the aphorism "power tends to corrupt and absolute power corrupts absolutely."[2] If power is corrupting, then all technologies and social arrangements that allow or promote concentrations of power should be resisted. Huxley's preferred path is decentralisation, which reduces the potential for abuse of power.

Huxley favours a society fundamentally different from the one that existed in 1946. But how should change occur, given that the overwhelming powers of violence and mass persuasion are held by what he calls the "ruling oligarchy"? Huxley believes that nonviolence is the only way forward. He sees hope in Gandhi's methods, called satyagraha but more commonly referred to in the west today as nonviolent action, and refers to the resistance by the German people to the French and Belgian occupation of the Ruhr in 1923.

Huxley argues for nonviolence as the only hopeful possibility given the power that science and technology, via modern weapons, has placed in the hands of oppressors. Huxley's support for nonviolence can be interpreted as an independent principle of action to supplement his analysis based on the corruptions of power. But support for nonviolence is a logical consequence of an overall analysis based on the idea that power is corrupting. Nonviolent action, as a method of struggle, allows widespread participation, gives any individual only limited power over others, and is most compatible with decentralised activity. Nonviolent

action, then, is the method of struggle against oppression that is least subject to the corruptions of power.

With his analysis based on the corrupting influence of power, Huxley is able to make many penetrating insights. For example, he notes that oil is unevenly distributed throughout the world. Therefore, it is susceptible to monopoly control, with wars being fought to acquire and maintain this control.[3] The obvious implication is that building an energy system around oil makes society prone to inequality and war.

Huxley also makes the point that nuclear power is complex and potentially destructive and therefore a bad option. He prefers instead the development of regional energy self-sufficiency, which would minimise the social power held by any group.

The modern warfare state needs a strong capital-goods industry and also the capacity to mobilise the entire population, either in the military or in industry, for war. Huxley was well aware of this process during World War II. This universal mobilisation is easiest when the population consists largely of rootless, propertyless employees who depend on the state for vital services. Another value of large industry, from the point of view of the state, is that it is much easier to tax than small decentralised manufacturing.

Huxley also makes some important general points. He laments the disastrous effects of nationalism; he notes that preparation for war is useful to the holders of centralised political power; and he says that socialist states combine the worst aspects of centralisation of power.

Most of Huxley's insights are fully relevant more than half a century after they were first published. The 1991 Gulf war is only the most recent example of a war fought over control of oil supplies. Huxley's concerns about nuclear power and his support for decentralised energy sources were taken up in a major way beginning in the 1970s. As for the process of mobilisation for warfare, it is certainly the case that many populations around the world are even more rootless and dependent on states than in the 1940s. Huxley's comments about the danger of nationalism are still relevant today. The cold war is testimony to his point that mobilisation for war serves the interests of political elites.[4] The failures of socialist states are now widely apparent.

On a few points Huxley's vision was not quite accurate. Today, it is possible that total mobilisation for war may be less necessary in countries with highly sophisticated weaponry, which make it possible for a relatively small professional military force to wage war. This is one development that Huxley did not foresee. But it is quite compatible with his critique of science and technology as serving to increase the power of oppressors.

He was worried about the opening of the arctic to food production, because it might be monopolised by Russian and Anglo interests. This has not happened, but something similar seems to have occurred with the green revolution and the current attempt by western corporations to control Third World agriculture through genetically engineered organisms that are controlled as a form of intellectual property. So even when Huxley's specific concerns have not been borne out, his general analysis still provides a fruitful perspective.

Huxley's critique of science and technology is a deep one. He sees them as having been developed to serve powerholders. In order to serve liberty and peace, science and technology must be redirected. Huxley recommends that scientists boycott harmful work. He also recommends action to foster positive scientific research. This could be either political action to inspect or control scientific developments, or action by scientists, for example to develop regional self-sufficiency in food and energy. These strategies are still among the most promising ones today. One additional option could be added to Huxley's list: the development of a movement for "community science and technology," in which people, many of whom are outside the formal corps of professional scientists and engineers, develop and

promote science and technology that is relevant to community needs.[5] This prospect was not outlined by Huxley, but it is quite compatible with his vision.

Huxley's far-reaching and perceptive essay provides an important lesson. It has no footnotes and only mentions a few sources in passing. It is an essay in the traditional sense, not a scholarly paper. In a world in which science and scholarship have become increasingly specialised, jargonised and professionalised, it is salutory to know that crucial and lasting insights can be derived from a few sound premises.

The response to *Science, Liberty and Peace* was at best lukewarm. Reviewers ranged from the mildly critical to the openly hostile, generally finding fault with one or more of satyagraha, decentralisation or the strategy of relying on scientists to bring about change.[6] The time was not ripe for developing the link between science and nonviolence. Huxley's essay is virtually unmentioned in the fields of both peace research and the critique of science.[7]

In this book I develop ideas about technology and nonviolence that can be interpreted as a development and application of Huxley's vision. A recurring theme is that those technologies that allow people to control their own lives are the ones best suited to enabling a community to use nonviolent methods to resist aggression or oppression.

Notes

1. Aldous Huxley, *Science, Liberty and Peace* (New York: Harper & Row, 1946; London: Chatto & Windus, 1947). It has been reprinted by the A. J. Muste Memorial Institute, 339 Lafayette Street, New York NY 10012, USA.

2. Since Huxley wrote this essay, several authors have written about the corruptions of power, including Alex Comfort, *Authority and Deliquency in the Modern State: A Criminological Approach to the Problem of Power* (London: Routledge and Kegan Paul, 1950); David Kipnis, *The Powerholders* (Chicago: University of Chicago Press, 1976); David Kipnis, *Technology and Power* (New York: Springer Verlag, 1990); Pitirim A. Sorokin and Walter A. Lunden, *Power and Morality: Who Shall Guard the Guardians?* (Boston: Porter Sargent, 1959). Kipnis' work reports on psychological experiments that provide strong evidence for Lord Acton's insight.

3. This point has also been made by Godfrey Boyle, *Living on the Sun: Harnessing Renewable Energy for an Equitable Society* (London: Calder & Boyars, 1975).

4. This point was also made most powerfully in the opening of Herbert Marcuse, *One Dimensional Man* (Boston: Beacon Press, 1964).

5. For further discussion, see chapter 9.

6. Some significant reviews are P. W. Bridgman, "Science and social evolution," *New York Times Book Review*, 24 March 1946, pp. 3, 28; R. Brightman, "Science and peace," *Nature*, Vol. 160, 29 November 1947, pp. 733-734; R. T. Cox, *Science*, 31 January 1947, pp. 134-135; Anne Fremantle, *The Commonweal*, 7 June 1946, pp. 197-198; Joseph Wood Krutch, "The condition of man," *The Nation*, Vol. 162, No. 14, 6 April 1946, pp. 402-403. I thank Mary Cawte for tracking down these and other reviews, plus considerable commentary on Huxley.

7. It is favourably cited and quoted in Godfrey Boyle, "Energy," in Godfrey Boyle, Peter Harper and the editors of *Undercurrents* (eds.), *Radical Technology* (London: Wildwood House, 1976), pp. 52-58, at p. 58.

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Chapter 1

Introduction

Let's begin with two bold propositions. First, methods of social action without violence can be extremely powerful—indeed so powerful as to be a possible alternative to military defence. Second, technology, which is now massively oriented to military purposes, can be reoriented to support nonviolent action.

These two propositions, if followed through, lead to two striking conclusions. First, nonviolent struggle, which is normally seen as primarily a social and psychological process, has vital technological dimensions. Second, reorienting technology to serve nonviolent struggle would involve a wholesale transformation of research directions, technological infrastructure and social decision making.

This is a quick overview of the task ahead in this book. The rest of this introduction provides a more measured approach to key ideas. It is useful to begin with weapons of war.

War has always involved suffering and death. Centuries ago weapons included swords, bows and arrows, catapults and battering rams, enough for plenty of killing. Today's weapons include rifles, tanks, giant battleships, aircraft for saturation bombing, precision-guided missiles, landmines, and biological, chemical and nuclear weapons.[1] Some types of weapons are much more powerful than in the past, while others are entirely new. It is now much easier for military forces to kill large numbers of people. Civilians are at much greater risk than in earlier eras, in part due to the development of antipersonnel weapons such as cluster bombs.[2] The rapid developments in technology for warfare over the past few centuries have relied on the dedicated efforts of scientists and engineers.

One of the biggest problems with science and technology is their use in war. In 1975, prominent philosopher Arne Naess listed 13 "current main grievances against science" which he considered to be justified and important. Second on his list was this: "Leading scientists take part in creating new terrible and ecologically devastating ways of warfare. Scientists support any state or regime if sufficiently rewarded. Some serve the State through research on how to torture, and take part in international teaching on how to torture without organized opposition from colleagues."[3]

In 1978, 26 individuals associated with the World Order Models Project, an initiative seeking to develop visions of and methods to achieve a better world, endorsed a statement entitled "the perversion of science and technology." Focussing on the impact of science and technology on the Third World, the statement listed the following problem as one of the initial four points: "the employment of 50 percent of all research scientists in the world in military R&D [research and development]; a significant proportion of that number for developing the technology of mass destruction and repression."[4]

In earlier eras, it was possible to imagine that military technologies could be a source of liberation as well as oppression. The sword and the rifle can be used not only by rulers but also against them.[5] But it is difficult to imagine cluster bombs and nuclear weapons being used for popular liberation. Modern weapons are mainly of use by governments against peoples, often against their own populations.

What is the alternative to military science and technology? The most common response of the world's governments is to seek controls,

such as treaties against biological weapons or agreements on numbers of nuclear missiles. Such reforms are welcome enough but do little or nothing to stem the development of ever more sophisticated weapons. Indeed, some critics argue that arms control negotiations serve only to regularise military races, not to halt them.[6]

Whereas most governments seek only those limited controls on weapons to which they agree, peace movements around the world have called for disarmament and totally getting rid of certain types of weapons, particularly nuclear, biological, chemical and antipersonnel weapons. Some groups and movements have pushed for complete elimination of weapons and armies. Peace movement campaigns have had some obvious successes, such as the banning of above-ground tests of nuclear weapons, and also have created a climate of opinion that has sometimes held back aggressive governments. However, peace movement campaigns have seldom dealt directly with the complex of scientific and technological operations serving military ends.

One exception to this is the movement for "peace conversion" or "economic conversion."[7] What this means is converting science, technology and industry from military purposes to civilian purposes, especially to activities that serve human needs. This might mean converting a gun factory to a home appliance factory or shifting from research into missile ballistics to research into public transport. Historically, this sort of conversion was routine at the ends of major wars. But as military technology becomes ever more specialised, conversion to civilian purposes becomes more difficult. Converting production from military trucks to civilian trucks is not so difficult; converting production from nuclear submarines to a useful civilian technology is quite a challenge. The technological dimension to peace conversion is actually the smaller hurdle. The major obstacle is the political and economic interests in continuing military production. These interests have become entrenched since World War II, so that governments administer what can be called a "permanent war economy."

Peace conversion is a vital part of any process of changing science and technology so that they no longer serve to sustain war and repression. But peace conversion can be only one part of this process, since it provides no alternative means of directly providing the security that is the stated rationale for, if seldom the consequence of, military forces. (The deeper driving forces behind military systems are discussed in chapter 2.)

One alternative to the military is nonviolent defence. The military option involves professional soldiers using specially designed instruments of violence to defend and attack. Nonviolent defence involves all concerned people using methods of nonviolent action such as rallies, refusals to obey, strikes, boycotts, sit-ins and setting up alternative institutions. As a full alternative to military forces, nonviolent defence is also called social defence, civilian defence, civilian-based defence and defence by civil resistance. From a nonviolence viewpoint, only some functions of the military—notably defending the core values of a society against attack—need to have a nonviolent replacement. A nonviolent defence system would not take up other functions of militaries, such as internal repression and threatening other societies.

Methods of nonviolent action can also be used in campaigns against oppression, such as the independence movement in India led by Mohandas Gandhi and the US civil rights movement led by Martin Luther King, Jr. There are numerous other examples, some of which are described later.

For those who are accustomed to thinking about weapons systems or to hearing about horrific wars and massacres around the world, nonviolent action at first glance may seem woefully inadequate. Actually, though, it can be an incredibly powerful technique. The key to nonviolent action is promoting refusal to consent. Even the most powerful weapons

system requires human decisions to build, maintain and operate it. If manufacturers, commanders or operators refuse to cooperate, weapons will not be created or used. There are many examples where this process has occurred.

Most studies of nonviolent action have focussed on social and psychological factors, such as how to mobilise support. This is appropriate, since social and psychological factors are the keys to successful nonviolent struggle. Nevertheless, there is a role for technology appropriate for nonviolent defence. That is the theme of this book.

Consider the vast resources, both human and material, that have been devoted to military purposes for many decades. This includes development of weapons systems, training of large armies, military exercises, military industries, and orientation of social institutions to military ends. By comparison, only a tiny effort has been made to improve methods of nonviolent struggle. Is it any wonder that nonviolent defence is not a well-developed alternative? Its occasional successes are all the more remarkable, considering that they are analogous to the success of an army that had no weapons production, no training, no money and no planning. The implication of this comparison is that nonviolent defence should not be dismissed until it has been investigated, supported and tested on a scale similar to military defence.

In the next chapter, the connections between technology and the military are analysed. Chapter 3 gives a brief introduction to the dynamics of nonviolent action. Chapter 4 introduces the main subject: how technology might be used to support nonviolent struggle.

Nonviolent struggle potentially can involve nearly any area one can imagine, from sculpture to soccer. Since technology is increasingly pervasive, this means that design and choice of technology for nonviolent struggle also potentially affects nearly any conceivable area. In many areas, it seems, no one has even begun to think through the implications. Chapters 5 to 8 give special attention to the key areas of communication, survival, the built environment and countering attack. Other areas that might be examined include art, sport, policing, prisons, money and jobs.[8] Chapter 9 discusses the implications of nonviolent action for methods of doing research. Chapter 10 addresses the issue of "policy": how to move from present-day militarised technology to a technology useful for nonviolent struggle.

The approach I take is to start with nonviolent struggle and see what implications it has for technology. Of course this is not the only way to approach these issues. Another is to start with a vision of a desired society—for example, based on participation, self-reliance, equity and ecological sustainability, as well as nonviolence—and then see what technology is most appropriate to create and sustain it.[9] But in practice these two approaches are not greatly divergent, since in most cases the sort of technology suitable for nonviolent struggle is also suitable for fostering participation, self-reliance and so forth, though in a few particular areas there may be incompatibilities. I find it useful for the purpose of clarity to focus on technology for nonviolent struggle, while noting at various points the potential role of the same technology for promoting other values.

Notes

1. See, for example, Frank Barnaby, *The Automated Battlefield* (New York: Free Press, 1986); Martin van Creveld, *Technology and War: From 2000 B.C. to the Present* (New York: Free Press, 1989); James F. Dunnigan, *How to Make War: A Comprehensive Guide to Modern Warfare* (New York: Quill, 1983); James F. Dunnigan, *Digital Soldiers: The Evolution of High-Tech Weaponry and Tomorrow's Brave New Battlefield* (New York: St. Martin's Press, 1996); Kenneth Macksey, *Technology in War* (New York: Prentice Hall, 1986); William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D.1000* (Oxford: Blackwell, 1983). On the continuing danger of nuclear war, see William E. Burrows and Robert Windrem, *Critical Mass: The Dangerous Race for Superweapons in a Fragmenting World* (New York: Simon and Schuster, 1994).

2. Eric Prokosch, *The Technology of Killing: A Military and Political History of Antipersonnel Weapons* (London: Zed Books, 1995).

3. Arne Naess, "Why not science for anarchists too? A reply to Feyerabend," *Inquiry*, Vol. 18, 1975, pp. 183-194, at p. 192.

4. Saul Mendlovitz and Rajni Kothari, "The perversion of science and technology: an indictment," *Bulletin of the Atomic Scientists*, Vol. 35, No. 1, January 1979, pp. 57-59, at p. 57.

5. Even if armed liberation is possible, it may not be a promising road to a better society, since it involves killing, secrecy, centralisation of power and male domination. The armed liberators often become the new oppressors.

6. Johan Galtung, "Why do disarmament negotiations fail?" *Gandhi Marg*, nos. 38-39, May-June 1982, pp. 298-307; Johan Galtung, *There Are Alternatives! Four Roads to Peace and Security* (Nottingham: Spokesman, 1984), pp. 131-138; Alva Myrdal, *The Game of Disarmament: How the United States and Russia Run the Arms Race* (New York: Pantheon, 1976). Among other factors, disarmament negotiations keep control over the agenda in the hands of the dominant governments and dampen public concern by giving the illusion that something is being done about the problem.

7. See, for example, Bonn International Center for Conversion, *Conversion Survey 1996: Global Disarmament, Demilitarization and Demobilization* (Oxford: Oxford University Press, 1996); Seymour Melman, *The Demilitarized Society: Disarmament and Conversion* (Montreal: Harvest House, 1988); Judith Reppy (ed.), *Conversion of Military R&D* (Basingstoke: Macmillan, 1998); Peter Southwood, *Disarming Military Industries: Turning an Outbreak of Peace into an Enduring Legacy* (Houndmills, Basingstoke: Macmillan, 1991); and the journal *Positive Alternatives*, published by the Center for Economic Conversion, 222 View Street, Mountain View CA 94041-1344, USA.

8. On the topics of policing, prisons and economics from the perspective of social defence, see Brian Martin, *Social Defence, Social Change* (London: Freedom Press, 1993).

9. I thank Andreas Speck for emphasising this point. A theoretical foundation for this approach is given by Nicholas Maxwell, who argues that most scientific and scholarly work is based on the "philosophy of knowledge," which assumes that knowledge is of value in itself. Maxwell argues that the philosophy of knowledge should be replaced by a "philosophy of wisdom," in which science is directly geared to solve major problems facing humanity, such as poverty, repression and war: 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, & Human Values*, Vol. 17, 1992, pp. 205-227.

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Chapter 2

Militarised technology

In order to understand the potential role of technology for nonviolent struggle, it is useful to understand the actual role of technology for military purposes. What is technology?[1] A simple and narrow definition is that technology is any physical object created or shaped by humans (or other animals). Technologies include paper, toothbrushes, clothes, violins, hammers, buildings, cars, factories, and genetically modified organisms. These objects can be called artefacts. A broader definition of technology includes both artefacts and their social context, such as the processes, methods and organisations to produce and use them. This includes things such as the manufacturing division of labour, just-in-time production systems, town planning and methods used in scientific laboratories. This broader definition is useful for emphasising that artefacts only have meaning within the context of their creation and use. In this book, the word "technology" refers to both artefacts and their social context.

Similarly, "science" can be defined as both knowledge of the world and the social processes used to achieve it, including discussions in laboratories, science education, scientific journals and funding. The distinction between science and technology, once commonly made, is increasingly blurred. The scientific enterprise is deeply technological, relying heavily on instruments and associated activities. Just as importantly, the production of artefacts requires, in many cases, sophisticated scientific understanding. This is nowhere better illustrated than in contemporary military science and technology. For example, the development of nuclear weapons depended on a deep understanding of nuclear processes, and in turn nuclear technologies provided means for developing nuclear science. For convenience, I often refer just to "technology" rather than "science and technology," with the understanding that they are closely interlinked and that each can stand in for the other.

In this chapter, I examine military influences on technology. Some influences are immediate and obvious, such as military contracts to produce bazookas and cruise missiles; others are deep and structural, such as military links with capitalism and patriarchy. My approach is to start with the immediate influences and later discuss the deep ones. The first section deals with military funding and applications, training and employment, belief systems and suppression of challenges. The second section deals with "countervailing influences," namely factors that resist military influence on technology: civilian applications, bureaucratic interests and popular resistance. The final section discusses connections between the military and social structures of the state, capitalism, bureaucracy and patriarchy, and how they can affect technology.

Military shaping of technology

Military priorities play a major role in the development of many technologies.[2] Figures 1 and 2 illustrate how this process, which can be called the military shaping of technology, can occur. Factors such as funding and employment are pictured as influences from the top ("military influence/context"). Military applications are shown in the middle and civilian applications at the bottom. Figure 1 shows the case of science and technology that are very

specifically oriented for military purposes, such as the computer software in a cruise missile; there are only occasionally a few civilian spinoffs. Figure 2 shows a more general perspective, looking at entire fields of science and technology. In this case, civilian applications are a significant competing influence.

With figure 1, the military-specific orientation is blatant. With figure 2, it is clear that both military and civilian purposes may be served by the same general fields. I now look in more detail at the specific areas of military funding and applications, training and employment, belief systems and suppression of challenges.

Military funding and applications

When money and other resources are provided to develop certain technologies, obviously this is an enormously strong influence on what technologies are actually developed. Military budgets for research and development (R&D) around the world are huge. They have resulted in an amazing array of powerful and sophisti

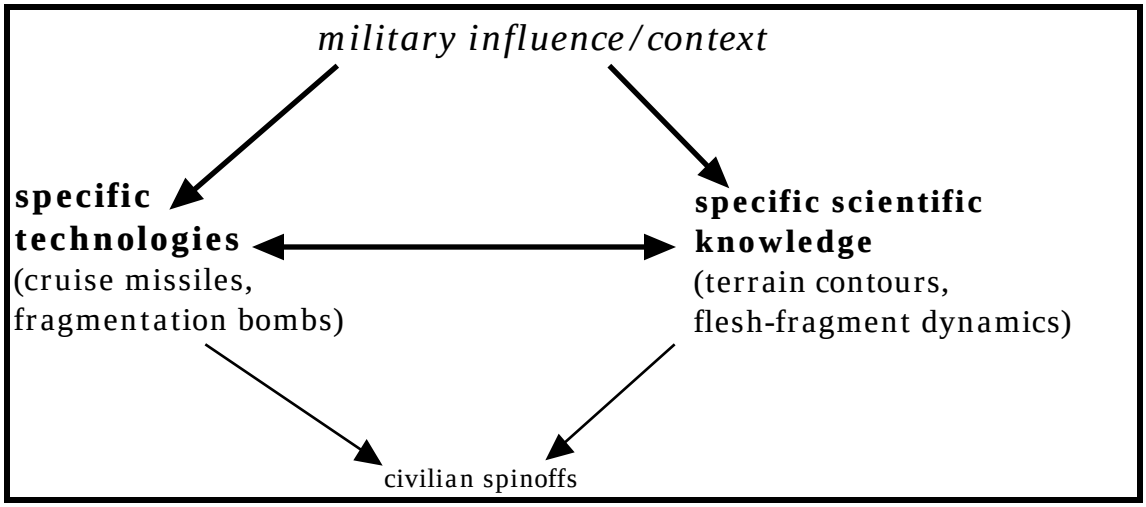

Figure 1. *A model of military shaping emphasising military-specific science and technology.*

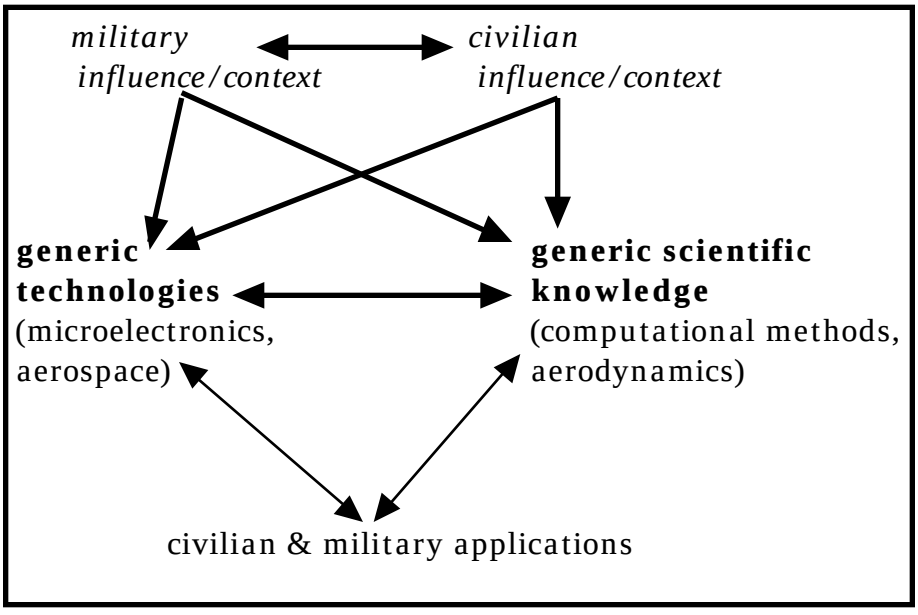

Figure 2. *A model of military shaping emphasising generic science and technology.*

cated weapons, from land mines to aircraft carriers.

Occasionally military funding leads to ideas, methods or products that are useful for civilian purposes. For example, the computer network called Internet grew out of a network set up by the US Defense Advanced Research Projects Agency (DARPA). However, examples like this are quite compatible with the idea that military funding is a powerful way of shaping technologies. The influence of funding simply makes it more likely—not inevitable—that the resulting technologies will be mainly useful for military purposes.

"Funding" is a shorthand for a more complex process which can be called "military technological innovation."[3] There are studies of how military and political elites steer the process of deciding upon, developing and deploying military technologies. This research provides insight into the specific features of military technological innovation in different countries and situations; it is fully compatible with the basic idea that military funding promotes and shapes technology to serve military purposes.

The military is always on the lookout for anything that can be used for its advantage. There is money to develop techniques and products. The possibility of applications has an influence on R&D, by encouraging at least some researchers to pursue areas where applications are more likely. For example, some researchers in pure mathematics are more likely to work in areas where there are possible applications. These applications might be computational methods, theoretical chemistry, energy conservation or ballistics.

Sometimes entire fields are shaped by military priorities. An obvious example is nuclear physics, which has received heavy military funding and provided jobs for many researchers. Furthermore, in several countries governments pursued nuclear power programmes as a means of keeping open the option of acquiring nuclear weapons or (in the US "Atoms for Peace" programme) to reposition nuclear technology as "peaceful." The priority on nuclear weapons and nuclear power has meant that non-military nuclear physics, carried out in universities, has had a higher priority than otherwise would have been the case. Military researchers have been ready to take advantage of any advance from university research. Without the military and commercial interest in nuclear technology, it is likely that other branches of physics such as solar physics would have received greater attention.

Microelectronics and computing are other fields that were, for many years, driven by military applications.[4] For example, the development of sophisticated nuclear weapons makes heavy demands on computer power. In the early decades of nuclear weapons, the US nuclear weapons design laboratories—Lawrence Livermore National Laboratory and Los Alamos National Laboratory—worked closely with computer manufacturers to develop machines serving their particular requirements for high-speed numerical computation, and in some cases purchased a large proportion of the resulting production runs. Some of the choices in the architecture of supercomputers consequently reflect military influences.[5]

Since the development of computers, the field of numerical analysis—which, in part, deals with ways to solve problems using computers—has dramatically expanded, and there are areas of pure mathematics that take up esoteric questions related to numerical analysis. Thus, the development of computers has influenced the research priorities of some mathematicians; in turn, pure mathematics research relating to numerical analysis occasionally leads to results that have practical value.

In this way, possible applications influence the direction of research. Military applications are one such application. Thus, although most pure mathematicians do not have military applications directly in mind, their work may be oriented in directions making it more likely to serve military purposes.

The large amount of US military funding for electronics in the years after World War II actually led to few transfers for civilian uses.[6] In recent years, commercial uses have played a larger role in microelectronics research. Commercialisation is even a goal for some military-funded research.[7]

In the case of the insecticide DDT during World War II, military applications served to accelerate research in one particular direction. As a result of the emphasis on short-term control of insect pests by chemicals to support the war effort, research into biological control of pests declined rapidly, institutionalising a pattern that has persisted long after commercial interests became the primary influence on pesticide research.[8]

The social science field of communication studies in the United States was shaped by massive military funding and military agendas, especially in the early years 1945-1960. The military's interest in the field derived from interest in psychological warfare which—in military terms—included not just propaganda but also techniques such as deception, "dirty tricks," assassination, and terrorism. This context was omitted from the academic face of communication studies. Leading researchers and research centres received massive military grants. Major military studies were often later published in academic forums, usually without acknowledgement of their link to the military. Communication research was oriented to the goals of domination and manipulation of mass audiences. The development and use of now-standard survey techniques also reflected military priorities.[9]

Similarly, research in educational technology in the US has been heavily funded by the military, with military priorities of developing man-machine systems. Douglas Noble argues that computers in classrooms and computer-related procedures are not neutral tools, but rather reflect military goals. For example, when educational institutions operate in terms of "instructional delivery systems," this can be said to reflect a military interest in command and control.[10]

It is worth emphasising that military shaping of science and technology can occur even when researchers themselves do not realise that military funding or applications are influencing their work. It is always possible to debate the true purpose of any research. For example, in military research on biological agents, military scientists and administrators may perceive or portray the research as "defensive"—designed to counter biological weapons of opponents—whereas outsiders may believe the research is a prelude to (offensive) biological warfare.[11] This "ambiguity of research" is always present to some degree, since any technology can be used for a variety of purposes, though more easily for some purposes than others.

In the following example, "pure" research is taken up by the military.

> I did my PhD on the theory of dense plasma—the hot, ionised gas found at the centre of the sun and red giant stars. The work involved the calculation of the spatial correlations between the electrons and atomic nuclei making up this plasma. The calculations could be done mathematically rather than on a computer, but the work was esoteric, painstaking and even a little tedious.
>
> En route to take up a postdoctoral position in London, I stopped over at the University of California in Berkeley to visit one of my thesis examiners. He congratulated me on the thesis, and then remarked, 'My colleagues at Livermore are finding it very useful for their calculations of what happens at the centre of a hydrogen bomb explosion.'
>
> Aware that Livermore is a design laboratory for nuclear weapons, I replied: 'Surely not! I thought of that possibility, but discarded it. My calculations are only valid for equilibrium systems. A hydrogen bomb explosion is not in equilibrium.'
>
> 'Aha!' he said. 'Of course the Livermore group use enormous computer programs to do their non-equilibrium calculations. But they need to check these highly complex programs by means of mathematical solu-

> tions in special cases. Your calculations are playing that role.'
>
> A feature of this example from my youthful innocence was that the nuclear weapons scientists were already using my calculations before they had been published. But the main scientific application of my thesis which I wished to see utilised, the correction of an error in existing models of the solar interior, was only adopted three or four years later.[12]

Such personal concern to avoid military uses for one's research is not that common. Much more typical is a concern to do good science and not worry about applications. Seldom, though, is it expressed as bluntly as by a graduate student at the Massachusetts Institute of Technology: "What I'm designing may one day be used to kill millions of people … I don't care. That's not my responsibility. I'm given an interesting technological problem and I get enjoyment out of solving it."[13]

Militaries need to ensure that weapons systems work as desired. Therefore, they set up systems to ensure compliance to military specifications, or simply order certain products or services that fit such specifications. These specifications sometimes have an impact on "civilian" science and technology. In order to ensure that weapons systems work, the US Department of Defense enforces regulations covering certain required standards. Checks are made of standards for the volt and ohm (units for measuring electrical potential and resistance) either by auditors or, more recently, by insisting on documentation of procedures. These standards may then be used in science.[14]

The influence of military R&D on technological specifications is a more subtle influence than the direct influence on choice of technologies to produce. It is possible to delve into the intricate issues of how standards or the form of civilian technologies have been shaped by military influences. But whether such influences exist is less important than the obvious existence of weapons: technologies designed to kill or destroy. The choice to produce weapons is the key issue. Investigating subsequent influences on the form or application of related civilian technologies is an intriguing intellectual puzzle but is not central to the problem of technology in war.

Training and employment

Prior to World War II, most scientific research was carried out by individuals or small groups, with small budgets. The war and the massive military funding that accompanied and followed it led to science carried out on an industrial scale, with big funding, enormously expensive pieces of apparatus, large teams of workers, managerial systems and centralised control, with an associated dependence on wealthy patrons, usually the government. This system of "big science" is ideally designed to allow control over scientific agendas by state managers, among whom the military features prominently.[15]

Today, most scientists and technologists are full-time professionals working for government, industry or universities. To get to these positions, they first have to undergo a long period of study and apprenticeship. To obtain a research post with some degree of authority and influence in a field, the researcher must proceed successfully through high school, university, PhD studies and often postdoctoral employment. The employment situation and the training to get there have a big impact on the sort of work the researchers do.

Most scientific training promotes conformity to standard scientific ideas and methods. In school and university, students are seldom encouraged to question conventional ideas such as cell structure, quantum theory or bridge design. Most science teachers simply teach "the facts," including a set of methods for solving standard problems. They might want in principle to foster a more questioning approach, but in practice the syllabus is usually so filled with facts and skills that there is little time to do so. Students who are good at solving complex problems of the standard type—whether this is calculus or chemical analysis—are given the greatest encouragement through the system of assignments, examinations and grades. Those

who develop their own methods, or who question the point of the exercises, are seldom favoured, unless they are also extremely good at the standard approaches.

By the time students are ready to begin their research apprenticeship, they have imbibed the current scientific world view. Research then involves a certain breaking down of the textbook picture of science, exploring areas where answers are less predictable and encouraging limited challenges to orthodoxy.

Although scientific training promotes conventional orientations to science, a few individuals come through their education with unorthodox perspectives. However, it is most difficult to develop a career at variance with standard views, because there are few jobs that allow this. Most jobs in government and industry are for applied research and development, or in pure research very obviously related to applied areas. Researchers in government agriculture departments might study transport of chemicals in soils. Chemical companies are likely to employ researchers to develop more effective pesticides. University researchers typically have more freedom, but they often rely on industry or government for grants to obtain equipment and technical support. Setting off in a research direction divergent from the standard one is not an easy road.

The military influence comes in at this level. The military provides jobs for a vast number of scientists and engineers, perhaps one quarter or even one half worldwide. Although a few military-funded scientists are able to do "pure research," it is in areas of potential interest to the military, such as theoretical nuclear physics rather than sustainable agriculture.

The social location of most scientists and engineers who are *not* employed directly by the military is still quite convenient for military purposes. Most university and industry scientists and engineers are highly specialised in their training and work: they cannot readily switch from mechanical engineering to microbiology or vice versa. They are generally well-paid, see themselves as professionals and work among peers. As a group of workers who are mainly highly specialised, professionally oriented employees, most scientists and engineers are receptive to doing work where there is ample funding. They are trained and employed as technicians, namely to solve technical puzzles, and not to explore in depth who benefits and loses from their work. The funded research has to be in their field, so that their specialised skills can be brought to bear; it has to be sufficiently well funded, in keeping with their professional status; and it has to be recognised as acceptable by their peers.

The military can take advantage of this situation. Much military R&D requires highly specialised skills. The military has plenty of money to pay for research. Finally, military funding is acceptable to a good proportion of scientists and engineers. Most corporations are happy to have military funding, and so are most universities.[16] Most scientists and engineers are happy to accept whatever funding is available. There are also some who actively solicit military support, proposing projects that will appeal to military funders.[17]

Occasionally, though, there is opposition by scientists to military research. The most prominent case concerned the Strategic Defense Initiative (SDI), otherwise known as "star wars," promoted by the US government. SDI was announced in 1983 during a massive mobilisation of the peace movement, and was clearly an attempt to undermine opposition to US government and military agendas. Thousands of scientists, seeing SDI as a continuation of the arms race, refused to seek or accept funding for SDI projects.[18]

However, this was an exceptional case, and even so there were plenty of scientists who were quite willing to take money for SDI, often with the rationalisation that they would use the money for their own research purposes. Critics saw SDI as both technically infeasible and militarily provocative. Many of those who signed the pledge against receiving SDI funding were not opposed to military funding for research in areas not related to SDI; indeed,

many were seeking or in receipt of military funding.

As noted, SDI was an exception, linked to the strong antinuclear popular sentiment at the time. In most cases, there is no attempt at a boycott, and only a minority of scientists refuse military largesse on an individual level. For example, the cream of western physicists joined the Manhattan Project during World War II to produce the first nuclear weapons—of course with the honourable motivation of defeating an evil enemy—and there has been no shortage of scientists to produce hydrogen bombs, antipersonnel weapons and instruments of torture. When the Nazis took power in Germany in the 1930s, there was very little political resistance from the German physics community even though top scientists were dismissed and pressured to emigrate.[19]

Groups that might challenge military priorities in a fundamental fashion, such as peace movements, some churches, some trade unions and some political movements, seldom have the resources to fund scientific research, much less large-scale technological development. The technically trained labour force is mainly available to those groups that can afford to pay for it. The military is in an excellent position to do so. Even when scientists and engineers are working for industry and universities, or are unemployed, they provide a reserve labour force of experts of potential value for military purposes.[20]

Belief systems

Technology is shaped in various ways by systems of belief, or ideology to use another expression. At a basic level, it is necessary for a considerable number of people to believe in their society's superiority in order to justify killing members of other societies, either in defending against attack or in launching one. Underlying the existence of the military is the assumption that it is legitimate to use technology to defend a society by force, including these days mass killing of enemy soldiers and civilians. Technology is a means to achieve a widely shared aim.

Belief systems do not arise out of thin air. Education systems, cultural traditions, enforcement of ideological orthodoxy and a host of other mechanisms are involved. How beliefs influence technological development, and vice versa, is often hard to figure out. This topic is far too big to deal with fully here, so a few examples will have to suffice.

In the 1920s, most aeroplanes were made of wood but fully metal construction was heavily researched. The switch to metal aeroplanes occurred before there was much evidence of their superiority, arguably because of beliefs about science and progress. Metal symbolised both science and progress, hence far more effort was expended developing and justifying metal aeroplanes than improving wooden ones.[21]

During the Vietnam war, US planners conceptualised the war in terms of science, technology, bureaucracy and management. These were all areas in which the US was superior, hence defeat was unthinkable. The conceptualisation of the war as technological led to the deployment of sophisticated weapons, contributed to the enormous human and environmental impact of the war (two million Vietnamese deaths), and helped obscure the real reasons for US defeat.[22]

In the case of the Strategic Defense Initiative, there were massive military funding influences on scientific research, but just as important were ideological factors. The massive funding boom for star wars helped to draw corporations into service to the US military and to weaken opposition to US military policy, especially by promoting the idea that this was a "defence" system. Thus, although star wars never came close to achieving its technological ambitions, it "worked" in both economic and political senses.[23] On a wider scale, it can be argued that the US Cold War vision of global power on the basis of automated, centralised control both shaped the development of computers and was sustained

by both the technology and symbolism of computers.[24]

Suppression of challenges

Military funding, military applications and the training and employment of scientists and engineers are all influences that shape science and technology to be selectively useful for military purposes. Another influence operates in a different way, by negative rather than positive reinforcement: when a development occurs that challenges military priorities, it may be subject to attack. This process is not always straightforward, so it is worth looking at a few examples. In each of these cases, military influence is one among a number of influences on science and technology.

Lucas Aerospace is a large corporation based in the UK. Much of its work is for military contracts, specifically for aircraft. In the 1970s, workers at Lucas, concerned about loss of employment from declining military orders, developed an alternative corporate plan.[25] The alternative plan included a number of products that could be produced with the facilities and skills available at Lucas, but which were designed to serve "human needs" such as mass transit or mobility of disabled people. Note that the workers distinguished "human needs" from military contracts.

The management of Lucas consistently refused to accept any of the workers' proposals, insisting on managerial prerogatives, and rejecting even those alternatives that were projected to make a profit. This stance by Lucas management was not taken at the behest of the military, but it certainly served military ends (as well as maintaining managerial control). If initiatives such as those by the Lucas workers had been successful and imitated widely, they might have been a threat to the usual acquiescent role taken by industry in fulfilling military orders, and also a threat to the achievement of military priorities for technological development.

In the 1980s, the US National Security Agency (NSA) attempted to put controls on mathematical research in cryptography, the study of codes. Before publication, cryptography research was expected to be cleared through the NSA.[26] In the 1990s, the NSA developed a cryptography system—including a computer chip, the "Clipper chip," and an encryption algorithm, "Skipjack"—that would allow government agencies to read messages under certain conditions. Most computer network users strongly preferred encryption systems—of which a number were available—that could not be easily cracked by anyone. The US government banned export of encryption systems while promoting the Clipper chip. The primary stated justification for the Clipper chip was monitoring of criminals, but the role of the NSA showed the importance of military priorities. In this case, the alternative, a market of encryption systems useful for commercial or private purposes, was opposed by military interests.[27]

Another example is nuclear technology, in which military and civilian applications have long overlapped. Nuclear power, inasmuch as it is perceived to be a civilian technology, helps to legitimate nuclear technology generally, including nuclear weapons. There are many cases of critics of nuclear power—especially scientists and engineers—who have been reprimanded, transferred, harassed, slandered and dismissed.[28] Another dimension to this issue is the attack on alternatives to nuclear power, such as cutbacks on funding for solar energy.[29]

There are not so many examples of attacks on critics within nuclear weapons programmes, probably because few weapons scientists are in a position to dissent openly and still have any chance of retaining their jobs. Andre Sakharov in the Soviet Union was a prominent critic who was sent into internal exile as a result. In the United States, Hugh DeWitt, a theoretical physicist at Lawrence Livermore National Laboratory where nuclear weapons are designed, has spoken out against government weapons policies and come under attack within the lab several times as a result. The impor-

tance of such cases is not so much their effect on the individual dissidents, but the example provided to others who might otherwise have considered speaking out themselves. Even a few cases of this sort send a strong message that it is much safer to work on the job as it is defined from above.[30] In this way, conformity to military priorities is maintained.

Countervailing influences

Military shaping of technology is not all-powerful, otherwise every technology would be oriented to military purposes and we would all be wearing combat boots and living in fallout shelters. It is worth outlining the main influences that resist or challenge military priorities for science and technology, namely civilian applications, bureaucratic interests and popular resistance.

Civilian applications

This is undoubtedly the greatest influence, covering as it does influences from a host of other factors from basic needs such as food and housing to commerce and culture (including art). Civilian interest groups, including corporations, governments and consumers, usually want technologies to serve their immediate purposes. In capitalist societies, cost in the market is a key consideration. This explains, for example, why most industries are not designed to withstand a military attack. (Only in a few countries, such as Iraq, Sweden and Switzerland, are some factories built underground or otherwise designed with military threats in mind.) In most countries, there are few stockpiles of food, goods or strategic minerals beyond what is dictated by the search for profits. Most road and rail systems are designed primarily for civilian purposes.

Military influences do have some influences on all these areas, but civilian influences are usually much greater. Military influence on technology is greatest in areas where there is little civilian interest, such as missiles.

Bureaucratic interests

Within the military and within military industries, officers, soldiers, managers and workers have jobs, status, authority, routines, standard ways of thinking, and emotional commitments. In other words, the current way of doing things is a way of life. Changes in technology also introduce the prospect of social changes. These social changes are likely to be welcomed by some and opposed by others, in ways that don't necessarily correlate with military efficiency. In other words, vested interests within various bureaucracies constitute one influence on technological development.

Sometimes the main vested interest can be called conservatism, since it manifests itself as resistance to new technologies. For example, around 1900, when the new method of continuous-aim firing from ships was proposed, bureaucrats within the US Navy at first ignored and then did everything possible to discredit the method and delay its introduction, in spite of the fact that it was vastly superior to the existing method. The reason for the resistance was that the new method entailed changes in the organisation of tasks on board: it changed the arrangements in naval society.[31]

The introduction of the machine gun provides another example of military conservatism. It was vastly more effective than rifles and, because of this, threatened to make obsolete the traditional training and tactics based on beliefs in the importance of courage and quality of troops. Plentiful evidence was available of the superiority of the machine gun in various colonial wars, but these victories were attributed to white superiority over native peoples rather than to technological superiority. As a result, the implications of the machine gun for warfare were not grasped and integrated into military organisations and planning until well into World War I, when the suicidal implications of infantry attacks on positions defended by machine guns eventually became clear. Even in this situation, hundreds of thousands of soldiers were killed before

commanders were willing to recognise the failure of standard methods.[32]

Another example is the US-produced M-16 rifle, which was the result of prolonged bureaucratic manipulation. Another rifle had been developed, the AR-15, which attained a high reputation among soldiers. However, Eugene Stoner, the designer of the AR-15, worked outside the Army's arsenal system, and thus this rifle was a threat to the bureaucratic status quo. The AR-15 was subject to numerous design changes imposed by rigid specifications, many of which were irrelevant to practical conditions, such as performing in freezing temperatures. The design changes led to the M-16, which was much heavier, inconvenient and failure-prone, and led to more deaths in action. Soldiers who were aware of the problems with the M-16 wrote to their parents who in turn put pressure on Congress. As a result, the sabotage of the AR-15 was exposed in hearings of Congress.[33]

These examples are distinctive because strong bureaucratic interests favoured a clearly inferior technology for the purposes of warfare. However, bureaucratic interests are present at all times, and on many occasions they favour superior technology. This means that the adoption of a technology, whether technically superior or inferior, may have occurred in part because of bureaucratic considerations.

More generally, it is a reasonable assumption that military leaders will not voluntarily adopt any technology that undermines the need or rationale for their existence. As will be discussed later, even when nonviolent methods of struggle are superior in terms of reducing the threat from an enemy, militaries favour military methods. Military strength creates its own necessity, by posing a threat to other societies and stimulating military races.

Without actual war, military technologies would not need to be efficient for warfare, but could serve other functions, such as maintaining current bureaucratic systems, creating profits for industry and providing symbols of power and masculinity. During the Cold War, it has been argued, western military weaponry became more and more "baroque," namely excessively expensive and complicated and hence not likely to be particularly effective.[34] The Cold War confrontation provided the justification for massive military expenditures, but there was no practical testing of weapons designed for war between major industrial powers.

Popular resistance

Another key factor in technological development for the military is the unwillingness of people to support certain methods of fighting. "People" here includes civilians, politicians, soldiers, military commanders and engineers.

The role of civilians has been considerable. Peace movements have campaigned against various sorts of weapons and, in some cases, against any form of organised violence. There have been campaigns against nuclear, biological, chemical and antipersonnel weapons, among others. In many cases these campaigns are supported by government leaders. The results can be seen in the limited use of biological, chemical and nuclear weapons in warfare and in treaties against these weapons. The popular revulsion against certain types of weapons and warfare is a powerful factor. But this popular revulsion is subject to change. Before World War II, aerial bombing was thought to be totally outrageous; the 1937 bombing of Guernica by the German-supported fascists in Spain generated intense anguish. Yet aerial bombing was adopted by both sides in World War II. Through a gradual process of expansion from military to civilian targets, aerial bombing became a much more "acceptable" method of warfare. In the future, it is quite possible that biological, chemical or nuclear warfare may become seen as standard procedure, most likely as a result of all-out war. Many people have worked and continue to work to ensure that this does not occur, through publicity, international law, and destruction of stocks of weapons.

Soldiers and officers also have ideas about what is acceptable in warfare, and these ideas have an important impact on technological development. In previous centuries, armies faced each other in set-piece confrontations, in ways that, by present-day standards, seem incredibly restrained. Then, relatively few civilians were killed; technologies were designed mainly for killing soldiers. Today, many more civilians are killed in wars than soldiers; weapons of mass destruction are designed for this purpose.

Most people are highly reluctant to hurt others. Soldiers have to be trained to kill, especially when the enemy is confronted face-to-face. There is evidence that most front-line soldiers in World War II and other wars did not fire their rifles, and that many of those who did fire intended to miss. In many countries, armies cannot be filled by volunteers; conscription is needed. Technological development has made it easier to kill at a distance, without recognising the enemy as a person. Engineers who design bombers and pilots who fly them can maintain a psychological distance from the people who are being attacked. It is possible to see much of modern weapons development as a response to a pressure to use fewer people in fighting and to reduce the need for face-to-face combat. In this way, the repulsion most people feel towards killing is sidestepped. Another way to overcome this repulsion is to train soldiers using highly realistic simulations so that responses become automatic. This has been done increasingly in the US military since World War II, with correspondingly greater psychological impacts on those soldiers who engage in "intimate" killing, such as in the Vietnam war.[35]

With modern poisons and other small weapons, it is now possible for one individual behind enemy lines—especially an agent who has joined the other side's armed forces—to be more potent than a whole battalion of front-line soldiers. By planting poisons in water supplies or in the food of individuals or by just slitting throats, one agent could kill hundreds of soldiers and cause a crisis in morale. Technological developments could aid such an approach to warfare. But this has not been a major R&D focus compared to conventional weapons. One reason is that it would be difficult to recruit soldiers to undertake this sort of killing. Also, if adopted by both sides, it would be a threat to the military command, since agents would target officers who, in conventional warfare, are least likely to be killed.

Taking into account these various countervailing influences, it is possible to present a more complicated picture of military shaping of science and technology. Figure 3 shows some of the influences and some of the connections.

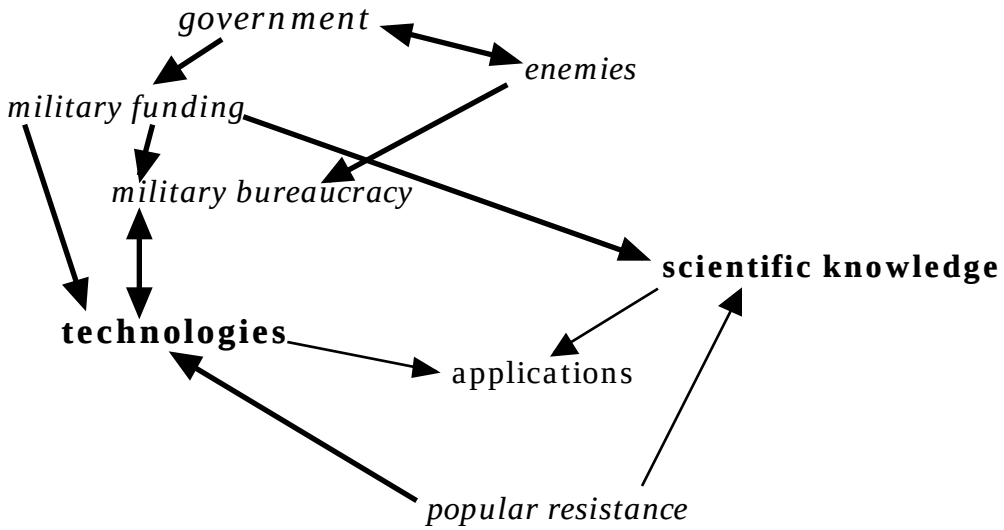

Figure 3. *A model of military shaping showing a variety of specific influences on science and technology.*

Deeper links

So far in this discussion of military influences on the development and use of technologies, it has been assumed that the purpose of the military is simply to defend societies against aggression. This is the usual picture drawn by militaries and governments and widely believed by members of the public. But there is another viewpoint: that the military is tied in fundamental ways to social structures, especially the state, capitalism, bureaucracy and patriarchy. In this picture, the military both supports and is supported by these structures. This has implications for understanding military-related technology.

Only occasionally are contemporary military forces used to engage in combat against military forces of another country. It is actually much more common for a country's military to be used against the people of the country itself, most obviously in military dictatorships. This suggests that militaries have as much to do with social control—in the interests of certain groups in a society—as with defence against foreign threats. At the global level, military forces and alliances such as NATO serve to protect dominant groups from challenge. For example, NATO troops help to sustain global economic inequality.

The state, in a sociological sense, can be defined as a community based on a monopoly over organised violence within a territory, this violence being considered "legitimate" by the state itself.[36] In modern societies, organised violence is only considered legitimate when exercised by the police or the military. The state is more commonly thought of as being composed of the government (including national and local officials), government bureaucracies, the legal system, the military, and government-run operations such as schools. The state maintains itself financially mainly through taxes, administers services and regulations through government bureaucracies, and maintains order through the police and the legal system. In any major challenge to the system—such as refusal to pay taxes—the police and, if necessary, the military are available to maintain state power. War is a primary impetus behind the rise of the state. Indeed, war-making and state-making are mutually reinforcing.[37]

The state must defend against external threats, to be sure, but internal threats are more frequent and more complex. Most contemporary states administer unequal societies, with wealth, status and privilege distributed very unevenly, usually accompanied by systematic methods to maintain this inequality, such as class structure and sexual and ethnic discrimination. The pervasive injustice of societies stimulates challenges to the status quo. In societies with representative governments, the usual methods of social control are schooling, manipulation of perception through the mass media, systems of legitimacy such as parliaments and courts, and the economic system. But when these systems are not sufficient to protect the interests of dominant groups, the police and the military may be deployed, for example to arrest demonstrators or break strikes.

During the cold war, the superpowers could justify their massive arsenals by pointing to the threat posed by the enemy. The cold war is over but military spending, though somewhat cut back, continues at a very high rate. It has been widely remarked by commentators that the US Department of Defense and spy agencies have been desperately searching for new legitimations for their existence—favourite rationales are "rogue states," terrorism and the drug trade. The lack of an overt justification for a continuing military megamachine provides added weight to explanations referring to the military's role in maintaining systems of inequality.

The links between the military and the state also have implications for technology. A large proportion of funding for R&D comes from the state. This includes many nominally civilian areas, such as transport systems, communications, sewerage, energy and industry. Planners

within the state are likely to prefer technological systems that ensure continuation of state power.

For example, central provision of energy, through oil and natural gas supplies and through electricity produced at large power stations, is ideally suited for allowing state control or regulation. Taxes can easily be imposed on such energy operations, since consumers must obtain their energy from a few large suppliers. Contrast this with a community in which building design eliminates the need for most energy for heating, town planning allows most people to walk or ride bicycles, and small local enterprises provide for energy from the sun, wind and biofuels. With such a community, there is much less need for strong state intervention. The energy system is low risk: there is no hazard from nuclear reactor accidents, large oil spills, or sabotage of electricity generating plants. There is less dependence on external supplies, and hence resource control—and struggles over this control—is not so vital an issue. There is no great need for heavy investment in automobile manufacture or freeway construction, and hence less need for central regulation or funding in these sorts of areas. Because the community is largely self-sufficient in energy, there is less justification for taxing the energy sector.[38]

As will be discussed in chapter 6, the conventional high-energy-use system, with its high risks, high vulnerability to disruption and large economic investments, also makes it a target for military attack. Thus, military forces are needed to defend such a system. By contrast, the low-energy self-reliant system has much less need for military defence.[39] This example shows the mutually consistent and reinforcing roles of the state and the military. The energy system that provides a convenient vehicle for state intervention and extraction of resources (taxes) for the state is also one that requires and justifies the military. Part of the state's extraction of resources is to provide energy supplies for the military itself. Centralised provision of energy is convenient for this purpose. By contrast, a system built around energy efficiency, solar heaters and town planning to reduce transport doesn't provide much scope for supporting an energy-hungry military.

From the point of view of the state, the traditional dichotomies between "peace" and "war" and between "civil" and "military" are increasingly irrelevant. The military capacity of a state depends on systems of education and training, R&D and industry, all ostensibly "civil" arenas. Especially since World War II, the states of industrial societies have pursued policies concerning knowledge and production that lay the basis for technological warfare.[40]

Monopoly capitalism—built around large corporations with active intervention by the state in support of these corporations—favours technologies that also tend to be useful for the military. The automobile industry is an example. A transport system based on large production plants is relatively easy to adapt for military purposes. This is partly because the plants can be converted to produce military goods, but more because the plants are controlled by a few people through large corporate bureaucracies. This organisational structure is easily influenced to serve military ends, either through military contracts or through direct administration in wartime.[41] By contrast, a production system based on smaller enterprises producing more bicycles and fewer heavy vehicles, with a great deal of worker control, is less subject to central control either by capitalists or military administrators.

The economic system commonly called communism—but better described as state socialism, bureaucratic socialism or state capitalism—serves military imperatives even more directly and easily than monopoly capitalism.[42] In the case of both capitalism and state socialism, the large scale of production, the role of the state in regulation and the system of bureaucratic management of enterprises all favour technological systems that are compatible with military purposes.

Similar considerations apply to the role of bureaucracy, which can be defined as a way of organising work built around the principle that workers are replaceable cogs.[43] Bureaucracies are hierarchical, based on a division of labour and operate using standardised procedures. Most government bodies are organised as bureaucracies, but so are large corporations, political parties, churches, trade unions and many other organisations. The military is perhaps the ultimate in bureaucracies, with its rigid hierarchy (the ranks) and system of command. Bureaucracy is the basic organising principle of the state, monopoly capitalism and the military. The technological systems favoured by bureaucratic elites are ones that ensure them a continuing role and position of power. They tend to favour large systems requiring centralised control, such as centralised welfare systems and large hospitals. The previous examples of transport and energy illustrate the interests of bureaucratic elites.

Yet another important social structure linked to the military is patriarchy, the organised social domination of men over women. Patriarchy is a pervasive set of relationships, including male violence against women, control over reproductive choice, discrimination in employment, devaluation of child rearing, different social expectations for men and women, and many other dimensions. It is possible to argue that any system of unequal power, such as systems of central government and corporate management, are patriarchal in themselves; in any case, they are highly compatible with patriarchy, since men control most of the elite positions and regularly use their positions to maintain male privilege.

Militaries are notoriously patriarchal.[44] Most soldiers and almost all top commanders are men, and most military forces strongly denigrate human characteristics that are considered feminine. On the other hand, militaries are designed for fighting against other men. Women are victims, to be sure, both as civilian casualties and through being raped in wartime and within the military itself. But, it may be argued, the function of patriarchy is to allow some men to dominate other men (as well as women). If men are mobilised to defend male privilege and male identity against women, it becomes easier to maintain the role of elites (who are mostly men).

The overt influence of patriarchy on science and technology can be found in a number of areas, such as reproductive technologies and theories of brain lateralisation. In terms of military technology, though, perhaps the greatest—if rather diffuse—influence is the built-in preference for violence and technology, which goes to the core of the military role in society. Violence is commonly associated with masculinity, whereas nonviolence is seen as stereotypically feminine. (This helps explain the common but quite false presumption that nonviolence means being passive.) Also, it is a characteristically masculine trait to be unemotional and aloof. Technology that allows killing at a distance thus meshes with a common conception of masculinity.

In recent decades, traditional forms of male domination in the military have come under threat as women seek equality within the armed services in some countries. Furthermore, some military women—seeing themselves as feminists—argue that they bring a different sensibility to the military role, with their greater ability to relate to local people, especially women, in UN intervention missions. This suggests that the conventional picture of militaries as composed of men exhibiting a traditional masculinity may no longer be adequate.[45] Women can adopt masculine values and men can adopt feminine values, and both types of values can be expressed in either positive or damaging ways. Thus, women can enter the military with the aim of making it less oppressive, but at the risk of themselves becoming acculturated to the military ethos of competitiveness, hierarchy, domination and violence. This struggle between military and feminist values will also be played out in struggles over choices and uses of military technology.

This discussion of deep links between the military and the state, capitalism, bureaucracy and patriarchy, and implications for science and technology, has only introduced a few ideas from a topic with many dimensions.[46] The issues are complex and seldom addressed. Nevertheless, a few key points are worth stating again. The military and military-inspired technology are not designed just for defence against foreign enemies, but are more centrally involved in maintaining social control. This control is at the service of the state, of economic elites (in today's societies, most commonly capitalists), of elite bureaucrats, and of the system of male domination. Understanding the shaping of science and technology for military purposes thus is not a simple undertaking, since it ultimately involves analysis of all social institutions. A possible picture is given in figure 4. Although this figure encompasses more of the processes involved, its vagueness reduces its usefulness. For many purposes figure 1, for example, is more helpful. Models should be chosen because of their value in providing insight, and sometimes simple—and hence inaccurate or incomplete—models are more helpful.[47]

In this chapter I have focussed on military influences on and uses of technology. Another perspective is that technology is shaped more generally by the structures of the state, capitalism, patriarchy, etc., with which the military is largely compatible. So even without a direct military influence, technology might still be "militarised"—oriented to military purposes—to a considerable extent. This model is compatible with figure 4. I'm not sure whether it is a better way to understand what's going on.

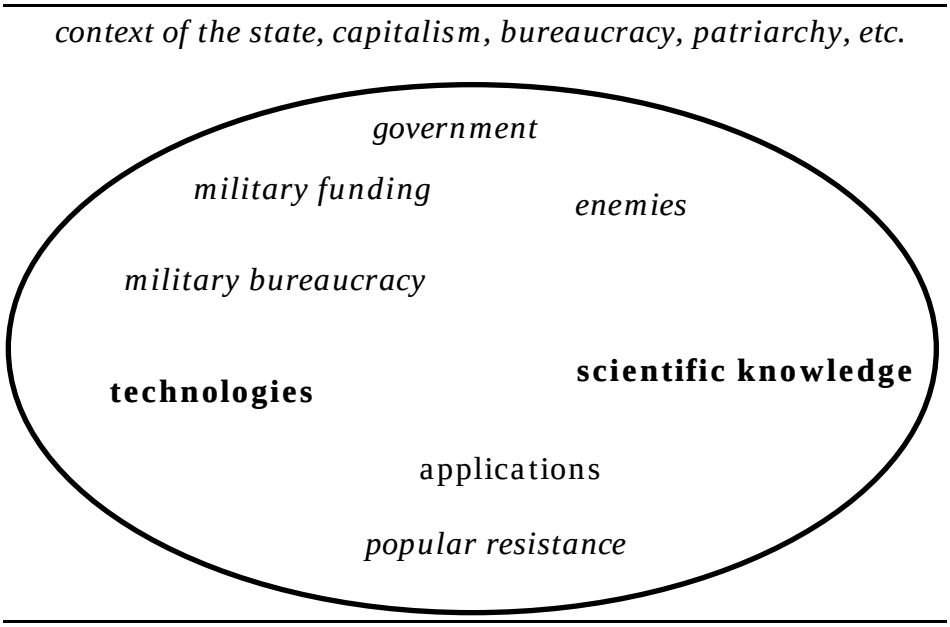

Figure 4. *A model of military shaping showing a variety of specific influences on science and technology in the context of social structures. There are no arrows because the various items are mixed together in a "soup" of mutual interactions.*

Notes

1. Theories of technology are discussed in the appendix. The general model adopted here is that military and other social factors influence but do not determine technology, and that any specific technology is easier to use for some purposes than others.

2. General treatments of the influence of the military on science and technology include J. D. Bernal, *The Social Function of Science* (London: George Routledge & Sons, 1939), chapter VII; Robin Clarke, *The Science of War and Peace* (London: Jonathan Cape, 1971); Paul Dickson, *The Electronic Battlefield* (Bloomington: Indiana University Press, 1976); Everett Mendelsohn, "Science, technology and the military: patterns of interaction," in Jean-Jacques Salomon (ed.), *Science War and Peace* (Paris: Economica, 1990), pp. 49-70; Everett H. Mendelsohn, Merritt Roe Smith and Peter Weingart (eds.), *Science, Technology and the Military* (Dordrecht: Kluwer, 1988); Robert K. Merton, *Science, Technology and Society in Seventeenth Century England* (New York: Howard Fertig, 1970 [1938]); John U. Nef, *War and Human Progress: An Essay on the Rise of Industrial Civilization* (London: Routledge & Kegan Paul, 1950); Merritt Roe Smith (ed.), *Military Enterprise and Technological Change: Perspectives on the American Experience* (Cambridge, MA: MIT Press, 1985). References to specific areas are given later. On arms production and trade, see William W. Keller, *Arm in Arm: The Political Economy of the Global Arms Trade* (New York: HarperCollins, 1995); Keith Krause, *Arms and the State: Patterns of Military Production and Trade* (Cambridge: Cambridge University Press, 1992).

3. See for example Matthew Evangelista, *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies* (Ithaca, NY: Cornell University Press, 1988); Wim A. Smit, John Grin and Lev Voronkov (eds.), *Military Technological Innovation and Stability in a Changing World: Politically Assessing and Influencing Weapon Innovation and Military Research and Development* (Amsterdam: VU University Press, 1992).

4. Janet Abbate, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999); Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: MIT Press, 1996); Paul Forman, "Behind quantum electronics: national security as basis for physical research in the United States, 1940-1960," *Historical Studies in the Physical and Biological Sciences*, Vol. 18, No. 1, 1987, pp. 149-229; Brian Martin, "Computing and war," *Peace and Change*, Vol. 14, No. 2, April 1989, pp. 203-222.

5. Donald MacKenzie, "The influence of the Los Alamos and Livermore National Laboratories on the development of supercomputing," *Annals of the History of Computing*, Vol. 13, No. 2, 1991, pp. 179-201.

6. Robert DeGrasse, "The military and semiconductors," in John Tirman (ed.), *The Militarization of High Technology* (Cambridge, MA: Ballinger, 1984), pp. 77-104.

7. Donald MacKenzie and Graham Spinardi, "The technological impact of a defence research establishment," in Richard Coopey, Matthew R. H. Uttley and Graham Spinardi (eds.), *Defence Science and Technology: Adjusting to Change* (Chur, Switzerland: Harwood Academic Publishers, 1993), pp. 85-124.

8. John H. Perkins, "Reshaping technology in wartime: the effect of military goals on entomological research and insect-control practices," *Technology and Culture*, Vol. 19, No. 2, April 1978, pp. 169-186.

9. Christopher Simpson, *Science of Coercion: Communication Research and Psychological Warfare 1945-1960* (New York: Oxford University Press, 1994). I thank Mary Cawte for drawing this book to my attention.

10. Douglas D. Noble, *The Classroom Arsenal: Military Research, Information Technology, and Public Education* (London: Falmer Press, 1991).

11. Susan Wright and Stuart Ketcham, "The problem of interpreting the U.S. biological defense research program," in Susan Wright (ed.), *Preventing a Biological Arms Race* (Cambridge, MA: MIT Press, 1990), pp. 169-196.

12. Mark Diesendorf, "On being a dissident scientist," *Ockham's Razor 2* (Sydney: Australian Broadcasting Corporation, 1988), pp. 9-14, at p. 10.

13. Quoted in Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993), p. 238.

14. Joseph O'Connell, "Metrology: the creation of universality by the circulation of

particulars," *Social Studies of Science*, Vol. 23, No. 1, February 1993, pp. 129-173. Andreas Speck gives the additional example that standards for German roads and airport runways—such as the width and the strength of the base—are set by military criteria.

15. Daniel S. Greenberg, *The Politics of Pure Science* (New York: New American Library, 1971); Gregory McLauchlan, "The advent of nuclear weapons and the formation of the scientific-military-industrial complex in World War II," in Gregg B. Walker, David A. Bella and Steven J. Sprecher (eds.), *The Military-Industrial Complex: Eisenhower's Warning Three Decades Later* (New York: Peter Lang, 1992), pp. 101-127.

16. On university-military links, see *Annals of the American Academy of Political and Social Sciences*, Vol. 502, March 1989; David Dickson, *The New Politics of Science* (New York: Pantheon, 1984), chapter 3; Jonathan Feldman, *Universities in the Business of Repression: The Academic-Military-Industrial Complex and Central America* (Boston: South End Press, 1989); Daniel S. Greenberg, *The Politics of Pure Science* (New York: New American Library, 1971); Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993); Christopher Simpson (ed.), *Universities and Empire: Money and Politics in the Social Sciences During the Cold War* (New York: New Press, 1998); Clark Thomborson, "Role of military funding in academic computer science," in David Bellin and Gary Chapman (eds.), *Computers in Battle—Will They Work?* (Boston: Harcourt Brace Jovanovich, 1987), pp. 283-296.

17. Bruno Vitale, "Scientists as military hustlers," in *Issues in Radical Science* (London: Free Association Books, 1985), pp. 73-87.

18. David Cortright, *Peace Works: The Citizen's Role in Ending the Cold War* (Boulder: Westview Press, 1993), pp. 179-186; Steve Nadis, "After the boycott: how scientists are stopping SDI," *Science for the People*, No. 20, January-February 1988, pp. 21-26.

19. Alan D. Beyerchen, *Scientists under Hitler: Politics and the Physics Community in the Third Reich* (New Haven, CT: Yale University Press, 1977). I thank Mary Cawte for mentioning this reference.

20. On scientists as a reserve labour force see Chandra Mukerji, *A Fragile Power: Scientists and the State* (Princeton, NJ: Princeton University Press, 1989).

21. Eric Schatzberg, "Ideology and technical choice: the decline of the wooden airplane in the United States, 1920-1945," *Technology and Culture*, Vol. 35, No. 1, January 1994, p. 34-69.

22. James William Gibson, *The Perfect War: Technowar in Vietnam* (Boston: Atlantic Monthly Press, 1986).

23. Vincent Mosco, "The military information society and 'star wars'," in *The Pay-Per Society: Computers and Communication in the Information Age* (Toronto: Garamond, 1989), pp. 131-172, also published in revised form as "Strategic offence: star wars as military hegemony," in Les Levidow and Kevin Robins (eds.), *Cyborg Worlds: The Military Information Society* (London: Free Association Books, 1989), pp. 87-112.

24. Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: MIT Press, 1996).

25. Hilary Wainwright and Dave Elliott, *The Lucas Plan: A New Trade Unionism in the Making?* (London: Allison and Busby, 1982).

26. David Dickson, *The New Politics of Science* (New York: Pantheon, 1984), pp. 141-145.

27. Lance J. Hoffman (ed.), *Building in Big Brother: The Cryptographic Policy Debate* (New York: Springer-Verlag, 1995).

28. Leslie J. Freeman, *Nuclear Witnesses* (New York: Norton, 1981); Brian Martin, "Nuclear suppression," *Science and Public Policy*, Vol. 13, No. 6, December 1986, pp. 312-320.

29. Daniel M. Berman and John T. O'Connor, *Who Owns the Sun? People, Politics, and the Struggle for a Solar Economy* (White River Junction, Vermont: Chelsea Green, 1996); Ray Reece, *The Sun Betrayed: A Report on the Corporate Seizure of U.S. Solar Energy Development* (Boston: South End Press, 1979).

30. Brian Martin, "Suppression of dissent in science," *Research in Social Problems and Public Policy*, Vol. 7, 1999, pp. 105-135.

31. Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge, MA: MIT Press, 1966), chapter 2.

32. John Ellis, *The Social History of the Machine Gun* (London: Croom Helm, 1975).

33. James Fallows, "The American Army and the M-16 rifle," in Donald MacKenzie and Judy Wajcman (eds.), *The Social Shaping of Technology*

(Milton Keynes: Open University Press, 1985), pp. 239-251.

34. Mary Kaldor, *The Baroque Arsenal* (London: Andre Deutsch, 1982).

35. Dave Grossman, *On Killing: The Psychological Cost of Learning to Kill in War and Society* (Boston: Little, Brown, 1995).

36. There is a large amount of writing about various forces that have weakened the power of the state, including transnational corporations, international organisations and social movements. Undoubtedly the state is no longer hegemonic, if it ever was. When it comes to examining the military, the state remains the dominant influence, but there is an increasing role being played by mercenaries, militias and international "peacekeeping" forces. Mary Kaldor, *New and Old Wars: Organized Violence in a Global Era* (Cambridge: Polity Press, 1999) provides an insightful analysis of the recent transformation of war from state-based invasion-and-defence mode to a postmodern form with state, paramilitary, criminal and international actors involved in a mixture of war, organised crime and mass human rights violations.

37. On the state and the military, see Ekkehart Krippendorff, *Staat und Krieg: Die Historische Logik Politischer Unvernunft* (Frankfurt: Suhrkamp, 1985), as reviewed by Johan Galtung, "The state, the military and war," *Journal of Peace Research*, Vol. 26, No. 1, 1989, pp. 101-105 (I thank Mary Cawte for this reference); Bruce D. Porter, *War and the Rise of the State: The Military Foundations of Modern Politics* (New York: Free Press, 1994); Charles Tilly, *Coercion, Capital, and European States, AD 990-1992* (Cambridge MA: Blackwell, 1992). For the case of the US, see Gregory Hooks, *Forging the Military-Industrial Complex: World War II's Battle of the Potomac* (Urbana: University of Illinois Press, 1991).

38. Andreas Speck notes that an alternative interpretation is that centralised energy systems are more a result of capitalist interests, with big companies using their control to keep competitors small and dependent.

39. A self-reliant system is much more useful in an actual war, since it cannot be destroyed as easily. The point here is that centralised systems, through their very vulnerability, provide a stronger *justification* for military defence.

40. Maurice Pearton, *The Knowledgeable State: Diplomacy, War and Technology since 1830* (London: Burnett Books, 1982).

41. For a nice treatment of different relationships between the state and war industry in the United States, see Gregory Hooks and Gregory McLauchlan, "The institutional foundations of warmaking: three eras of U.S. warmaking, 1939-1989," *Theory and Society*, Vol. 21, 1992, pp. 757-788.

42. See for example Carl Gustav Jacobsen, "Arms Build-ups under Socialism: The USSR and China," in N. P. Gleditsch and O. Njølstad, (eds.), *Arms Races: Technological and Political Dynamics* (London: Sage, 1990), pp. 285-294.

43. Fred Emery (personal communication) provided this convenient encapsulation of bureaucracy.

44. Cynthia Enloe, *Does Khaki Become You? The Militarisation of Women's Lives* (London: Pluto, 1983); Cynthia Enloe, *The Morning After: Sexual Politics at the End of the Cold War* (Berkeley: University of California Press, 1993); Betty Reardon, *Sexism and the War System* (New York: Teachers College Press, 1985); Jeanne Vickers, *Women and War* (London: Zed Books, 1993). On challenging this situation, see Birgit Brock-Utne, *Educating for Peace: A Feminist Perspective* (New York: Pergamon, 1985).

45. I thank Ellen Elster for suggesting these points.

46. Brian Martin, *Uprooting War* (London: Freedom Press, 1984). It is possible to go further and argue that science and technology have always been linked with warfare and that this connection is integral in western societies. See, for example, Jacques Grinevald, "The greening of Europe," *Bulletin of Peace Proposals*, Vol. 22, No. 1, 1991, pp. 41-47. I thank Mary Cawte for finding this reference.

47. Models are always simplifications of the object or situation modelled, and hence inaccurate and incomplete to a greater or lesser degree. Simple models usually are easier to understand and work with. The question is, which simplications should be made? See Brian Martin, *Information Liberation* (London: Freedom Press, 1998), chapter 8.

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Chapter 3

Nonviolent struggle

Having looked at militarised technology, it is intriguing to ask, "what would technology be like if it was motivated by an entirely different goal?" There are, of course, many possible nonmilitary goals. The relevant one here is nonviolent struggle.

To many people it may seem that military weapons are so sophisticated and powerful that it would be impossible to stop them except by other weapons. This line of thought is sensible so far as the weapons are concerned. Its flaw is that weapons do not operate themselves.[1]

To win a battle or a war, humans must cooperate. To begin, victory requires that "the enemy" stops resisting. The enemy army may be defeated and disarmed, but the population can continue resisting. What then? The people can simply be killed until they agree to cooperate. If they continue to resist, then all of them can be killed. End of story. In reality, populations do cooperate, at least to some degree, well before total extermination.

But there is another sort of cooperation required: cooperation by the commanders, soldiers and civilians in the victorious power. It is impossible to continue to kill "the enemy" if no one agrees to do it. This is where nonviolent action comes in. It works, in part, by promoting noncooperation.

Methods of nonviolent action include petitions, slogans, rallies, marches, strikes, boycotts, fasts, sit-ins, setting up alternative institutions, and many others. Any method not involving physical violence is a possibility. Nonviolent action can be used by workers seeking higher pay, women opposing male violence or local citizens opposing a freeway. When nonviolent action is used systematically to obtain a particular objective, such as stopping arms shipments to a country or opposing racial harassment, this will be called nonviolent struggle or a nonviolent campaign.

As the term "nonviolent action" suggests, the emphasis is on action, not passivity. But the action has to be nonviolent, meaning that it does not cause physical harm to others.[2] Violent actions include imprisonment, beatings, maiming, torture and killing.

Like any distinction, the distinction between violence and nonviolence is not always clear-cut. What about violence against property, such as sabotage? What about "emotional violence"? What about self-immolation? What about a nonviolent technique that leads to physical harm, such as a strike by maintenance workers that leads to people being hurt in accidents? These and other issues have been and need to be debated, since the answers derive as much from social values as from logic. In any case, the main distinction is clear enough. Military methods are based centrally on threatening and using violence against people and property. Nonviolent methods are built on refusing to cooperate without causing physical harm to others.

All the available evidence shows that human beings have no instinctual urge to physically harm other people.[3] Indeed, cooperation is much more "natural" than competition.[4] Without day-to-day cooperation, what is called society would be impossible.

Military forces have to work hard to get over the natural resistance that humans have against killing each other. Most people do not want to join armies, hence the need to promote nationalistic fervour and, if necessary,

introduce conscription, especially in wartime. To get a person to kill on command—as is required in armies—requires extensive training. To prevent soldiers from fleeing in the face of battle, stiff penalties, including summary execution, are used.

As the standard of living rises, people are less and less willing to be conscripted, and many armies are becoming fully professional.[5] In this situation, the main motivation for joining up is no longer compulsion, patriotism or peer pressure, but jobs and careers. When most of those who join do so because they are unable to obtain other jobs, this can be called "economic conscription."

Another factor is that most members of high-technology armed forces do not engage in face-to-face combat. The vast majority remain behind the lines as planners, mechanics, cooks, accountants and the like. Even many of those who are on the "front line," such as pilots and tank drivers, do not see the eyeballs of those they are trying to defeat. Killing is much easier at a distance.[6]

On the front line, soldiers may kill because they have been trained to do so, to protect their buddies, to maintain their self-image or out of fear of being killed themselves. Dehumanisation and hatred of the enemy make this easier. They also make it easier to rally civilians behind the military effort. Commanders—both politicians and military chiefs—regularly create fear about the danger from the enemy. Aggression by the "other side" is used as a justification for retaliation, even if the "retaliation" is vastly disproportionate to what preceded it. German Führer Adolf Hitler, in justifying the invasion of Poland in 1939, created a fabricated attack by Polish troops. US President Lyndon Johnson in 1964 used the alleged Tonkin Gulf incident in Vietnam as the excuse for a massive mobilisation of US troops.

These examples illustrate that violence often provides the justification for counterviolence. When one group or one country uses violence, the other side feels justified in using violence in return, thereby justifying the original violence. This process is behind the familiar idea of military races. In the case of violence, the principle of fighting fire with fire simply leads to a bigger fire.

Nonviolent action challenges and undermines the cycle of violence. If one side in a struggle renounces violence, then soldiers on the other side need not fear for their lives. As well, the justification for violence is greatly weakened. This means that it becomes much harder for the commanders on the side still authorising the use of violence to actually get soldiers to obey orders to use it.

One of the most famous uses of nonviolent action was the struggle for independence of India from Great Britain, waged under the leadership of Mohandas K. Gandhi. This struggle went on for several decades until independence was achieved in 1947. Some of the methods used were rallies, marches, boycotts of British textiles, Indian production of cloth in villages as a symbol of autonomy, and civil disobedience to laws prohibiting manufacture of salt. On the Indian side, the independence campaign was largely, though not entirely, nonviolent. The British, in turn, did use violence at times—there were some major massacres of unarmed civilians, and thousands of Indians killed overall—but were remarkably restrained.

Many people attribute this restraint to the British being particularly kind colonialists. Other evidence suggests a different view. In Kenya, another British colony, the independence movement in the 1950s—called the Mau Mau rebellion—had an armed wing. British settlers carried out the most dreadful violence on the native Kenyans, perpetrating massacres and setting up dozens of concentration camps in which anyone suspected of being a Mau Mau was liable to be tortured relentlessly, leading to numerous deaths.[7] The obvious explanation for the difference between British behaviour in India and in Kenya is that the limited armed struggle by the Mau Mau provided a justification for massive British

violence. By maintaining nonviolent discipline, the Indian independence movement inhibited British violence.[8]

In both cases, a key element was public opinion in Britain itself. Within both India and Kenya, more violence might have been used against the independence movements except for the political repercussions back home. Massacres of unarmed civilians in India caused outrage within Britain. However, massacres in Kenya created less impact because the struggle was—and was seen to be—violent on both sides. Even so, when reliable reports of extensive torture and deaths in Kenyan concentration camps became known in Britain, this was a key factor in the granting of independence. Significantly also, many British troops and commanders in Kenya were appalled at the violence perpetrated by the British settlers.

Nonviolent campaigns are largely struggles for loyalties. First is the loyalty of the people waging the nonviolent struggle, such as the Indians under British rule. Initially, only some may support the struggle and only a few may be willing to take a stand. Using only nonviolent methods allows others to join in, since anyone can participate in nonviolent actions, unlike armed force where young fit men are the main participants. If the other side uses violence against the nonviolent resisters, this is likely to create outrage in the community and generate increased support.

When the Palestine Liberation Organisation endorsed the use of violence to oppose Israeli rule in the occupied territories, this limited the degree of support from the Palestinians themselves. Only a few Palestinians participated in secretly organised violent acts, often against civilians—commonly called "terrorism"[9]—intended to overthrow Israeli military occupation. In 1987, a spontaneous unarmed opposition to Israeli rule developed, called the intifada. Independent of the PLO, it involved rallies, vigils, strikes, tax refusal, boycotts of Israeli businesses, shop closing, self-sufficiency through local gardens, home-based schooling when schools were shut down, and many other tactics. Many Palestinians threw stones at Israeli soldiers, but otherwise almost all the methods used were nonviolent. The range of nonviolent methods used meant that everyone could be involved, for example by observing a boycott. As a result of the nonviolence of most of the methods, many more Palestinians became involved in the intifada than had ever been involved in terrorism, and many more Palestinians supported the resistance than before, for example including rich Palestinians.[10]

Nonviolent action is also effective in winning the loyalty of soldiers on the other side. If they are opposed only by nonviolent methods, they are less likely to be willing to obey orders to beat or kill. The fear of being killed themselves is largely removed, and the justification for killing is greatly weakened. Many Israeli soldiers were repelled by their commanders' orders or expectations that they beat unarmed resisters. Another example occurred in 1986 in the Philippines during the popular nonviolent resistance to the Marcos dictatorship, in what was called "people power." Hundreds of thousands of people lined the street in protest. Soldiers refused to fire on the demonstrators. A small contingent of troops declared their loyalty to the popularly elected president Cory Aquino. These troops were "defended" by massive numbers of nonviolent demonstrators in the surrounding streets. Pilots sent to bomb the rebel soldiers did not carry out their mission for fear of harming the nearby civilians.

Nonviolent action thus can be effective in winning the loyalty of two key groups: the participants or potential participants in the nonviolent struggle and the soldiers on the other side. It is also effective in winning the loyalty of a third group: people elsewhere in the world, especially those in the country deploying the troops against an unarmed population. Killing of unarmed civilians is a cause for outrage; military action against a population using only nonviolent methods is likely to stimulate the creation of an opposition movement. The intifada quickly won the sympathy

of people around the world for the plight of the Palestinians, something that years of terrorist activity by the PLO had never achieved. The massacre of civilians at Sharpeville in South Africa in 1960 generated enormous opposition to apartheid throughout the world. By contrast, killings of far more people in the course of guerrilla warfare seldom lead to any attention or concern at all.

There are numerous historical examples of the use of nonviolent action, some of which are mentioned in later chapters.[11] For the purposes here, it is only necessary to note that nonviolent struggle is a possible alternative to armed struggle. Rather than using violence to subjugate or destroy the enemy, nonviolent struggle works by building the will to resist and by undermining the will of the opponent.

Nonviolent methods are widely used in social struggles. One famous example is the civil rights movement in the United States, led by Martin Luther King, Jr. Campaigns by environmentalists, feminists and many others are almost entirely nonviolent, though sometimes violence is used against them.

It is possible to imagine organised nonviolent action as an alternative to military defence. When a community makes systematic plans and preparations to use nonviolent action to defend itself against aggression or repression, this can be called social defence, nonviolent defence, civilian defence, civilian-based defence or defence by civil resistance.[12] Social defence can be considered to be a special application of nonviolent struggle, namely to defend a community against military aggression or repression. The community could be a town, an ethnic group, a country or a transnational organisation.

In reality, no sizeable community has ever introduced social defence, so discussions about how it would operate are based on what is known about actual nonviolent struggles. There are some important differences in the way that nonviolent defence is conceived. Some see it as a functional replacement for military defence, focussing on national defence, with the rest of society pretty much unchanged. This orientation is often associated with the name civilian-based defence.[13] A different orientation, indeed almost a different definition, sees social defence as virtually any form of nonviolent action against governments, and aims at major social change through nonviolence. This orientation is adopted by many grassroots activists.

My preference is to define social defence as an alternative to military defence, but not restrict "defence" to defence of the state. Rather, defence of "community" is the key, leaving considerable ambiguity in the term community. This is compatible with the grassroots orientation to social change but retains an emphasis on defence against military aggression and repression.

Whatever the definition, there are some important differences between military defence and social defence, as suggested by the following table.

	Military defence	**Social defence**
Means of struggle	Violent action	Nonviolent action
Participants	Mostly professional soldiers, especially young fit men	Potentially everyone
Thing defended	The state; ruling class	Community; a way of life
Method of organisation	Bureaucracy; chain of command	Network, consensus and/or bureaucracy
Characteristic technologies	Weapons	Network communication and community self-reliance

Why use nonviolent methods?

For those who do not have armies or sophisticated weapons, nonviolence is likely to be more effective than violence.[14] Groups that oppose a military dictatorship, for example, have no chance of matching the firepower of the state. Militaries have planes, tanks, missiles and advanced surveillance technologies. Guerrilla opponents often have little more than guns, and also usually far fewer soldiers.

Technological developments have increased the military advantage held by governments over opponents. In a direct military confrontation, guerrillas will almost always lose. Their only chance is to use political means to win popular support and undermine the cohesiveness of the ruling group. Guerrilla warfare is in practice mainly a form of political struggle with precisely this aim. Guerrillas can win support by promoting land reform, opposing exploitation by local elites, carrying out labour to help the people, and by being honest and frugal rather than corrupt.

However, the impact of guerrilla warfare as an oppositional strategy is limited by its use of violence. Nonviolent methods are more effective in winning support from the uncommitted population and in causing splits among the supporters of the regime.[15]

Nonviolent methods are more participatory and democratic. To use violence usually means that only small numbers can be involved and that secrecy must be maintained. Nonviolent methods allow nearly everyone to be involved who wants to be. Because less secrecy is required, there can be more open discussion of goals and strategies, thus fostering a more democratic culture in the opposition movement. Thus, even if those cases where nonviolence does not undermine rulers as quickly in the short term as violence, activists with a priority on participatory democracy have good reasons for favouring nonviolent action.

By fostering greater participation and democracy in opposition movements, there is a greater chance that, after a dictatorial regime is toppled, the new society will be an improvement. A great danger in successful guerrilla struggles is that the secrecy, centralised command and violence—not to mention ruthless annihilation of factional opponents—will usher in a new regime in which secrecy, centralised command and violence continue to be used against opponents. Nonviolence, by allowing women to participate equally and by fostering a model of courage without violence, helps to undercut the mutually reinforcing package of violence and stereotypical masculinity. In addition, nonviolent methods provide a suitable means to oppose male violence against women.

Supporters of violence (even as a last resort) argue that the end—a better society—justifies the means. The contrary view is that the means become incorporated in the ends and that, for example, secrecy, centralised control and violence are likely to perpetuate rather than undermine themselves. Ensuring that the means reflect or incorporate the ends is a safer strategy for social change. If a nonviolent struggle for change succeeds, the methods used set a precedent for continuing their use in an ongoing fashion. If the struggle fails, at least in the short run, the process may still lay the basis for future nonviolent struggles.

Finally, nonviolent struggle is less likely than violence to lead to death and suffering along the way. Those who practise nonviolence do not cause death and suffering by their own actions, though it is always possible and sometimes likely that violence will be used against them. But because nonviolent methods are less of a threat and because it is harder to get soldiers or police to attack nonviolent resisters, there is usually far less violence from the other side. For example, in Algeria the guerrilla struggle for independence from France left a million people dead. The death toll in the largely nonviolent struggle for Indian independence was in the hundreds or thousands, out of a far larger population than Algeria.

Pacifists refuse to engage in warfare because they believe it is morally wrong. To use

violence requires a certain arrogance, a belief in the righteousness of one's cause that warrants the irrevocable step of taking another's life. If one accepts the possibility that people—including oneself—might change their minds and that dialogue is a path for seeking the truth, then nonviolence is a suitable process for moral struggle. Violence, on the other hand, undermines and overwhelms dialogue.

Nonviolent action is compatible with a pacifist commitment, though not all pacifists support or engage in nonviolent struggle.[16] But to support nonviolent action it is not necessary to be a pacifist. Probably the majority of activists who choose to use nonviolent methods do so for pragmatic reasons, namely because they are believe nonviolent action will be more effective and more compatible with the sort of society they are seeking.

The question is, "what sorts of technology would aid nonviolent struggle?" Existing technologies have been massively shaped by military priorities. What would they look like if instead they were shaped by a priority on nonviolent struggle?

Most of the debate about defence policy is built around the assumption that defence means military defence, and usually the capacity for military offence as well. Quite a few supporters of nuclear disarmament want to retain so-called conventional weapons, such as tanks, submarines, aircraft and explosives. In the days of the cold war, a key decision in many countries was whether to be aligned with one of the two blocs led by the superpowers (the United States and the Soviet Union), whether instead to become or remain nonaligned, or whether to become neutral (like Switzerland). Many debates were carried out concerning these options. A few governments considered "defensive defence," in which offensive weapons, such as bombers and long-range missiles, would be eschewed in order to reduce the threat posed to other countries. In the Third World, guerrilla struggles have been waged for decades and have been seen as a model by some revolutionaries in the rich countries.

Although many types of defence systems have been used and proposed, all but one of them ultimately rely on organised violence. For each of these, then, violence thus becomes a key motivator for technological development, as shown by the following table. Only social defence provides a fundamentally different incentive.

Defence system	**Role of technologists**
Nuclear	Making weapons of war, including nuclear weapons
Conventional, aligned	Making weapons of war
Conventional, nonaligned	Making weapons of war
Armed neutrality	Making weapons of war
Defensive military defence	Making weapons of war (defensive only)
Guerrilla warfare	Making weapons of war (mostly small scale)
Social defence	Making tools for nonviolent struggle

The following chapters focus on technology that can support a social defence system, namely a community defence system based on nonviolent action.

Sabotage

Sabotage includes such things as jamming factory equipment, destroying computer files and putting sand in a vehicle's fuel tank. There is a long history of sabotage in the workplace, much of it due to workers being bored, alienated or seeking revenge on bosses.[17] There is also some use of sabotage in a more directed fashion to resist repression. For example, some workers in Nazi-occupied Europe slowed down factory production in various subtle ways, trying to hurt the Nazi war effort without being easily identified and consequently punished. There has been some debate among nonviolent activists and scholars about

whether sabotage—violence against property—should be considered violent or nonviolent, as well as whether it is a good tactic. Here, though, I want to address a different issue: is sabotage a useful way to push for changes in technologies and the social arrangements associated with them?

A few writers and activists have supported a strategy involving sabotage.[18] This approach has the advantages of encouraging action rather than passivity, of attacking the direct manifestation of oppression without hurting people, and of causing economic harm to the owners of the technology. There are also some severe limitations to this approach. Because most saboteurs do not want to be caught, using sabotage fosters secrecy and individualism and makes groups vulnerable to infiltration. It can alienate potential supporters. Opponents of monkeywrenching routinely claim that it causes danger to life and limb, such as to workers in timber mills at risk due to hidden nails in trees. This rhetoric highlights the importance of not only being nonviolent but of being seen to be nonviolent.

For the purposes here, a key problem is that sabotage is negative: by itself, it offers no picture of a desirable society. The idea of technology for nonviolent struggle, by contrast, is based directly on such a picture.

There are some principled saboteurs, such as the peace activists who hammer missile nose cones, pour blood on military files or damage rail lines used to transport nuclear materials, and who after taking action then fully acknowledge their responsibility and surrender themselves to police.[19] These sorts of actions can be thought of as a form of civil disobedience, with the primary impact occurring through symbolism rather than economic disruption.

It would be possible to investigate the most appropriate technologies for engaging in sabotage, whether carried out covertly or openly, as part of a grassroots nonviolent struggle against repression, aggression or oppression—acknowledging the view by some activists that sabotage is incompatible with the principles of nonviolent action. I have not done this here, so this remains an area deserving further investigation.

Notes

1. Robots and other automatic devices do operate themselves to some extent, and this may be a future emphasis in warfare. But this only moves the discussion back to the design of weapons. Robots do not design themselves—at least not yet.

2. This is a narrow definition of nonviolence. Some activists and scholars prefer a broader definition, such as the Gandhian conception of nonviolence as a way of life and a principled method of challenging oppression and building a self-reliant and self-governing society. See Robert J. Burrowes, *The Strategy of Nonviolent Defense: A Gandhian Approach* (Albany, NY: State University of New York Press, 1996).

3. Jeffrey H. Goldstein, *Aggression and Crimes of Violence* (New York: Oxford University Press, 1975); Ashley Montagu, *The Nature of Human Aggression* (New York: Oxford University Press, 1976).

4. Alfie Kohn, *No Contest: The Case Against Competition* (Boston: Houghton Mifflin, 1986).

5. David Cortright and Max Watts, *Left Face: Soldier Unions and Resistance Movements in Modern Armies* (Westport, CT: Greenwood, 1991).

6. Dave Grossman, *On Killing: The Psychological Cost of Learning to Kill in War and Society* (Boston: Little, Brown, 1995).

7. Robert B. Edgerton, *Mau Mau: An African Crucible* (New York: Free Press, 1989).

8. This comparison of India and Kenya was made by Robert J. Burrowes, *The Strategy of Nonviolent Defense: A Gandhian Approach* (Albany, NY: State University of New York Press, 1996), p. 239.

9. Terrorism as normally defined refers only to small nonstate actors. Arguably, terrorism on a far larger scale is carried out by governments. See for example Edward S. Herman, *The **Real** Terror Network: Terrorism in Fact and Propaganda* (Boston: South End Press, 1982).

10. Souad R. Dajani, *Eyes Without Country: Searching for a Palestinian Strategy of Liberation* (Philadelphia: Temple University Press, 1994);

Andrew Rigby, *Living the Intifada* (London: Zed Books, 1991).

11. Numerous examples are given in Gene Sharp, *The Politics of Nonviolent Action* (Boston: Porter Sargent, 1973), the classic source in the field. See also Jacques Semelin, *Unarmed against Hitler: Civilian Resistance in Europe, 1939-1943* (Westport, CT: Praeger, 1993).

12. Anders Boserup and Andrew Mack, *War Without Weapons: Non-violence in National Defence* (London: Frances Pinter, 1974); Burrowes, op. cit.; Theodor Ebert, *Gewaltfreier Aufstand: Alternative zum Bürgerkrieg [Nonviolent Insurrection: Alternative to Civil War]* (Freiburg: Rombach, 1968); Gustaaf Geeraerts (editor), *Possibilities of Civilian Defence in Western Europe* (Amsterdam: Swets and Zeitlinger, 1977); Stephen King-Hall, *Defence in the Nuclear Age* (London: Victor Gollancz, 1958); Bradford Lyttle, *National Defense Thru Nonviolent Resistance* (Chicago, IL: Shahn-ti Sena, 1958); Brian Martin, *Social Defence, Social Change* (London: Freedom Press, 1993); Michael Randle, *Civil Resistance* (London: Fontana, 1994); Adam Roberts (editor), *The Strategy of Civilian Defence: Non-violent Resistance to Aggression* (London: Faber and Faber, 1967); Gene Sharp, *Making Europe Unconquerable: The Potential of Civilian-based Deterrence and Defense* (Cambridge, Mass.: Ballinger, 1985); Gene Sharp with the assistance of Bruce Jenkins, *Civilian-Based Defense: A Post-Military Weapons System* (Princeton: Princeton University Press, 1990); Franklin Zahn, *Alternative to the Pentagon: Nonviolent Methods of Defending a Nation* (Nyack, NY: Fellowship Publications, 1996).

13. Gene Sharp is the most prominent advocate of this perspective.

14. Nonviolence can also be more effective than violence for those who *do* have armies. Many of the points below apply.

15. Stephen Zunes, "Unarmed insurrections against authoritarian governments in the Third World: a new kind of revolution," *Third World Quarterly*, Vol. 15, No. 3, 1994, pp. 403-426.

16. Some pacifists oppose social defence because it perpetuates the idea of the enemy. They believe instead that the goal should be a cooperative society. Supporters of social defence accept that it is impossible (or even undesirable) to eliminate conflict and argue instead that the goal should be to wage conflict using nonviolent rather than violent methods.

17. Pierre Dubois, *Sabotage in Industry* (Harmondsworth: Penguin, 1979). For numerous examples see Martin Sprouse with Lydia Ely (eds.), *Sabotage in the American Workplace: Anecdotes of Dissatisfaction, Mischief and Revenge* (San Francisco: Pressure Drop Press, 1992).

18. The most notable are David F. Noble, *Progress without People: In Defense of Luddism* (Chicago: Charles H. Kerr, 1993) and the radical environmental group Earth First!, for which key books are Dave Foreman and Bill Haywood (eds.), *Ecodefense: A Field Guide to Monkeywrenching* (Tucson, AZ: Ned Ludd Books, 1988, second edition) and *Earth First! Direct Action Manual* (Eugene, OR: DAM Collective, 1997). See also *The Black Cat Sabotage Handbook* (Eugene, OR: Graybill, n.d.) and the magazine *Processed World*.

19. See for example Per Herngren, *Path of Resistance: The Practice of Civil Disobedience* (Philadelphia: New Society Publishers, 1993); Liane Ellison Norman, *Hammer of Justice: Molly Rush and the Plowshares Eight* (Pittsburgh: PPI Books, 1989). I thank Andreas Speck for helpful comments concerning sabotage.

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Chapter 4

Priorities for research and development

Suppose you have control over lots of money for research and development and want to spend it in the best way possible to serve military purposes. What areas have priority? The usual practice is simply to look at current funding and to assess which areas are producing valuable results. Some unproductive areas—unproductive for military purposes, that is—can be dropped, and some new areas can be added, drawn from new funding proposals.

Prior funding patterns provide little guidance in setting priorities for science and technology for nonviolent rather than military purposes since there has been almost no funding for nonviolent struggle, much less for relevant science and technology. There has been a little funding for social analyses of the feasibility of social defence, but that's about all.

Another possibility is to examine the use of science and technology in actual nonviolent struggles, and then to assess whether there are technological improvements that would aid the struggle. This might involve looking at the use of radio in Czechoslovakia in 1968 or the role of agriculture and food delivery systems in Palestine during the intifada. This approach is valuable in gaining a feeling for particular research projects, but it does not provide an overview of the areas of science and technology most likely to be useful for nonviolent struggle.

Research proposals

The next possibility is to look at proposals for research. To get an overview, it is useful to look at the Dutch book *Research on Civilian-Based Defence*, which describes in detail 24 areas for major research projects into social defence.[1] Here is a sketch of these projects.

• An inventory of organisations and social structures, such as government bureaucracies, corporations and pressure groups, examining how an aggressor might seek to control them and how they might be strengthened to resist takeover.

• An examination of centralised versus decentralised coordination of social defence, surveying studies of resistance to the Nazis during World War II, guerrilla warfare, military strategy and other areas.

• Collection of information about technologies of repression and what can be done to oppose them. (This is discussed in chapter 8.)

• An examination of the influence of the new information technologies on the capacity for both repression and social defence. (This is a central theme in chapter 5.)

• An investigation of databases and personal files, how they might be misused and protected, and the social effects of measures for dealing with them. (This topic is dealt with briefly in chapter 5.)

• An assessment of the value of instructions for workers in government bureaucracies on resisting occupation by an aggressor.

• An inventory of key people and positions in government bureaucracies in relation to social defence.

• A study of the reception to the idea of social defence, surveying social defence advocates, media, government bureaucracies, etc.

• A study of factors promoting psychological health, focussing on child rearing and the school system, and their relevance to willingness to resist injustice.

• A listing and examination of basic assumptions and unsolved questions in writings about social defence.

• A survey of theories and ideas of writers on nonviolent resistance and their relevance to action.

• An analysis of Dutch nonviolent struggle during the 1920s and 1930s and Dutch resistance to the Nazis.

• An assessment of Alex Schmid's ten conditions needed for the success of social defence.

• An examination of the process of conversion from military defence to social defence, called "transarmament." (An aspect of this is discussed in chapter 10.)

• An assessment of the value to social defence of Lazare Carnot's method of studying new fields "by stating problems as double negating sentences to come to new knowledge."

• An examination of the idea of the centre of gravity in a defence system, looking at both theory and case studies.

• An inventory of means of confrontation, their relationships, their connection to the centre of gravity, and their relevance to strategic goals.

• A study of different social defence security systems and how building each one up might affect social conditions after a war.

• An examination of Jürgen Habermas's distinction between strategic action and communicative action and the relevance of this distinction to social defence.

• An inventory of goals and weapons of opponents of social defence, and an assessment of likely conflicts.

• An examination of occupations by military forces since World War II and implications for social defence.

• A study of the political effects of introducing social defence, including effects on diplomacy, the economic system and political structures.

• An analysis of spying ("intelligence services"), how it might operate against a social defence system and how it might be resisted.

• An examination of what and how information might need to be collected as part of a social defence system; in other words, an examination of social defence intelligence services.

Most of these research projects would require years of investigation. Their scope is not revealed by these brief descriptions. This list hints at the vast amount of research that could be carried out into social defence. Indeed, given that the military spends billions of dollars each year on research, it can be anticipated that a full-scale social defence system might spawn a similar mass of research. Therefore, the 24 projects listed here from de Valk's book would only be the barest beginning of a full-scale social defence research effort.

Most of the 24 projects are social rather than technological: they deal largely with history, psychology, politics, ideology, strategy and policy. Only three—the third, fourth and fifth as listed—provide any focus on technology. This gives an indication of the relative neglect of the technological dimension in the nonviolence field. Indeed, searching through writings on nonviolence, there is remarkably little attention to technology, so it is worth mentioning those few writers who deal with it.

The earliest and most important was novelist and essayist Aldous Huxley, whose ideas are described in the prologue. Then there is leading peace researcher Johan Galtung, who has made specific suggestions for specific technological developments that would aid a social defence system, especially in his 1968 paper "On the strategy of nonmilitary defense: some proposals and problems." He suggests, for example, that research could be done into how to design a country's physical equipment so that it can be sabotaged appropriately. Since Galtung's ideas are so insightful, it is worth quoting his entire account on this point.

> The task would not be to blow up a factory completely, *but to remove that minimum part which would cause maximum uselessness*. Which part this is and how much will have to be removed would be a subject of meticulous

> calculation, where the availability of substitutes, or substitute uses of the remaining parts of the factory, would play a great role. Such calculations are well within the reach of modern, computerized societies. Thus, in an airplane it would probably not lead to the removal of the propeller (since the engine could then be used for other purposes), but of some small, highly specialized part of the engine, and so on. In the tertiary sectors of society, it would generally be easier since these sectors (except transport and communication) are mainly concerned with symbolic activity, so that the removal or destruction of files, codes, manuals of procedure, membership files, population data, means of financial tranactions, etc., should cause a high degree of uselessness. Transport and communication are also relatively easily reduced in efficiency. But in the primary sector it would generally be less easy, since the facilities here are more like territory. However, pits can be undermined and fields can be rendered useless by chemical means—and better technology could make both strategies time dependent, so that even though the destruction would be irreversible for the time being, it would still only be temporary. It might be argued that all the enemy then would have to do, would be to sit down and wait for usefulness to recur—but the counter-strategy against that again would be to calculate the timing of destruction as well as recovery, or to have options for repeated destruction.[2]

Richard Wendell Fogg raised a few relevant points, for example noting the importance of broadcasting to the population of an aggressor's country.[3] Eminent nonviolence scholar Gene Sharp devoted a page to general comments about the need to question standard assumptions about large technological scale and centralised control over energy, food, production and transport; he suggested that attention should be paid to technology with the aim of diffusing social power.[4] Aside from these authors, though, little had previously been done before my own work. The contrast with the enormous military research and development programmes is striking.

There are two obvious groups who might have been expected to undertake studies of science and technology for nonviolent struggle. The first is activists and scholars in the field of nonviolent action. As far as activists go, there have been untold millions of people who have participated in nonviolent action, ranging from workers engaging in strikes to participants in mass rallies, but only some of these have seen their action as part of a strategic method for social change. The number of reflective activists and researchers who have striven to improve the capacity for nonviolent action is much smaller, but is still quite considerable. Why haven't they examined technology systematically?

One important reason is that the most important factors in making nonviolent action successful are psychological, social, organisational and strategic. Technology seldom is a crucial factor. In warfare, by contrast, technological factors are much more obvious and important. It makes sense to tackle the most important factors first, and so supporters of nonviolence have concentrated on non-technical dimensions of action. But this can't be the entire explanation, since technical factors sometimes are vital, as in the case of communication technology in quite a number of struggles.

Another factor may be that most peace researchers (like most other researchers) are cut off from grassroots movements and more oriented to standard belief systems. For career and status reasons, as well as funding, they are more likely to direct attention to military technology than to nonviolent action, reconciliation and building peaceful societies, with technological facets of such topics being very low in priority.[5]

Another reason is that few of those who have pushed forward the frontiers of nonviolent action have been scientists or engineers. Peace research is seen primarily as part of the social sciences, and most writers on social defence have been trained as social scientists. It is relevant that Galtung, who has dealt with

technical dimensions, was originally a mathematician.

Yet another possible reason stems from the contrasting agendas of the two main approaches to nonviolent action, the principled and the pragmatic approaches. Many of those who believe in nonviolence as a matter of principle, irrespective of its immediate effectiveness, also adopt a critical analysis of modern technology and industry. Gandhi argued for technologies that allowed for local control, for village industries rather than mass production. This Gandhian approach contains a strong critique of technology but, because it is primarily a rejection of sophisticated technologies, doesn't encourage thinking about selecting, adapting and developing technologies that might support nonviolent struggle more effectively.

The pragmatic approach to nonviolence is based on the view that nonviolent action is more effective than the use of violence. The approach is, in many cases, joined with an acceptance—for the time being at least—of many features of current society: industrialism, the system of states, capitalism, etc. In other words, nonviolent action as a pragmatic method is commonly used as a method of reform within the present system, with no plan for long-term transformation of social structures except the military. As part of this, technology is not questioned in any fundamental fashion, and hence its capacity for supporting nonviolent action is not examined.

In this picture, the transformation of technology to serve nonviolent action falls between the agenda of principled nonviolence, which rejects much of modern technology, and the agenda of pragmatic nonviolence, which accepts most nonmilitary modern technology. Undoubtedly, this picture is much too simple. There are, after all, many activists and scholars who support principled nonviolence without rejecting modern technology and who support pragmatic nonviolence as part of a programme for fundamental change in social structures. But perhaps there is an element of truth here that, along with other factors, has contributed to the neglect of technology for nonviolent struggle.

Another way into this field is to begin as a scientist or engineer and to become involved with nonviolence. For decades, many scientists and engineers have been involved in peace movements, but this has led to little engagement with the nonviolence movement.

Just as importantly, few scientists have linked their concerns about war and peace with a critique of science itself. Critics of science have exposed the use of science for profit and social control.[6] There are several reasons why they have given so little attention to nonviolence.

The first reason is that nonviolence has a very low scholarly profile. As an intellectual tool, a critic of science might use political economy, Marxism, feminism or even postmodernism, but would be unlikely to be even aware of nonviolence theory. Few of the critics of science have been involved in campaigns where ideas and writings about nonviolence are raised.

Another reason is that most critics of science study what exists and don't spend much time envisioning alternatives. Exposés of the corporate abuse of science abound, but there are few investigations of what science would be like under cooperative economic structures.

Finally, much of the critique of science has been undertaken from socialist perspectives, which are primarily built on a critique of capitalism. Socialists seek the end of capitalism through the capture of state power, whether in a revolution or through electoral politics. In either case, there is no rejection of the use of violence. Armed struggle—especially in Third World countries—is usually supported or reluctantly accepted as a necessity.

These are some of the reasons why there has been so little investigation of nonviolence by scientists, engineers or critics of science. The reasons presented here for the neglect of science and technology for nonviolent struggle are

somewhat speculative. All that is certain is that the topic has been neglected.[7]

Key factors approach

So far I have presented several ways for setting priorities for science and technology for nonviolent struggle:

• look at previous funding priorities (not useful, since there has been almost no prior funding);

• look at actual uses of science and technology in nonviolent struggles (useful, but providing little guidance for priorities);

• look at research proposals (useful, but limited in scope).

Another way to proceed is to draw up a list of areas important for engaging in struggle and then determine which scientific fields have the greatest potential of contributing in those areas. Let me first consider military struggle, for which the most obvious area is weapons. Many branches of the physical sciences and engineering are vital for this, from nuclear physics and chemistry to molecular biology.

But there are other, less obvious, areas where improved knowledge may be helpful. One important area is recruitment and retention of skilled personnel. For this, psychological and sociological studies might prove useful. Other areas important for military strength are arms manufacture, transportation, logistics, training, leadership and communication. By going through all key areas, assessing needs and then assessing which (if any) fields of science and technology might prove useful, a set of priorities can be set up for funding research and development.

Of course, there are other considerations that affect military funding for science and technology. These include financial constraints, availability of skilled and willing scientists and technologists, political support or opposition, possible civilian spinoffs and arms control treaties, among others. But the general approach, namely of listing key areas and seeing which technical fields are most useful to them, still has merit.

This approach can now be applied to social defence. The first thing to do is to list key areas important to a social defence system. This is not so easy! There is no generally accepted list, and certainly no list designed for this purpose. So, on the basis of my knowledge of social defence and in consultation with Mary Cawte, who had just read through many of the writings on social defence, I wrote down a number of areas. I then sent the list to a few social defence experts, who suggested additions.[8] Here is the list that resulted from this process.

Key factors in a social defence system

Active factors

Psychological and organisational factors

• morale, unity, will
• knowledge, education, understanding, analysis, strategy, tactics, evaluation
• coordination, decision-making, organisation, leadership

Physical infrastructure

• communication
• survival: food, water, clothing, shelter, energy, transportation, health
• industry, production, economics

Other factors

• skills
• self-reliance
• allies
• constructive programme (building a nonviolent society)

Reactive factors (including direct disarmament[9])

• anti-nuclear weapons (countering the threat and effects of nuclear weapons)
• anti-biological weapons
• anti-chemical weapons
• anti-conventional weapons.

It is impossible to give weights to these factors in terms of their importance, since there is no theoretical framework available for this purpose. Nevertheless, a general ranking is possible by looking at studies of nonviolent struggles. Undoubtedly the greatest attention is given to psychological and organisational factors, as suggested by the 24 Dutch social defence research proposals.

The priority given to psychological and organisational factors also can be illustrated by examining the views of writers on social defence who have examined the centre of gravity, a key concept proposed by the classic military strategist Carl von Clausewitz.[10]

Anders Boserup and Andrew Mack, in their pioneering book *War Without Weapons,* apply Clausewitzian strategic theory to social defence. The centre of gravity is the opponent's central source of strength, which should be the main target for destruction. The centre of gravity of the defence is determined by the mode of defence, which is the basis for Clausewitz's idea of the superiority of the defence over the offence. Boserup and Mack conclude that for a social defence system, the centre of gravity is the unity of the resistance: "It is against this point that the whole thrust of the attack must be directed and to its preservation that all efforts of the defence must tend."[11] If the defence is able to absorb the attack, then its next task is to mount a counterattack against the centre of gravity of the opponent. Boserup and Mack say that in the case of military attack against a social defence system, the centre of gravity of the offence depends on the mode of attack and that, generally speaking, it will be those things that allow the offence (for example, repression of the nonviolent defenders) to continue.

Other social defence theorists have built on Boserup and Mack's analysis but differed about the precise nature of the centre of gravity. Gene Keyes, who studied the Danish resistance to the Nazis, concludes that the centre of gravity for a social defence system is the morale of the resistance.[12] Robert Burrowes, in a far-reaching Gandhian approach to social defence strategy, argues that the strategic aim of the defence is to "consolidate the power and will of the defending population to resist the aggression" and the strategic aim of the counteroffensive is to "*alter* the will of the opponent elite to conduct the aggression, and to *undermine* their power to do so."[13] In Burrowes' model, the centre of gravity is the sum total of social resources that support the strategy; more specifically, it is the power of a party to a conflict to conduct the struggle and its will to do so. Both Keyes and Burrowes say that the centre of gravity for the offence is the same as for the defence, namely morale for Keyes and power/will for Burrowes.

Although Boserup and Mack, Keyes and Burrowes differ concerning the location of the centre of gravity of a social defence system, they agree that it lies primarily in the social and psychological facets of the resistance, namely either unity, morale or will. It certainly is not technology (weapons). However, technology can be used to bolster unity, morale and will.

As for factors classified as physical infrastructure in the list of key factors in a social defence system, communication technology is probably the most important because of its close link to psychological and organisational factors. Only seldom is survival of the population threatened in a nonviolent resistance,[14] and industry only occasionally plays an important role. The capacity to understand, resist, and dismantle weapons of the aggressor is a topic seldom discussed in the nonviolence literature.

This list of key factors provides a preliminary way to assess the importance of scientific fields to nonviolent struggle. For example, consider biology: it can offer some help in the task of survival, for example via understanding of ecology, such as knowledge of species not requiring pesticides or fertilisers (which might be unavailable in event of a blockade) or fruit-bearing species. Biologists could also provide

some insight into the capability of biological weapons and how to counter them.

Proceeding in this fashion for all the key factors leads to the following list.

Relevance of science and engineering to key elements in a social defence system

- *biology*: survival; anti-biological weapons
- *chemistry*: anti-chemical weapons
- *earth sciences*: survival
- *medicine*: survival
- *agricultural science*: survival
- *physics/mathematics*: communication
- *computing/electrical engineering*: communication
- *engineering*: survival; industry, etc.; communication; anti-conventional weapons
- *psychology*: morale, etc.
- *languages*: communication
- *economics*: industry, etc.
- *sociology, politics, philosophy, history, education*: knowledge, etc.; coordination, etc.

Although this list is not definitive, it gives a good indication of the relevance of various fields to nonviolent struggle. It is apparent that a number of fields of science and engineering can contribute to survival (earth sciences, medicine, agricultural science, most branches of engineering) and a number of them can contribute to communication (computer science, electrical engineering, mathematics). But aside from a few other areas (chemistry can contribute to anti-chemical warfare; engineering has a crucial role in designing industry for a social defence system), the bulk of science and engineering has little to offer to nonviolent struggle.

This conclusion needs an immediate qualification. Aside from contributions to survival and communication, the bulk of *present-day* science and engineering seems to offer little to nonviolent struggle. It is quite possible that these fields could be more relevant if they were redirected—for example through a change in funding patterns—from military to nonviolent goals. In terms of present systems of knowledge, skills and hardware, the social sciences have a much more important role to play in supporting social defence than do the natural sciences and engineering.

In summary, a comparison of research priorities for military and nonviolent ends shows some dramatic differences at a number of levels. Research into improving nonviolent struggle would lead to a much greater emphasis on social science than does military-related research. Within individual disciplines, a priority on nonviolent struggle would mean greater attention to particular fields, such as telecommunications. Finally, within particular fields, such as telecommunications, a nonviolence-oriented research agenda would lead to emphasis on different puzzles.

Implications

A science and technology policy based on promoting social defence would be dramatically different from one based on promoting military strength. The following changes would be among the most significant.

(1) There would be much greater emphasis given to social sciences compared to natural sciences and engineering. The implication is that the present situation in which natural science and engineering receive the bulk of research monies is, to some degree, a product of military priorities operating in the past century, and that quite a different balance between the 'soft' and 'hard' sciences might eventuate if social defence received the same investments and priority now given to the military.

Complaints by scholars in the humanities and social sciences that they are shortchanged in the struggle for research money typically make appeals to intellectual worthiness or the importance of culture. The analysis here provides quite a different argument: that social science—or, more precisely, particular branches of social science—are central to the development of the capacity of a society to defend itself using nonviolent methods. (It should be

noted that present-day social science has been shaped by military priorities and that a social science shaped by social defence priorities might look quite different.)

(2) The effort given to different research fields would be shifted considerably. For example, particle physics would be a much lower priority whereas telecommunications and social psychology would be much higher priorities.

(3) Different particular projects in any field would be emphasised. Examples will be given in the following chapters.

(4) Research would be responsive to and involve the participation of a wide range of community interests, unlike the present situation where military interests predominate. This point will be discussed further in chapter 9.

Notes

1. Giliam de Valk in cooperation with Johan Niezing, *Research on Civilian-Based Defence* (Amsterdam: SISWO, 1993). The background to this book is described in chapter 10.

2. Johan Galtung, "On the strategy of nonmilitary defense: some proposals and problems," in Johan Galtung, *Peace, War and Defense. Essays in Peace Research, Volume Two* (Copenhagen: Christian Ejlers, 1976), pp. 378-426, 466-472, quote at pp. 390-391.

3. R. W. Fogg, "A technical equivalent of war," in H. Chestnut (ed.), *Contributions of Technology to International Conflict Resolution* (Oxford: Pergamon Press, 1986), pp. 113-120.

4. Gene Sharp, *Social Power and Political Freedom* (Boston: Porter Sargent, 1980), pp. 403-404.

5. I thank Ellen Elster for this point. See Berenice Carroll, "Peace research: the cult of power," *Journal of Conflict Resolution,* Vol. 16, No. 4, December 1972, pp. 585-616.

6. See for example Hilary and Steven Rose (eds.), *The Political Economy of Science: Ideology of/in the Natural Sciences* (London: Macmillan, 1976) and *The Radicalisation of Science: Ideology of/in the Natural Sciences* (London: Macmillan, 1976); and the journals (all now defunct) *Science for the People*, *Science for People* and *Radical Science Journal*. Unfortunately, the critique of engineering does not boast an extensive literature.

7. The reasons are harder to pin down, because there are few definite actions or motivations to investigate, as in all cases where the issue is lack of interest and lack of investigation. I think that the reasons mentioned above are plausible, and have some basis in the writings and activities of activists and scholars (though I haven't gone into this sort of detail). By searching for explanations for neglect, it may be possible to find ways to stimulate greater interest in the topic.

8. I thank Robert Burrowes in particular for useful comments.

9. Direct disarmament is the disabling and dismantling of weapons by people without the permission of governments and commanders.

10. Carl von Clausewitz, *Vom Kriege [On War]* (Berlin: Ferdinand Dümmler, 1832). The following paragraphs on the centre of gravity are taken from Brian Martin, "Social defence strategy: the role of technology," *Journal of Peace Research,* Vol. 36, No. 5, 1999, pp. 535-552.

11. Anders Boserup and Andrew Mack, *War Without Weapons: Non-violence in National Defence* (London: Frances Pinter, 1974), pp. 148-182, quote at p. 163.

12. Gene Keyes, "Strategic non-violent defense: the construct of an option," *Journal of Strategic Studies*, Vol. 4, 1981, pp. 125-151, at p. 133.

13. Robert J. Burrowes, *The Strategy of Nonviolent Defense: A Gandhian Approach* (Albany, NY: State University of New York Press, 1996), p. 209.

14. One case is the Palestinian intifada, though the resistance is better described as unarmed than nonviolent.

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Chapter 5

Communication

An effective military depends heavily on effective communication, including transmission of commands, coordination of actions, transmission of information about enemy activities and about the progress of battles, among others. To serve the needs of military communication, massive investments are made into research, development and production of communication systems. For example, specially designed satellites are used to collect information about enemy installations. Massive computer systems are used to decipher foreign and domestic telecommunications. Satellites are also used to detect enemy missile launches, and special facilities are ready to transmit orders to launch nuclear attacks. Military communications are designed to be highly secure and to enable transmission of commands even when some channels have been incapacitated.

Communication is even more central to nonviolent struggle, but the type of communication most useful for nonviolent struggle is quite different than for military purposes. In the military, the role of the commanding officer is central: that person must have reliable information and be able to issue commands. This explains why there is so much attention to maintaining secure communications to the commander-in-chief in the face of attack. Extraordinary efforts—bomb shelters, special telephones, personal guards—are used to protect commanders, especially in times of crisis. Ordinary soldiers are trained to obey, not to take independent initiatives. Soldiers who disobey orders are usually subject to severe penalties; in wartime, they may be executed.

In a nonviolent struggle, participation must be voluntary: there is no way to force people to join in. Therefore, the struggle cannot have commanders in the military sense, since obedience to orders cannot be enforced. A nonviolent struggle can, however, have leaders. Noted examples include Mohandas Gandhi, Martin Luther King, Jr. and Aung San Suu Kyi. In these and other cases, leaders have influence through their example, intelligence, commitment and charisma. But it is not wise to depend too strongly on such individuals to provide guidance. Many nonviolence leaders take a front-line role, participating in civil disobedience and other confrontations with the opponent. They may be arrested, imprisoned or killed. In general, they are much more vulnerable than military commanders, who usually stay away from the fighting. Therefore, nonviolent activists must be prepared to continue the struggle effectively in the absence of their most experienced and knowledgeable members. All of this means that as many people as possible should be ready and able to analyse the situation, initiate action, make decisions and in general carry on the struggle.

For these reasons, nonviolent struggle is best served by a decentralised, interactive and cooperative system of communication, decision-making and action.[1] This provides a very different set of priorities for science and technology than military agendas.

The following sections examine a number of communication media: television, radio, cassettes, newspapers, leaflets and the underground press, telephone and fax, the post, conversations and meetings, and computer networks. In each case, I comment on the value of the medium for nonviolent struggle and on ways in which this value might be

increased. When giving case studies, I try to provide some context for the role of communication technology which, in every case, is only one component of a complex struggle in which social factors are of central importance. The chapter concludes with a general assessment of the types of communication technology most likely to be useful for nonviolent struggle, drawing on theoretical considerations as well as the case studies.

Television

Television is an enormously powerful medium. Most people in western societies watch it for many hours each week. Furthermore, there is a great deal of trust in the image of reality presented on the TV screen, more than in newspapers for example.

There is very little opportunity for participation in the production of broadcast television. It is essentially an autocratic medium. A very few people make decisions about content, which is then transmitted to a large audience. Furthermore, the television image is quite an artificial and manipulated production. Few people are aware of the tremendous effort that goes into shaping each moment on the screen. Producing a high-quality television programme requires a lot of skill, equipment and money. This means that experienced professionals produce most programmes, especially the ones that most people prefer to watch.

For these reasons, television is ideal for rulers. They can influence popular perceptions by appointing or controlling a small number of television executives and producers. Dictatorships are only willing to allow television that is under their control. It is no surprise, then, that one of the prime targets in military coups is television stations.[2] Precisely because it is an undemocratic medium, it is highly useful to aggressors. Hence, it is important to develop ways to subvert or disable it when a hostile takeover occurs. Many television journalists, producers and technicians are sympathetic to popular movements. If they are aware of methods for nonviolent struggle, they might well be willing to participate by hindering efforts by aggressors to control television and by enabling popular concerns to be broadcast.

Redesigning broadcast facilities and making advance preparations could aid the use (or interruption) of television in a nonviolent struggle. For example, broadcast facilities could be designed so that technicians, staff or even viewers could interrupt transmission in case of a hostile takeover. Some means would be necessary to prevent use of this facility in "normal" times, such as the need for a considerable number of people to enter codes. Broadcast facilities could be designed so that, in case of emergency, a special signal indicating a hostile takeover was transmitted along with the picture. Special tapes could be produced—dealing with methods of nonviolence, ways to undermine control of television by aggressors, etc.—and stored safely for transmission in case of emergency.

Heavy consumption of broadcast television makes a society more vulnerable to takeover. For long-term security based on nonviolent techniques, the role of television should be reduced. If most people are active transmitters rather than just receivers of messages, then there is less possibility for manipulation and central control.

Occasionally, television broadcasts inadvertently aid nonviolent struggle, as in East Germany. From 1945, East Germany was ruled by a communist dictatorship. Secret police monitored activity in all spheres of life. However, West German radio and television broadcasts were readily received throughout East Germany, giving an attractive—indeed perhaps unrealistically attractive—picture of life under capitalism. In 1961, the border with West Germany was walled off to prevent emigration.

Under the Soviet Union's new policies in the late 1980s, there was no longer a guarantee of armed intervention to support client states in Eastern Europe. On 11 September 1989, Hungary opened its borders with

Austria. East Germans, by going "on holiday" to Hungary, could escape to the west. As word spread, including via news on West German radio and television, the initial trickle of emigration became a torrent. At the same time, there were public rallies against the regime in East German cities. Initially attracting only a few people, in the space of weeks the rallies were attended by hundreds of thousands. News of the growing open dissent was again provided by West German mass media. In the face of massive emigration and enormous protests, East German leaders resigned. The regime collapsed in the face of nonviolent expression of opposition.[3]

If television is produced locally for small audiences, its vulnerability to takeover is reduced, especially if there are numerous independent channels. For the purposes of nonviolent resistance, a multitude of locally controlled broadcasts is the direction to go.[4] But the technical skills and costs to produce high quality programmes are significant obstacles to such a goal.

Radio

In an examination of nonviolent struggle, large and powerful radio stations with many listeners are similar to television stations. They are prime targets for an aggressor, since they can be controlled by a few people and have an enormous influence. A long-term goal in developing a social defence system should be to replace such radio stations by interactive communication media. In the meantime, preparations should be made to be able to broadcast resistance messages or, if necessary, shut down big stations in the event of a threat.

Looking over some of the historical instances of nonviolent struggle suggests a more positive role for radio. One case is the collapse of the Algerian generals' revolt in 1961. In Algeria, an armed struggle for independence from France was waged from the mid 1950s. It was met by severe repression by French troops. French president Charles de Gaulle, seeing that independence for Algeria was inevitable, began negotiations with the independence movement. French generals in Algeria, bitterly opposed to this course of action, staged a coup on the night of 21-22 April 1961. There was even the possibility that they might lead an invasion of France.

Opposition to the coup was quickly demonstrated in France. There was a national one-hour strike and massive rallies. After vacillating a few days, de Gaulle made a passionate plea for troops to refuse to join the rebels. Meanwhile, in Algeria the rebelling generals failed to gain the support of the troops, many of whom were conscripts. Troops heard de Gaulle's broadcast on transistor radios that they had refused to turn in as instructed. Many soldiers just stayed in their barracks. Others reported for duty but purposely failed to do it. About one-third of the fighter aircraft were flown out of the country, never to return. The coup collapsed after four days without a shot being fired against it.[5]

The most prominent example showing the power of radio for nonviolent struggle is the Czechoslovak resistance to the Soviet-led invasion in 1968. During 1967 and 1968, communist rule in Czechoslovakia was rapidly liberalised, a process supported throughout the country. This was a severe threat to the Soviet rulers, who organised an invasion of the country in August. Military resistance would have been futile and there was no help from the West. Instead, there was a spontaneous nonviolent resistance to the invasion. People poured out onto the streets. They talked to the invading soldiers and quickly convinced many of them that the Czechoslovak cause was just.

The Czechoslovak military had set up a sophisticated radio network to be used in the event of a NATO invasion. It was used instead by citizens to broadcast messages of resistance, to warn about impending arrests, to counsel the use of nonviolent methods, to tell where troops were headed, and to call a meeting of the Czechoslovak communist party. It took a week before the radio resisters could be shut down.

But the Soviets did not obtain their initial objective—setting up a puppet government—until April 1969.[6]

The Czechoslovak radio network had been set up by the Czechoslovak military to survive an invasion from Western Europe; this network was put at the service of the people's nonviolent resistance, with spectacular results, especially given that the full story of the struggle could be heard on the airwaves in nearby countries. How is it that a technological system designed by the military for centralised control turned out to be so useful for nonviolent struggle?

The answer to this question is that a centralised communication system such as radio, television or the press can be useful to a nonviolent resistance when there is virtually complete support for the resistance and, of course, the system is controlled by the resistance. The Czechoslovak people were united, from workers to top party officials, against the Soviet invasion. Therefore, the radio system, in the hands of the resistance, was a powerful tool. It didn't matter too much which particular Czechoslovaks were making the broadcasts, because there was such widespread agreement about the aims and methods of resistance. For example, when the Soviets brought in jamming equipment by rail, this information was passed to the radio stations, which then broadcast an appeal to halt the rail shipment. Rail workers shunted the equipment onto a siding. It is obvious that if even a single person listening to the broadcasts had alerted the Soviets, they could have avoided this delay. Eventually they brought in jamming equipment by helicopter.

Although a centralised communication medium such as radio can be useful to a nonviolent resistance in these special circumstances, the technology of electronic broadcast remains a vulnerability for the resistance. Once the Soviets took over the Czechoslovak radio network, this brought the active, public phase of the nonviolent resistance to a rapid end. The occasional value of central radio broadcasts to a resistance can be misleading about the general value of radio, which is likely to be of more value to an aggressor.

The strengths and limitations of radio are also suggested by the long history of clandestine radio.[7] In countries where governments control all mass communication, it is commonplace for dissident groups to set up their own radio stations, sometimes broadcasting from a nearby country or sometimes from secret—and moveable—locations within the country. Clandestine radio of this sort is an indication of the lack of free communication. But there are many more clandestine radio stations run by governments, usually by spy agencies. Many of these are "black" stations, pretending to be from a resistance movement and aiming to destabilise a government. This means that a large proportion of clandestine broadcasting is disinformation. Much more can be said about clandestine radio, and there are some fascinating stories. The important point here concerns radio stations: sometimes they can be useful for a nonviolent resistance, but often they seem of greater use to powerful groups seeking to manipulate public opinion rather than respond to it.

Big radio—large, powerful stations with many listeners—is only one sort of radio. There are also a number of other possibilities. Community radio, in which a station is run with a great deal of participation from local people, and in which the power and range of the broadcast is limited, is much more suited to a resistance.[8] If a city has thousands of community radio stations rather than a dozen dominant stations, it is much better situated to resist a takeover. The greater the diversity of stations, the more likelihood that some of them will be willing to take a stand.

Even more valuable for nonviolent struggle are radio systems that are cheaper and that transmit to only a few people. Citizens band or CB radio is mainly used for person-to-person communication, and is ideal. Even more valuable is short-wave radio, since it can be received thousands of kilometres away. It would be impossible to shut down communica-

tion out of a country if every household had a short-wave radio, supplemented by many "public short-waves," namely short-wave radios available for anyone to use, like public telephones.

Short-wave radio was important in the resistance to the Fiji coups in 1987. Fiji became independent of Britain in 1970. The Alliance Party, led by Ratu Kamisese Mara, controlled parliament until 1987. In that year, a coalition of the National Federation Party and the newly formed Labour Party won the election. Six weeks later, there was a military coup led by Lieutenant Colonel Sitiveni Rabuka. The coup was justified by the false claim that the rights of the majority Melanesian Fijians were under threat; the real effect of the coup was to check the challenge to the chiefs of Eastern Fiji who had exercised power via the Alliance Party. But by using the rhetoric of ethnic problems, Rabuka was able to justify the coup in the eyes of many Fijians and outsiders.

Censorship of the media within Fiji was imposed. However, since Fiji is composed of many islands, short-wave radio is widely used and, after the coup, provided direct access to foreign news. In the complicated political situation after the coup, the loyalties of the Fijian people, and also of governments and people overseas, were wooed. For example, Australian trade unions banned the loading or unloading of ships going to or from Fiji. The Rabuka regime applied pressure on the Fiji trade union leaders to say that their rights were protected; after a few assurances were provided, the Australian bans were suspended. Meanwhile, Fiji Labour Party leaders tried to mobilise support from other governments, to little avail.[9]

One potential limitation of radio is that it is possible for anyone to listen in. Therefore, using short-wave radio to send a message could lead to the sender being tracked down and arrested. But this is more likely if only a few people have access to short-wave transmitters. The more people who have access and skills to use the technology, the less likely anyone is to be targeted. The introduction of public short-waves would reduce the risk still further.

Even better protection is possible using packet radio. A computer is attached to a radio transmitter. A message is typed into the computer, which is then transmitted in digital form to a receiver. No one can simply "listen in." To decipher the message, a suitable computer programme would be required. Even greater security would be provided by putting the message into code. The packet radio transmission can be sent up to a ham radio satellite, which saves the message and transmits it later, perhaps halfway around the world. Packet radio has enormous potential value to a nonviolent struggle.

One other vulnerability of radio is electricity. All large transmitters and most small transmitters and receivers depend on electricity, usually delivered through the grid. For the smaller systems, this vulnerability can be easily reduced. Electricity can be provided by generators—such as an automobile engine—or batteries. For example, a laptop computer and transmitter for packet radio can easily run on batteries. There is also the possibility of radios running on very tiny amounts of power, that can be supplied by batteries, solar energy, or just a wind-up spring such as for a manual alarm clock.[10] In the 1960s, Victor Papanek and Richard Seeger designed a cheap (9 cent) radio receiver for the Third World, based on a used juice can and parafin wax.[11]

In summary, there are a number of ways to make radio facilities more useful to nonviolent struggle. As with television, radio broadcast facilities could be designed so that technicians, staff or even viewers could interrupt transmission in case of a hostile takeover. Broadcast facilities could be designed so that, in case of emergency, a special signal was transmitted along with the normal signal indicating a hostile takeover. Special tapes could be produced—dealing with methods of nonviolence, ways to undermine control of television by aggressors, etc.—and stored safely for

transmission in case of emergency. Information and kits for building small radio transmitters and amplifiers can be disseminated. Cheap, simple-to-use, durable and reliable CB and short-wave radios could be designed and mass produced. The short-wave radios in particular could be designed for smuggling into countries with repressive governments. Encryption for person-to-person radio transmissions can be developed.

Cassettes

Use of audio and video cassettes creates less of a vulnerability than broadcast radio and television, since people use different cassettes. Cassettes are similar to books, in that a relatively few people produce them, but there is a considerable diversity and lack of central control over producing them. With inexpensive video cameras, it is now possible for many more people to produce video cassettes.

Audio cassettes played a role in the Iranian revolution of 1978-79. The Shah of Iran began his rule in 1953. His regime seemed invincible. With enormous oil revenues, he created a massive military machine. Secret police terrorized the population through torture and killings. The regime was actively supported by the United States government and was not opposed by the governments of Israel, the Soviet Union or most Arab countries. This apparently overwhelmingly powerful government was brought down by mass nonviolent action, triggered by religious opponents. The speeches of Ayatollah Khomeini, in exile, were circulated on cassette tapes. Funerals, held forty days after deaths, became protests. When police opened fire and killed mourners, further funerals were held. Opponents burned pictures of the Shah in front of spy cameras of the secret police. Tens of thousands of nonviolent demonstrators were shot dead by troops. Eventually sections of the military defected, and the regime quickly collapsed.[12] (It should be said that although the Shah's regime was toppled largely by nonviolent methods, the successor theocratic regime led by Khomeini was also highly repressive.)

In 1991, a video cassette, combined with television, helped expose Indonesian atrocities in East Timor. The former Portuguese colony of East Timor was invaded and occupied by the Indonesian military regime in 1975. There was continued resistance to the occupiers, both nonviolent civilian resistance and an armed guerrilla struggle. Indonesian troops were highly brutal. As well as torture and killings of civilians, the search and destroy missions against the guerrillas led to widespread starvation. The United Nations condemned the invasion and occupation, but never took any action against them.

Indonesian authorities controlled almost all communication channels. News of resistance and atrocities against the civilian population only reached the outside world via travelers or emigrés. A short-wave transmitter in northern Australia, used to communicate with the East Timorese guerrillas, was shut down by the Australian government.

In November 1991, foreign journalists observed a massacre of hundreds of East Timorese engaged in a nonviolent protest in Dili, the capital of East Timor. One of the journalists, British film-maker Max Stahl, recorded the events on videotape, which was smuggled out of the country. This documentation caused an international scandal. Although there had been many previous massacres witnessed by East Timorese who later left the country, these did not lead to much publicity, partly because of categorical denials by Indonesian authorities. It was the testimony of foreign, independent journalists and of videotape which turned the 1991 Dili massacre into a public relations disaster for the Indonesian occupiers.[13]

Newspapers

Large daily newspapers are enormously influential. Authoritarian governments normally control newspapers directly or subject them to

censorship. This is illustrated by the case of the Emergency in India. The Indian government led by Indira Gandhi was widely seen as corrupt and unresponsive. A mass movement developed around the popular figure of Jayaprakesh Narayan, and this appeared to provide a political threat to the government. On 26 June 1975, Indira Gandhi declared an Emergency. Thousands of people were imprisoned, parliament was muzzled, and the press was censored. For the first few days, the electricity supply to key newspapers was cut off. Financial pressures were applied to those that refused to toe the government's line.

Control of information was a key feature of the Emergency. There was enormous resistance to the government, but groups in different parts of the country knew little of each other. Major demonstrations, with up to half a million people, were not reported and hence unknown elsewhere. Some newspapers capitulated quickly to the censorship requirements, whereas others resisted in various ways. The international press was a key force of opposition; correspondents found innovative ways of getting around censorship. When foreign dignitaries refused to visit India, this hurt the regime; visits by British political figures Margaret Thatcher and Michael Foot were used for propaganda purposes by the regime.

In 1977, Mrs Gandhi called elections, perhaps believing her own government's censorship-created propaganda about her support. In spite of continued (though relaxed) censorship, the opposition Janata Party was elected. Thus the Emergency came to an end.[14]

Because large newspapers are so easily controlled by a few owners and editors, they are not a good communication medium for a social defence system. In the long term, it would be better to aim at systems of dispersed publication. For example, wire service stories might be directly received, at low cost, in numerous small communities. There, any interested person could select a bundle of stories, compile and edit them if necessary, and make them available to others—in printed or electronic form. Thus there might be many thousands of "editors" from whom a person could select. As well, the skills required would be made straightforward enough so that new people could step in without too much trouble. With such a system, an aggressor could not easily take over the press. It is also necessary for wire services to be diversified. At the moment, four international services provide most stories published by the western press. If, instead, there were thousands of small international services, control over the orientation of stories, by whatever means, would be much more difficult.

However, large newspapers will not be abandoned or replaced easily or quickly, so in the meantime it would be useful to have ways to resist aggressors. Printing presses could be designed so that they could be shut down by operators in the face of a takeover and so that a special symbol is printed on every page whenever the press is used against the wishes of the editors and printers. Wire service terminals could be designed so that messages go automatically to a range of other locations.

Leaflets and the underground press

It is easy for an aggressor to take over a few large printing presses, because only a few people are required at crucial locations in the process. By contrast, small local means for printing leaflets, posters and newsletters are difficult to control. Anyone with a microcomputer and printer can produce high-quality leaflets quickly and easily. The photocopier is even more powerful. A handwritten notice can be reproduced in the hundreds or thousands.

The power of dissident publications in the resistance to the Nazis in occupied Europe is described by Jacques Semelin:

> The central role of the underground press in the general development of institutional resistance must be emphasized. The existence of the underground press must not be considered as just one element among others in resisting Nazism. It does not belong in the same category as sabotage,

> intelligence activities, protest marches, and so on; nor was the underground press a simple instrument of counter-propaganda in the psychological war carried on by rival powers. This press was the central axis around which internal resistance movements could organize and develop. It was as if the resistance needed an initial ideological basis in order to develop combat structures. Early resisters therefore distributed pamphlets, bulletins, and various newspapers to formulate the values for which they were fighting Nazism. The underground press operated out of conviction rather than from the desire to disseminate information. Its function was not only to address those whom it wanted to rally to its cause, but even more to convince and assert a collective self on the basis of which the new ideological order—that of the occupation—could be rejected.[15]

One vulnerability of small printing operations is electricity. One solution is to have reserve power through generators. Another is manual typewriters and hand-operated copiers using specially-prepared originals, which were quite common until the 1980s.

In rich countries, photocopiers are found in almost every office and in a number of homes. Their role as a basis for community resistance to aggression could be fostered by setting up communal printing facilities in every street or apartment block, with access to a number of means of producing and copying leaflets and newsletters. The more people who have used equipment to produce information for local use, the more difficult it becomes for any aggressor to control communication centrally.

In highly authoritarian states, such as the old Soviet Union, freely available photocopying was a mortal danger to the state. Guards were posted over photocopiers to ensure that no unauthorised copying occurred. This sort of control inhibited free communication and consequently prevented development in a number of fields, from science to the economy. By making production and distribution of information a part of everyday life—whether to produce a leaflet for a political meeting, a sports event or a sale of goods—the community is very well prepared to continue communicating in a crisis.

To aid nonviolent struggle, cheap, durable and reliable copiers could be designed for use in poor countries. In the case of countries under repressive rule, such copiers could be smuggled into the country in various ways, by tourists or through commercial trade. Copiers could be developed that can be operated even without mains electricity. This might be through batteries or through an optional muscle-powered system.

Some governments and companies, concerned about the leaking of vital documents, have sought the development and introduction of photocopiers that leave some mark on each copied page indicating its source. Generally speaking, such technology is far more useful to an aggressor than to the nonviolent resistance.

Telephone and fax

The telephone is, in many respects, an ideal communication medium for nonviolent struggle. It cannot be used by a single person to send messages to a large number of passive recipients, but rather it is most suited for conversations between two people. True, it's possible to have conference calls, but these become unwieldly with more than a handful of people.

Since telephone is so useful for communication in a nonviolent struggle, the general aim should be to keep the system going. Aggressors are unlikely to shut down an entire telephone system because society depends on it so much—including the aggressors. There are some important vulnerabilities in telephone systems that deserve attention.

First, it is possible to cut off certain phones, either an individual phone or all those in a whole building or suburb. Aggressors might want to cut off telephones used by the resistance, and the resistance might want to cut off telephones used by the aggressors. In most cases, it would not be so difficult to get around

this problem: people can find other phones. Furthermore, with mobile phones the lines become less important. Generally, resisters seek to keep open lines of communication, including communication with the aggressor, so it is not desirable to cut off telephones. It would be important to keep in contact with technicians to encourage them to oppose attempts to shut down phones.

Second, and more important, is the possibility of telephone surveillance.[16] This is quite easy to do, especially with new electronic switching systems. Surveillance of conversations, however it is done, is labour-intensive: someone has to listen to the conversations long enough to make sense of them. This applies even when there are computer systems with voice recognition that are programmed to keep track of conversations only when certain key words are mentioned. Furthermore, the system can be easily foiled if people know the key words and agree not to use them—or to use them all the time!—in their conversations.

If there are only a few resisters, surveillance can be used to keep track of them. If, on the other hand, large numbers of people join the resistance, mass surveillance becomes impossible.

Surveillance becomes even less useful if the resistance operates without secrecy, as many nonviolent activists recommend. If rallies and civil disobedience actions are announced to the authorities beforehand, surveillance is rather pointless.

Nevertheless, telephone surveillance, even when it is quite infrequent and gains little useful information, is very important psychologically. Many people are frightened enough to reduce their activism. Therefore, antisurveillance measures are important. Cordless and cellular phones should be avoided, since their transmissions can easily be picked up by radio scanners, as some public figures have discovered to their embarrassment.[17] One easy method is to use other telephones, especially public telephones. Another is to use the "call forward" mechanism on some phones, to bounce a call to a different phone and thus hide the location or identity of the caller.

As well as such practical on-the-spot techniques, there are a number of technological approaches worthy of investigation. Secure methods of putting telephone messages into code—encryption—would make surveillance more difficult. Telephone systems could be designed so that taps are impossible without alerting the callers. They might also be designed so that, in an emergency, no single person could cut off phones. (In ordinary times, technicians often need to cut off phones for quite legitimate purposes.)

Another issue is caller number identification: the ability of the person called to see and capture electronically the phone number of the caller. Arguably, in some cases in an emergency it is useful for people to be able to make anonymous phone calls. On the other hand, the aggressor may try to disrupt the resistance by feeding lots of misleading information into the resistance networks, in which case caller number identification would be useful to the resistance. More investigation and the running of simulations would help in deciding in what circumstances caller number identification would be an advantage for a nonviolent resistance.[18]

Fax machines run on telephone lines, but are different in two ways: they transmit a printed document rather than sounds, and the recipient does not need to be there for the transmission to occur. Fax is a decentralised communication system and has many similarities to both the post and computer networks. Generally speaking, fax is quite useful to the resistance. "Secure" transmissions—sending a fax that can only be printed when the receiver puts in a code—are now possible with some fax machines. The main improvement for fax would be encryption, so that messages cannot be intercepted en route.

The post

The postal system is a global communication network which is generally quite useful for nonviolent activists. A government seeking to monitor the post cannot hope to open and inspect every piece of mail without large amounts of labour and considerable disruption of everyday life. Therefore the usual procedure is selective monitoring of mail: intercepting, reading and sometimes confiscating mail sent by or to particular targeted individuals or organisations. In order to achieve this, it is helpful for all mail in a country or region to be routed through a single central post office.

To get around monitoring of the post mostly requires organisational rather than technological means. The more that collection, sorting and distribution of mail are done locally, the more difficult it is for any group to monitor or intercept the post. Also, the more decentralised are the authority structures within the postal service, the more difficult it is for an aggressor to take control using only a few trusted staff. If there are several, rather than just one, postal services—such as competing private carriers—then it becomes more difficult to take central control.

It is significant in this regard that most governments have tried to monopolise postal delivery by outlawing, heavily taxing or tightly regulating private delivery services. In the historical development of the post, this was done in order to raise revenue and to prevent enemies from communicating without the ruler's knowledge.[19] This shows that secure and reliable postal delivery—not easily monitored centrally—is of great value to nonviolent opponents of tyranny.

More fundamental than formal ownership of postal services is the attitude of postal workers. If they are sympathetic to the resistance, then they can ensure that important letters or parcels are delivered without inspection. They are also in a good position to deliver messages from the resistance along their delivery routes. It's also possible for the resistance to avoid interception by using false names and addresses, putting one letter inside another, and various other techniques.

There are a few technological systems that are relevant. One is automatic sorting of letters by postcode. If this is used in some way to help monitor the post, the machines could easily be disabled. In any case, it would be an interesting problem to design such equipment so that it provided no advantage for any group wishing to monitor the post. Another issue is the surveillance of postal workers using videocameras and other apparatus. Such surveillance could be used by agents of an aggressor to detect postal workers supporting the resistance. For the purposes of nonviolent resistance, it would be best to get rid of technology that puts workers under surveillance.

Conversations and meetings

In spite of all the technological advances, face-to-face conversations remain one of the very best means of communication. Also quite useful are meetings, whether this involves 3, 30 or 300 people. The smaller the number of people in a meeting, generally, the more each person can contribute and the fewer opportunities there are for manipulation or domination. It may be worthwhile for an aggressor to send observers or arrange for surveillance of mass meetings of hundreds or thousands of people. But monitoring of hundreds or thousands of small meetings becomes impossible.

It might seem that technology is largely irrelevant to face-to-face conversations, but this is not so. Modern technology has greatly increased the capacity for surveillance, for example by electronic listening devices.[20] Investigations are needed into convenient, low-cost ways of avoiding or foiling such surveillance.

Computer networks

Computer networks are a powerful means of communication most suitable for nonviolent struggle.[21] Such networks are interactive and cannot easily be dominated by a small number

of users. Information on the network is transmitted by telephone lines and, indeed, computer networks are very similar to telephone systems. There are several major differences. First, computer networks deal mainly with text rather than voice. Second, it is much easier to save, copy and distribute text via computer networks than via phone. Third, the skills and investment required to become a skilled user of computer networks are much greater than to become a proficient user of the telephone.

The first two factors generally make computer networks a more powerful means of communication, from the point of view of nonviolent struggle, than the telephone. The third factor considerably reduces its value. As the price of computers declines and the software for hooking into networks becomes more user-friendly, computer networks will become more and more valuable as a people's communication technology.

Computer networks—collectively called "cyberspace"—will undoubtedly play an increasing role in communication in crisis situations. They have been used to send alerts about human rights violations, to mobilise opposition to vested interests and to provide information to activists opposing repressive regimes. For example, computer networks have been used for communication by the peace movement in former Yugoslavia,[22] to resist the 1991 Soviet coup[23] and to organise publicity about persecution of minority groups in Iran.

Computer networks have several vulnerabilities, again similar to the telephone. If the telephone system is shut down, so is most computer communication. But this is not so likely because, like the telephone system, computer networks are used more and more for functions such as commercial transactions. Therefore, anyone who shut down the networks would risk alienating a large proportion of the population, including powerful organisations.

Another key problem with computer networks is surveillance, namely logging into particular accounts or intercepting particular electronic messages. The system administrator in charge of local networks has the capacity to monitor or cut off the accounts of individuals. Hackers are able to surreptitiously enter other people's computer files or to read their messages.[24] There is also the less elegant method of tapping telephone lines and deciphering computer-generated data that is being transmitted.

System administrators are key individuals in computer networks. If they support the resistance, then the networks become a powerful tool for resistance. But system administrators could also serve the aggressor, whether as a result of sympathy, bribery or intimidation, for example by monitoring messages from certain individuals or by closing down their accounts. Therefore, it would be useful to design networks so that the power of system administrators is limited, either permanently or just in emergencies.

Another solution to the problem of surveillance is encryption of messages, namely putting them into code. There are various ways to do this, including some extremely powerful encryption techniques that also give a highly reliable way of verifying the sender's identity: an electronic signature.

There was an enormous controversy over the US government's promotion of a system of encryption designed by the National Security Agency (NSA), a multi-billion dollar spying enterprise focussing on electronic communication. The NSA's proposed encryption system—commonly associated with one of its components, the Clipper Chip—relied on a system of coding that could be deciphered using information obtained from two specified organisations, given the permission of legal authorities. Some sceptics, though, did not trust the claims of the NSA, and believed that the agency designed the algorithm and Clipper Chip so that all messages could be read by the NSA.[25]

Generally speaking, secure communication is valuable to a nonviolent resistance, which therefore would be better served by unbreakable encryption. The most popular system outside

the government is called Pretty Good Privacy or PGP.[26] It reportedly has been used by guerrillas in Burma and dissidents in Russia.

There may seem to be some contradiction here, in that many proponents of nonviolence argue against secrecy. For example, they inform police and other relevant authorities about details of their planned nonviolent actions. They argue that openness reduces fear and hence the possibility of violence by authorities, and that this approach is the best way to win more supporters.

However, this opposition to secrecy is quite compatible with support for confidentiality and privacy in other circumstances. The point is that the nonviolent activists choose to communicate their plans for rallies, strikes or occupations to others. This is quite different from eavesdropping on friends having a personal conversation. Encryption of telephone or computer communication is roughly similar to ensuring the confidentiality of a private talk.

There are quite a number of developments that would make computer networks even more effective for nonviolent struggle. Computer systems could be designed so that certain powers of the system administrator are overruled when a certain percentage of users enter a designated command designed for emergencies. Computer systems designed for business or scientific purposes could be adapted so that, in the event of emergency, resistance messages could be hidden within the usual data. Principles and methods of nonviolent resistance on computer networks can be developed.

Computer networks can be prepared for resistance. For example, important data can be stored in remote locations. Names and addresses of key activists can be protected, for example by being embedded in larger lists. Contingency plans to use other computers, other accounts and other networks can be prepared. Emergency messages and sequences of action can be prepared. Simulations of resistance communication in emergencies can be run, and the results used to redesign systems for more effective operation in such situations.

Communication in nonviolent action

The acknowledged pioneer of nonviolent action was Mohandas Gandhi. Gandhi was not a systematic theorist, but rather developed his ideas in conjunction with his campaigns, first in South Africa and then in India. Gandhi's writings and practice provided much of the inspiration for later development of nonviolent action theory and practice.[27]

Gandhi believed in the power of truth.[28] He felt that truth could communicate directly to the heart of an oppressor. He called his method of struggle "satyagraha," which literally means truth-force but can also be translated as meaning nonviolent action.[29]

It is possible to go so far as to argue that the essence of satyagraha is communication: whereas violence, as a form of communication, is a monologue, nonviolence tries to turn a conflict situation into a dialogue.[30] Although this is only one interpretation of satyagraha, it highlights the close connection between communication and nonviolence. The connection can also be argued directly in terms of a Gandhian theory of nonviolent communication.[31]

For Gandhi, truth was not just a linguistic construction. It had to be present in the lives of its advocates, through their humility, compassion, good works and willingness to suffer for the cause of justice. The key issue here is the power of such truth, or truth-in-life, to achieve a better society.

How can such truth be communicated? In his campaigns, Gandhi was always careful to first try conventional channels, such as making polite requests of officials to change their policies which were causing suffering or lack of freedom. If this did not work, he would then, quite openly, initiate a campaign utilising nonviolent methods, such as marches, boycotts, or undertaking illegal activities. These methods might be interpreted as a form of coercion, albeit nonviolent coercion. Gandhi, though, conceived nonviolent action as a method of conversion, of "melting the heart"

of the opponent. When the oppressors saw the suffering that was willingly accepted by the nonviolent activists—known as satyagrahis—they would recognise the satyagrahis' commitment to their cause and be converted to it.[32]

This was Gandhi's theory, but his campaigns did not always work this way in practice. Thomas Weber analysed the 1930 "salt satyagraha" to see if suffering led to conversion as Gandhi claimed.[33] In this campaign, Indians challenged the British colonial regime's monopoly on salt manufacture by marching to Dharasana to take possession of the salt works there. As they approached the salt works and attempted to enter, they were arrested or beaten. Over a period of days, hundreds of nonviolent activists approached the salt works, and were met by force. The beatings were so bad that hundreds were taken to the hospital, most with serious injuries. Far from softening the hearts of the lathi-wielding police, the brutality became worse. However, the colonial government denied any violence by the police, saying that the protesters were faking their injuries. Weber concludes that direct conversion of opponents was a failure.

Nevertheless, the campaign was a success because of a different process of conversion. Observing the operation was a journalist for the United Press in the US, Webb Miller. His moving reports reached an enormous international audience, challenging the disinformation of the official reports. Public opinion in many countries was turned against the British role in India. It was this conversion process that helped achieve India's independence.

Johan Galtung's idea of a "great chain of nonviolence" is quite relevant in this connection,[34] as noted by Weber. Galtung argues that nonviolence can work to persuade opponents via intermediaries: a chain of people, each similar enough in social location, who communicate the social concerns. In the case of the salt satyagraha, Webb Miller provided a link between the satyagrahis and white westerners; in turn, some of the latter had links with British colonial decision-makers.

An interesting connection can be made between Gandhi's idea of satyagraha and Jürgen Habermas's theory of communicative action, in particular his "ideal speech situation."[35] Habermas's ideal speech situation builds on the capacity of all humans to communicate, to enter dialogue and reach intersubjective agreement (rather than individually find truth in nature). In other words, truth for Habermas is obtained through rational discussion in the absence of domination. This theory, though, provides little guidance for communication in situations of unequal power. The confrontation between the satyagrahis and the police at Dharasana in 1930 was very far from an ideal speech situation.

However, the relationship between the satyagrahis and Webb Miller was closer to an ideal speech situation: neither had significant power over the other. The cultural gap between Miller and his western readers was far less than between the satyagrahis and the British colonial rulers. So it might be said that Galtung's great chain of nonviolence operates in practice like a chain of "reasonable speech situations" which, while certainly not ideal, provide better prospects for the sharing and creating of truths than the two end points of the chain.

Thus, Gandhi's idea that the willing suffering of nonviolent activists can communicate direct to the hearts of oppressors requires considerable modification. Communication of truth works better when there is no power imbalance, and this means that communication via intermediaries is often more effective than direct communication between unequals.

Assessment of communication technologies

These considerations suggest that communication technologies that foster or enable dialogue are more useful for the purposes of nonviolent action than those that inhibit dialogue. If one

side in a dispute controls television and radio stations, there is no dialogue. Even if a substantial proportion of the population refuses to listen, the communication imbalance continues. There is little or no opportunity for listeners to present their points of view. It is not surprising, therefore, that dictatorships normally exercise complete control over one-directional electronic communication media. The value of radio and television to oppressors is highlighted by the fact that they are often the first targets in military coups.

The same considerations apply to communication among those who resist an oppressor. With a one-directional means of communication, resistance leaders can certainly get their messages to supporters with minimum effort—but these leaders become quite vulnerable to both repression and cooption. Even more importantly, without dialogue, the resistance cannot take into account the views of current and possible supporters, and cannot foster the capacities of others to use skills and take initiatives.

If the only means of communication in a society were interactive, network systems—face-to-face discussion, telephone, short-wave and CB radio, and computer networks—then an aggressor or oppressor would have the greatest difficulty in controlling the population. Network communication technologies do not by themselves eliminate hierarchy and exploitation, but they do aid resistance. The telephone can be used to issue orders, but it is far too labour-intensive for controlling large populations. Also, the subordinate can always talk back.

James C. Scott's idea of public and hidden transcripts is relevant here.[36] In situations of domination, such as slavery, aristocrat-peasant relations and landlord-tenant relations, the public record or transcript tells the story of the dominators. There is also a hidden transcript in which the side of the oppressed is revealed. According to Scott, the oppressed are well aware of their oppression: the concept of false consciousness is false. The hidden transcript can be a rehearsal for a challenge to power-holders, a challenge that can develop quickly when the mechanisms holding back resistance are weakened.

In the modern world, mass media are a form of public transcript. The mass media under dictatorships omit the perspective of the oppressed, who therefore must use other media—covert discussions, graffiti, leaflets and clandestine radio, as well as symbolic communication at funerals, concerts and other "legitimate" events—to share experiences. This also applies to some aspects of life in societies with representative government: for example, police treatment of stigmatised minorities, or oppression and alienation in working life, are seldom portrayed in the mass media. Thus, mass media are useful tools for dominators, whereas network media are useful for developing the voices of the weak.

Galtung's "great chain of nonviolence" provides another way to explain the advantage of network media for nonviolent resistance. With mass media, the chance of a chain of reasonable speech situations between the oppressed and the oppressors is limited. With network media, the chance is increased, and the denser the interlinkings of the communication network, the greater the ease of dialogical communication.

Several of the examples given in this chapter support the conclusion that mass media are selectively useful for oppressors. For example, control over the mass media was crucial to government and military control in the shutting down and censoring of the press during the Emergency in India, in the cutting off of electronic communication during the military coup in Poland and throughout the continuing occupation of East Timor. Similarly, control over the mass media was a crucial factor in the Fiji coups and in the Shah's Iran. But in these two cases the opposition had access to alternative sources of information, via short-wave radio in Fiji and cassette tapes in Iran.

On the other hand, some of the cases seem to contradict the idea that mass media are

selectively useful for oppressors. Radio broadcasts were vital to nonviolent resistance in the Algerian generals' revolt, the Czechoslovak resistance to the Warsaw Pact invasion, and the collapse of the East German communist regime. In each of these cases, a one-directional medium served a nonviolent resistance to repression. What made this possible was a short-term congruence between those who controlled the medium and a dialogue-based mass movement. French conscripts in Algeria, through their own experiences and interactions, were already predisposed to refuse cooperation. De Gaulle's broadcast made them aware that they were supported by the French government and the French people.

In the case of Czechoslovakia, the liberalisation of communist rule during 1968 was a mass-based process that challenged the normal control—including control of the media—by those following the Soviet line. The Czechoslovak radio system was temporarily a powerful force for the nonviolent resisters, in a situation where there was a high intensity of face-to-face dialogue, both among the population and between Czechoslovaks and invading soldiers. It is also worth noting that capture of the radio network by the Soviet army decisively ended the active phase of the resistance.

In East Germany in 1989, the Communist Party retained control over the local mass media. West German radio and television provided a window into alternative views, including news of events in East Germany itself, that fed into the protest by East Germans, which itself was based on a commonality of experience.

These cases suggest that one-directional media can sometimes be useful to a nonviolent movement against repression, but only under certain conditions. There must be a strong underlying unity of purpose, itself the outgrowth of common experience and dialogue. Also, the one-directional media are used in a challenging mode, against an even more pervasive or powerful system of persuasion or control.

This conclusion can be summarised by saying that one-directional media are selectively useful for oppression and network media are selectively useful for resistance to oppression.[37] Technologies are not neutral, but nor are they tied to certain uses only. Technologies are stamped by the social groups and goals involved in their creation and application. But the uses of technologies are not fixed by their creators: users can adapt them to some extent. For example, the US military originally set up the computer network that later evolved into the Internet which has become one of the most participatory media available.

Generally speaking, the greater the opportunity for users to choose, use and modify the technology, the greater its potential for fostering popular participation and the more likely it is to be useful for nonviolent action against repression. Interactive network media can aid nonviolent action most of all when they are generally accessible, easy to use, difficult for dominators to control, and when they encourage widespread development of appropriate skills.

Notes

1. Andreas Speck notes that this same list of values—decentralised, interactive, cooperative—can also be obtained by starting from the values of a just society.

2. T. E. Finer, *The Man on Horseback: The Role of the Military in Politics* (London: Pall Mall Press, 1962); D. J. Goodspeed, *The Conspirators: A Study in the Coup d'État* (London: Macmillan, 1962); Edward Luttwak, *Coup d'État: A Practical Handbook* (London: Allen Lane The Penguin Press, 1968), pp. 111-116.

3. Roland Bleiker, *Nonviolent Struggle and the Revolution in East Germany* (Cambridge, MA: Albert Einstein Institution, 1993). Andreas Speck points out that there was also a negative side to the role of West German television. Many leading East German activists wanted to turn East German into a democracy, even a genuine people's democracy (as opposed to a dictatorship calling itself a people's democracy). However, West German television did not broadcast the ideas of this East German opposition, instead

pushing for German unification under the West German model.

4. Tony Dowmunt (ed.), *Channels of Resistance: Global Television and Local Empowerment* (London: British Film Institute in association with Channel Four Television, 1993) provides a number of useful case studies.

5. Adam Roberts, "Civil resistance to military coups," *Journal of Peace Research*, Vol. 12, 1975, pp. 19-36.

6. Royal D. Hutchinson, *Czechoslovakia 1968: The Radio and the Resistance* (Copenhagen: Institute for Peace and Conflict Research, 1969); H. Gordon Skilling, *Czechoslovakia's Interrupted Revolution (*Princeton, NJ: Princeton University Press, 1976); Joseph Wechsberg, *The Voices* (Garden City, NY: Doubleday, 1969); Philip Windsor and Adam Roberts, *Czechoslovakia 1968: Reform, Repression and Resistance* (London: Chatto and Windus, 1969).

7. Lawrence C. Soley and John S. Nichols, *Clandestine Radio Broadcasting: A Study of Revolutionary and Counterrevolutionary Electronic Communication* (New York: Praeger, 1987).

8. Bruce Girard (ed.), *A Passion for Radio: Radio Waves and Community* (Montreal: Black Rose Books, 1992); 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, 1999).

9. Brian Martin, "Lessons in nonviolence from the Fiji coups," *Gandhi Marg*, Vol. 10, No. 6, September 1988, pp. 326-339.

10. On micropower radio, see 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, 1999).

11. Victor Papanek, *Design for the Real World: Human Ecology and Social Change* (London: Thames and Hudson, 1985, second edition), pp. 224-227.

12. David H. Albert (ed.), *Tell the American People: Perspectives on the Iranian Revolution* (Philadelphia: Movement for a New Society, 1980); F. Hoveyda, *The Fall of the Shah* (London: Weidenfeld and Nicolson, 1980).

13. Andrew McMillan, *Death in Dili* (Sydney: Hodder and Stoughton, 1992), pp. 163-164, 230-232. On the role of nonviolent action in the East Timorese struggle, see Chisako M. Fukuda, "Peace through nonviolent action: the East Timorese resistance movement's strategy for engagement," *Pacifica Review*, Vol. 12, No. 1, 2000, pp. 16-31.

14. Michael Henderson, *Experiment with Untruth: India under Emergency* (Delhi: Macmillan, 1977).

15. Jacques Semelin, *Unarmed against Hitler: Civilian Resistance in Europe, 1939-1943* (Westport, CT: Praeger, 1993), p. 85.

16. Patrick Fitzgerald and Mark Leopold, *Stranger on the Line: The Secret History of Phone Tapping* (London: Bodley Head, 1987).

17. Thomas Icom, "Cellular interception techniques," *2600*, Vol. 12, No. 1, Spring 1995, pp. 23-27.

18. Caller number identification also raises issues concerning protection of personal data. Thus, it is possible that there could be friction between priorities on privacy and on nonviolent resistance. For a discussion of potential problems with surveillance in a social defence system, see Brian Martin, "Possible pathologies of future social defence systems," *Pacifica Review*, Vol. 7, No. 1, 1995, pp. 61-68.

19. On the early history of the British post office, including attempts to shut down alternative posts, see Herbert Joyce, *The History of the Post Office from its Establishment down to 1836* (London: Richard Bentley and Son, 1893). On postal worker struggles in Britain, see H. G. Swift, *A History of Postal Agitation from Fifty Years Ago till the Present Day* (London: C. Arthur Pearson, 1900). For a comprehensive history of disputes in the US Congress over what things should be allowed to be mailed, censorship and wartime controls, see Dorothy Ganfield Fowler, *Unmailable: Congress and the Post Office* (Athens: University of Georgia Press, 1977). On government attempts to monopolise the post, see Carl Watner, "'Plunderers of the public revenue': voluntaryism and the mails," *The Voluntaryist*, No. 76, October 1995, pp. 1-7. A pilot study of the post in relation to social defence is reported in Alison Rawling, Lisa Schofield, Terry Darling and Brian Martin, "The Australian Post Office and social defence," *Nonviolence Today*, No. 14, April/May 1990, pp. 6-8.

20. See, among others, Ann Cavoukian and Don Tapscott, *Who Knows: Safeguarding Your Privacy in a Networked World* (New York: McGraw-

Hill, 1997); Simon Davies, *Monitor: Extinguishing Privacy on the Information Superhighway* (Sydney: Pan Macmillan, 1996); David H. Flaherty, *Protecting Privacy in Surveillance Societies: The Federal Republic of Germany, Sweden, France, Canada, and the United States* (Chapel Hill: University of North Carolina Press, 1989); Oscar H. Gandy, Jr., *The Panoptic Sort: A Political Economy of Personal Information* (Boulder, CO: Westview, 1993); Simson Garfinkel, *Database Nation: The Death of Privacy in the 21st Century* (Sebastopol, CA: O'Reilly & Associates, 2000); David Lyon, *The Electronic Eye: The Rise of Surveillance Society* (Cambridge: Polity Press, 1994); Gary T. Marx, *Undercover: Police Surveillance in America* (Berkeley: University of California Press, 1988).

21. There is a vast body of writing about the net. Useful treatments of net culture include Wendy M. Grossman, *Net.wars* (New York: New York University Press, 1997); Howard Rheingold, *The Virtual Community: Finding Connection in a Computerized World* (London: Secker and Warburg, 1994).

22. David S. Bennahum, "The Internet revolution," *Wired*, Vol. 5, No. 4, April 1997, pp. 122-129 and 168-173.

23. Bob Travica and Matthew Hogan, "Computer networks in the x-USSR: technology, uses and social effects," in Debora Shaw (ed.), *ASIS '92: Proceedings of the 55th ASIS Annual Meeting*, Vol. 29 (Medford, NJ: Learned Information, 1992), pp. 120-135.

24. On hacking see the magazine *2600* and The Knightmare, *Secrets of a Super Hacker* (Port Townsend, WA: Loompanics, 1994).

25. For the dabate over government-sponsored encryption, see Whitfield Diffie and Susan Landau, *Privaacy on the Line: The Politics of Wiretapping and Encryption* (Cambridge, MA: MIT Press, 1998) and Lance J. Hoffman (ed.), *Building in Big Brother: The Cryptographic Policy Debate* (New York: Springer-Verlag, 1995).

26. See for example Simson Garfinkel, *PGP: Pretty Good Privacy* (Sebastopol, CA: O'Reilly & Associates, 1995).

27. Richard B. Gregg, *The Power of Nonviolence* (New York: Schocken Books, 1966); Krishnalal Shridharani, *War without Violence: A Study of Gandhi's Method and its Accomplishments* (London: Victor Gollancz, 1939).

28. M. K. Gandhi, *An Autobiography or the Story of my Experiments with Truth* (Ahmedabad: Navajivan Press, 1927).

29. According to a constructivist perspective, "truth" is always based on human interests rather than objective reality, and hence is more problematical than Gandhi believed. But for this outline of his ideas, "truth" is used without quotes.

30. See V. V. Ramana Murti, "Buber's dialogue and Gandhi's satyagraha," *Journal of the History of Ideas*, Vol. 29, No. 4, 1968, pp. 605-613. I thank Tom Weber for pointing out this reference.

31. Robert A. Bode, "Gandhi's theory of nonviolent communication," *Gandhi Marg*, Vol. 16, No. 1, April-June 1994, pp. 5-30.

32. Note that feminists have criticised the Gandhian emphasis on suffering by nonviolent activists.

33. Thomas Weber, "'The marchers simply walked forward until struck down': nonviolent suffering and conversion," *Peace & Change*, Vol. 18, No. 3, 1993, pp. 267-289.

34. Johan Galtung, *Nonviolence and Israel/Palestine* (Honolulu: University of Hawaii Institute for Peace, 1989).

35. Jürgen Habermas, *The Theory of Communicative Action, Vol. 1. Reason and the Rationalization of Society* (Boston: Beacon Press, 1984); Jürgen Habermas, *The Theory of Communicative Action, Vol. 2. Lifeworld and System: A Critique of Functionalist Reason* (Boston: Beacon Press, 1987).

36. James C. Scott, *Domination and the Arts of Resistance: Hidden Transcripts* (New Haven, CT: Yale University Press, 1990).

37. In the appendix, this terminology is explained in the context of theories of technology.

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Chapter 6

Survival

For a society to engage effectively in a struggle, whether violent or nonviolent, it must be able to maintain the necessities of life, such as food and shelter. In industrialised societies, many important systems, including agriculture, energy, water, transport and housing, have become highly vulnerable to either military attack or sabotage.

Take the electricity system, for example: a few bombs or just some calculated breaches of proper procedures could put large generating plants and transmission stations out of action. If computer programs that ensure a balance between electricity supply and demand were intentionally altered, a system breakdown could easily be triggered.

Fuel supplies are only somewhat more secure. Oil refineries are perhaps the most vulnerable point: a few knowledgable workers could put them out of commission. Oil pipelines and ocean tankers are also easy targets for determined saboteurs.[1]

Water supplies for many cities are quite vulnerable to attack. All it would take is destruction of a few large dams or poisoning of the water supply.

Food supplies are far more vulnerable to disruption than just a century ago. Production is now heavily dependent on fertilisers and pesticides; factories producing these could be put out of action. Biologically sophisticated saboteurs might be able to spread pests and diseases to major crop areas. Few people still live on the land; city populations depend on shipment of large quantities of food from agricultural areas.

Then there is the transport system. Disruption of electricity and fuel supplies would be devastating. Another approach would be tampering with transport computer systems. City traffic would be reduced to a crawl if traffic lights were out of action, and air traffic would become much more risky if automated systems were disrupted.[2]

For a military system, these vulnerabilities mean that an effective defence must prevent the enemy from entering the country's territory. A single bomber or missile can cause enormous havoc. The vulnerability of modern technological systems thus is a justification for so-called "forward defence," namely powerful offensive capacities, including nuclear weapons as deterrents. Vulnerability is also a justification for tight internal security, to guard crucial facilities from saboteurs and to keep information about both military and civilian facilities secret. Thus, vulnerable technological systems play a role in promoting two of the worst features of the warfare society: offensive military capacity and internal repression.[3]

These considerations in themselves should be enough to motivate investigation into less vulnerable systems. In the case of nonviolent struggle they become overwhelming. Without military forces, there is nothing to physically stop enemy troops from entering the community, taking over key facilities such as power stations, cutting off supplies or even destroying the facilities. Given this possibility, developing resilient systems is essential.

Actually, the problem of survival is seldom a telling factor in major struggles. In most wars, even the most ferocious, no attempt has been made to starve the enemy population to death. Nevertheless, there are some instructive examples where survival has played a key role.

After Iraqi troops invaded Kuwait in August 1990, international sanctions were applied to Iraq, preventing most imports and exports. Even after the defeat of Iraq military forces by the US-led coalition in March 1991, the blockade was continued. The bombing of Iraq in early 1991 destroyed much of the country's infrastructure, including water purification plants, electricity generating plants and industry. The continuation of the blockade—which also prevented import of food and medicines, in contravention of international humanitarian agreements—has led to enormous suffering and increased mortality and perhaps a million or more deaths as a result.[4] This example illustrates the high vulnerability of a westernised society.

Although economic "sanctions"—restraints on trade—are commonly seen as a nonmilitary alternative to war, they rely on armed force for implementation and definitely cannot be considered a method of nonviolent action. Sanctions often are ineffective or counterproductive.[5]

Beginning in 1975, the Indonesian government enforced an effective blockade against East Timor in order to combat guerrilla and popular resistance. Since East Timor is half of a remote island, the other half of which is Indonesian territory, enforcing the blockade was not difficult, given that no other government did much to challenge the Indonesian occupation in spite of repeated United Nations resolutions.[6] Direct killings and starvation due to the blockade led to the deaths of perhaps one third of the East Timorese population. In this case, the blockade has been a potent tool against a largely rural society.

In 1988, people of the island of Bougainville in the southwest Pacific declared their independence from Papua New Guinea. The PNG government mounted a military operation against the Bougainville Revolutionary Army, supplementing this with a blockade. The blockade was intended to be total, preventing even medicines from being brought in. As might be expected, this has led to considerable suffering on the island.

In the cases of Iraq, East Timor and Bougainville, blockades were used to help subjugate an armed resistance and, in each case, caused hardship and death in the population. The existence of an armed resistance helped to provide a public justification for these blockades, however inhumane and illegal they may be. If the resistance is totally nonviolent, it becomes more difficult to justify a blockade. Perhaps the best example of such tactics used against an unarmed resistance is the Israeli occupation of Palestine, mentioned in chapter 3. During the intifada, from 1987 to 1993, the Palestinian resistance to the Israelis was largely nonviolent, though it is more appropriate to call it unarmed since it was mostly a lack of arms rather than a principled position that restricted the use of violence. (The throwing of stones was a commonly used tactic.) The Israeli occupiers used a variety of harsh methods to quell the resistance, including beatings, destroying houses and shops, enforcing curfews (often for days at a time), closing down schools and universities, and preventing travel. The net effect of these measures made survival problematic for many Palestinians, for example when economic sanctions reduced family finances to minimal levels and curfews prevented movement out of houses for all but a few hours per day. The Palestinian case is different from that of Iraq, East Timor and Bougainville both in the lack of a resistance armed with more than slingshots and stones and in the enormous international sympathy and support generated by the struggle.

Although a population waging a nonviolent resistance—at least one with a capacity to communicate to the rest of the world—is unlikely to be starved to death or otherwise find its very survival at stake, it is prudent to be prepared for the worst. This is a task for engineers.

Historically, the engineering profession began with military applications. When a branch of engineering developed that was

concerned with nonmilitary applications, it was called civil engineering to emphasise the civilian orientation. Today, there are many branches of engineering, from mechanical to computer engineering, all of which can be used for military or nonmilitary purposes. As described in chapter 2, even ostensibly nonmilitary engineering can often be adapted for military purposes. There are very few engineers who have even considered what it would mean to direct their specific engineering talents to promoting peace.[7] Presented here are a few preliminary ideas about redesigning technological systems to make them more suitable for nonviolent struggle.[8] It would only take a few dedicated engineers or other experts to test and develop these ideas.

The water supply, especially one based on large dams, is highly vulnerable to disruption. Dams could be designed so that, in an emergency, the water could be released quickly but safely. In a number of countries that are still developing their infrastructure, choosing microhydro rather than large dams would greatly aid resilience against attack. Another approach is using water tanks and dry toilets to reduce water requirements from a central supply system which might be destroyed by an aggressor.

Similarly, producing steel at numerous minimills, geographically dispersed, provides greater resilience than having a few large integrated steelworks. Installing solar and wind power systems throughout the country would mean that the population could not be held hostage by control over electricity generating plants. The challenge is to develop technologies that are efficient and require little maintenance. Of course, economic incentives are important in promoting such alternatives.

Bridges are often attacked by aggressors. Building a bridge that would survive any attack would be impossibly expensive, though designs allowing easy rebuilding would be possible. Also, bridges might be designed so that saboteurs could easily be detected. Laser detectors, perhaps?

Similar considerations apply to housing. In order to be able to reconstruct destroyed buildings, designs should be simple and straightforward, relying on readily available materials. Portable homes might be useful for moving people around the country. There is some research on cheap, effective housing for the Third World which may be applicable. Research could be done on materials to make tents long-lasting. Combined with telecommunications, tent-based activists would be hard to track down.

In the case of manufacturing, aggressors often take over plants for their own purposes. To resist, workers could go on strike, but torture against workers or their families could be used to break the strike. Another approach is to go slow and make "inadvertent" mistakes, as done in some factories taken over by the Nazis in World War II. A technological solution—raised by Johan Galtung, quoted in chapter 4—is to design the factory so that vital pieces of equipment can be removed or destroyed. Replacements could be kept in a safe place, such as another country. Torture would be pointless, since it couldn't get the factory going again. Actually, in many modern factories, the technological sophistication is so great that outsiders would not know whether the workers were resisting or not.

When hierarchies are flattened and groups of workers can operate without a boss, the workforce is better equipped to resist a takeover. Therefore, manufacturing systems that are tied to empowering the workers may be the best for nonviolent struggle.

Large-scale monocultures are vulnerable to disruption. A more resilient food system would include many local gardens and food-bearing trees. Relevant research here includes seed varieties robust to lack of fertilisers and pesticides, nutritious diets from wild natives, and methods for long-term storage of food.[9]

A transport system highly resilient to attack can be achieved by designing communities so that most travel can be accomplished by walking or cycling, in contrast with systems of

roads or rail which can be interrupted by cutting off fuel. Powered vehicles are very useful for shipping goods, so it would be valuable to design vehicles that are simple to build and repair, use fuels that can be easily produced or stored throughout the community and, perhaps, in an emergency could be powered by human muscles.[10] There is likely to be a trade-off between the convenience of maintaining some forms of motorised transport and their vulnerability. Thus there is a general challenge to develop motorised transport technologies that cannot be easily disrupted by an aggressor.

Health

Many doctors and health workers have been involved in peace activism over the years,[11] but only some of this involvement is directly relevant to nonviolent resistance to aggression and repression. One of the ways that health professionals today help to oppose repression is by documenting cases of torture or execution. Governments routinely deny that they are involved in torture and extra-judicial execution; investigations and authoritative pronouncements by medical and forensic experts can help to expose such abuses. Some of the activities of physicians and medical researchers concerned about violations of human rights include:

- assessing cases of alleged torture;
- exhuming bodies (sometimes buried months earlier) and determining the cause of death;
- using genetic tracing to track down relatives of orphans whose parents have disappeared, presumed murdered;
- estimating the number of casualties in wars;
- carrying out psychiatric assessment of torture survivors;
- examining conditions in prisons;
- training health workers in skills related to the topics above and in the ethics of collaborating with regimes using torture.[12]

Technologies used for torture are mostly familiar: batons for beatings; electricity for shock; cigarettes to cause burns. Occasionally there is some innovation in torture, such as beatings on the soles of feet (falanga) in order to inflict pain without leaving physical traces. In such cases there is a place for research to develop new means of detecting torture. Turkish physician Veli Lök helped develop a method of detecting falanga using bone scintigraphy. Courts have used medical reports based on this method as proof of torture.[13]

As well as exposing abuses by repression regimes, another and bigger task for health workers is to promote a healthy society. A society in which people are healthy and self-reliant in health care is undoubtedly better prepared to resist aggression and repression. Maintaining health in the face of attack is a tall order. Aggressors might

- assault nonviolent protesters or bystanders;
- engage in forced labour and torture;
- impose a blockade that cuts off food and medical supplies;
- destroy power supplies or sanitation facilities, increasing the risks of disease;
- lay landmines;
- spread diseases, inadvertently or purposefully;
- launch military attack, including bombing.

When a population uses only nonviolent methods of resistance, full-scale military attack is less likely than when there is violent resistance. Nevertheless, it is important to be prepared for serious health consequences of aggression. In such a situation, it is unlikely that the conventional medical system could cope. A large influx of casualties would overwhelm hospitals. Emergency procedures, familiar to doctors working in theatres of war, are appropriate.[14] Disaster planning—usually the province of civil defence managers—is needed for the health sector as well as others.

More generally, many members of the community need to develop skills in diagnosis and treatment. Simple first-aid measures are often sufficient, even for some serious injuries.

A society prepared for the adverse health consequences of aggression might:

• make first-aid training a regular part of nearly everyone's continuing education;

• run medical disaster simulations, analogous to fire drills;

• provide subsidised packages of basic medical materials to every household and building;

• make widely available handbooks describing basic medical procedures;

• set up decentralised production facilities for basic medical items such as anaesthetics and antibiotics;

• promote a simple, nutritious, locally obtainable diet;

• support use of effective alternatives to conventional medicine[15];

• engage in ongoing discussion and debate about self-help and low cost methods of promoting health.

These sorts of initiatives towards self-reliance in health care often conflict with the priorities of industrialised medicine, with its reliance on expert professionals, expensive technology and drugs provided by transnational corporations. Industrialised medicine is vulnerable in the face of attack, whereas self-reliant health care is resilient.

Miriam Solomon, a researcher into health and democacy, has thought about these issues. She draws attention to the rhetoric of the World Health Organisation (WHO) "on primary health care and health promotion, as embodied, for example, in the Ottawa Charter. That document urges a range of strategies, including political ones, for developing personal skills, strengthening communities, improving the social and physical environments, reorienting health services (away from the medical model), and incorporating health sensitive public policies in all sectors." She notes that the same principles that apply to food, energy and so forth also apply to health.

> The decentralisation of service provision, the shift away from high technology, specialised, institutionalised curative oriented care, towards community and individual control over social, political and physical environments, as well as being consistent with health promotion and primary health care strategies, would probably also be the best preparation for social defence. Thus the uncorrupted interpretation of the New Public Health and the WHO interpretation of Health Promotion are what is needed for preparing for social defence. They are about giving people control of their own lives, empowering individuals and communities, learning skills for becoming politically and socially aware, and building community cohesion and political constituencies, with adequate sensitivity to the needs of other environments and communities.[16]

Appropriate technology (AT)

Generally speaking, the entire body of work on community self-reliance is relevant to the task of building technological systems to ensure the survival of the population in the face of aggression. Much of this work goes under the title of "appropriate technology," "alternative technology," "intermediate technology" or various other names. There are various definitions of AT and a host of arguments about AT-related strategies for technological and social change.[17] It's not necessary to traverse these definitions and arguments here, since my aim is to point out some commonalities and differences between AT and technology for nonviolent struggle.

According to one typical source, AT covers tools and techniques that:

"1) require only small amounts of capital;

"2) emphasize the use of locally available materials, in order to lower costs and reduce supply problems;

"3) are relatively labor-intensive but more productive than many traditional technologies;

"4) are small enough in scale to be affordable to individual families or small groups of families;

"5) can be understood, controlled and maintained by villagers whenever possible, without a high level of special training;

"6) can be produced in villages or small workshops;

"7) suppose that people can and will work together to bring improvements to communities;

"8) offer opportunities for local people to become involved in the modification and innovation process;

"9) are flexible, can be adapted to different places and changing circumstances;

"10) can be used in productive ways without doing harm to the environment."[18]

AT for the Third World includes simple tools for working sheet metal, organic gardening, simple-to-construct ox carts, small farm grain storage methods, techniques of growing tropical fruit trees, methods of fish farming, hand-dug wells, inexpensive water filtration techniques, local production of fuel alcohol from agricultural wastes, self-built stoves, simple windmills, small hydropower, passive solar design, biogas generators, inexpensive techniques for house building, low-cost vehicles, community health care techniques, and management skills for small businesses.[19] This list highlights the important point that AT is not just about implements but includes techniques for using them and fitting them into a wider programme of community development.

It is straightforward to examine these ten criteria to see whether they are also relevant to technology for nonviolent struggle.

1) If only small amounts of capital are required, then technology can more readily be replaced after destruction by an aggressor. By contrast, hugely expensive fertiliser plants, electricity generating stations or dams are obvious targets to be destroyed or taken over.

2) If materials are locally available, then an aggressor cannot cut off supply. For example, most oil supplies are imported from another part of the country or world and hence constitute a source of leverage for an aggressor.

3) Being relatively labour-intensive does not directly aid nonviolent struggle. There may be an indirect advantage, though. If more labour is required and much of it does not require highly specialised skills, then it is more likely that there will be work for anyone who wants it, with a reduction in alienation and social divisions. This in turn would help unify a community in the face of attack.

4) Affordability to families seems similar to point 1.

5) If ordinary people can understand, control and maintain technology, then it is much harder to hold them hostage via the technology. For example, most people can learn how to ride and fix a bicycle. Most can drive but not many can fix more than a few problems with cars. Few can drive a train or fly an aeroplane, much less fix them. The greater the number of people who can keep the technology going if necessary, the less vulnerable the community is.

6) Local small-scale production is less vulnerable to attack than centralised large-scale production. Water tanks to collect rainwater can be produced locally; large dams cannot and hence are a vulnerability in the face of aggression.

7) Bringing people together to work aids the potential for nonviolence resistance by fostering social cohesion. Working together in community gardens seems more likely to foster solidarity than buying food in a supermarket.

8) Having local people involved in technological adaptation and innovation builds skills and commitment that become highly valuable in case of a threat.

9) Flexibility is an obvious advantage if an aggressor tries to subjugate a population through control over technological systems.

10) Low environmental impact seems to have no direct relevance to survival of a population waging nonviolent struggle, at least in the short term. For example, if centrally generated power is not available, local coal or wood supplies might be used, causing lots of pollution but not necessarily weakening the

resistance. On the other hand, local solar and wind power might be an alternative without the same environmental impact.

Thus, most of the ten criteria for AT are also suitable for selecting technology for nonviolent struggle and none is incompatible with requirements for nonviolent struggle. This suggests a high degree of overlap between these two ways of approaching technological choice. There are a few differences, though. The ten criteria are mainly aimed at poor countries. In rich countries, there are some technologies that do not fit AT criteria but may still be highly useful for nonviolent struggle. For example, a sophisticated system of telecommunications will aid nonviolent struggle, especially if designed so that it cannot be readily controlled or monitored centrally. There are enough technically trained people in rich countries to allow for some degree of community control of telecommunications, though in practice many changes would be necessary to bring this about.

When it comes to the major systems necessary for survival—agriculture, energy, manufacturing, transport—rich countries mostly have been moving away from criteria for AT and instead becoming more vulnerable to disruption and takeover. The AT movement provides a direction for change, and many individuals and groups have made valiant efforts to move in this direction, but they have not been very successful in the face of dominant forces, including the military—military technology is seldom AT.

The connection between AT and technology for nonviolent struggle almost seems too easy. If AT advocates had been more successful over the years, then technological systems would be set up for effective nonviolent resistance. Why should the convergence be so neat? To begin, further study is needed to determine whether the connection is really as straightforward as it seems from a preliminary analysis. But there are some general reasons for the convergence. AT can be considered to be the technological component of a general strategy of community self-reliance, which can be treated as a strategy for development.[20] The strategy of self-reliance challenges the usual approach of development from above, which typically involves centralised governments (often dominated by the military) and harsh economic control by international agencies, all of which make local populations subject to both repression and international economic exploitation. Self-reliance is thus a strategy that aims at liberation from both repression and oppression. In as much as AT fits into this strategy, it provides support for nonviolent struggle against repression and oppression. Of course, AT won't provide everything useful for nonviolent struggle, but it's a good place to begin.

In poor countries, most people have traditionally lived on the land. With their integration into the world economy, there have been strong pressures to produce cash crops for export. No longer being self-sufficient in food, this makes the people more vulnerable to local dictators as well as foreign aggressors. This form of "development" thus works hand-in-hand with military systems. In this context, land reform becomes a measure to foster the capacity for nonviolent struggle. The technology of local food production is one aspect of this issue, but the key is self-reliance and local control.

Notes

1. On energy vulnerability see Wilson Clark and Jake Page, *Energy, Vulnerability, and War: Alternatives for America*. New York: Norton, 1981; Amory B. Lovins and L. Hunter Lovins, *Brittle Power: Energy Strategy for National Security*. Boston: Brick House, 1982; James L. Plummer, ed., *Energy Vulnerability*. Cambridge, MA: Ballinger, 1982.

2. See Colin Kearton and Brian Martin, "Technological vulnerability: a neglected area in policy-making", *Prometheus*, vol. 7, no. 1, June 1989, pp. 49-60; Peter G. Neumann, *Computer-Related Risks* (New York: ACM Press, 1995).

3. Brian Martin, "Technological vulnerability," *Technology in Society*, Vol. 12, No. 4, 1996, pp. 511-523.

4. Geoff Simons, *The Scourging of Iraq: Sanctions, Law and Natural Justice* (Basingstoke: Macmillan, 1998, 2nd ed.); Nikki van der Gaag (ed.), "Iraq: What United Nations sanctions have done" (theme issue), *New Internationalist*, No. 316, September 1999.

5. David Cortright and George A. Lopez (eds.), *Economic Sanctions: Panacea or Peacemaking in a Post-Cold War World?* (Boulder: Westview Press, 1995).

6. The contrast between UN inaction over Indonesia's invasion and occupation and UN-sponsored action over Iraq's invasion and occupation is striking.

7. One who has done so is David Paterson, "Peace and engineering," in Sandra Sewell, Anthony Kelly and Leonie Daws (eds.), *Professions in the Nuclear Age* (Brisbane: Boolarong Publications, 1988), pp. 201-212.

8. Many of these ideas come from engineers at the University of Wollongong interviewed by Mary Cawte and me.

9. Methods used by farmers to survive the impact of warfare are relevant here. For example, in Angola farmers intensively cultivated tiny plots, grew the very hardy grains millet and sorghum, took up hunting and fishing, saved seeds to sow the next year's crop and adopted mutual aid systems for planting, weeding and harvesting. Although some of these practices, such as choosing hardy grains and saving seed, reduced yields, they were more resilient in times of intense threat and stress. See David Sogge, *Sustainable Peace: Angola's Recovery* (Harare, Zimbabwe: Southern African Research and Documentation Centre, 1992), pp. 39-41. I thank Rebecca Spence for providing this reference.

10. Ivan Illich, *Energy and Equity* (London: Calder & Boyars, 1974), argued that in an equitable society, transport speeds should be no greater than about 15 miles per hour. He favourably referred to the example of a slow-but-efficient goods vehicle used in Mexico. Although Illich's strict limit on speeds can be criticised, his basic analysis is relevant to the task of building a transport system for nonviolent struggle. Arguably, an equitable system, in which no segment of the population obtains transport privileges at the expense of others, is likely to promote the sort of community solidarity so necessary for waging nonviolent struggle. As well as fostering solidarity, is it also the case that "slow is beautiful" when it comes to developing a transport system resilient against attack?

11. Nick Lewer, *Physicians and the Peace Movement: Prescriptions for Hope* (London: Frank Cass, 1992).

12. An excellent compendium of materials is Carola Eisenberg and Susannah Sirkin (directors), *Human Rights and Medicine: The Uses of Medical Skills in Documenting Abuses and Treating the Victims* (conference proceedings) (Department of Social Medicine, Harvard Medical School and Physicians for Human Rights (100 Boylston Street, Suite #702, Boston MA 02116, USA), 10-11 April 1992). These proceedings include, among others, copies of the following publications: Clyde Collins Snow, Eric Stover and Kari Hannibal, "Scientists as detectives: investigating human rights," *Technology Review*, Februrary/March 1989, pp. 43-51; Paul Wise, Nancy D. Arnison, Gregg Bloche and Jane G. Schaller, "Operation *Just Cause*: a case study in estimation of casualties after war," *PSR Quarterly*, Vol. 1, No. 3, September 1991, pp. 138-144; Anne E. Goldfield, Richard F. Mollica, Barbara H. Pesavento and Stephen V. Faraone, "The physical and psychological sequelae of torture," *Journal of the American Medical Association*, Vol. 259, No. 18, 13 May 1988, pp. 2725-2729; Kenneth S. Pope and Rosa E. Garcia-Peltoniemi, "Responding to victims of torture: clinical issues, professional responsibilities, and useful resources," *Professional Psychology: Research and Practice*, Vol. 22, No. 4, 1991, pp. 269-276.

13. Veli Lök, letter to Brian Martin, October 1994.

14. An excellent practical reference is Hans Husum, Swee Chai Ang and Erik Fosse, *War Surgery Field Manual* (Penang: Third World Network, 1995). The authors provide information for emergency operations in forward clinics and argue that in war zones surgery can be done by people without formal medical qualifications.

15. Robert Burrowes suggested the points about diet and alternatives to conventional medicine.

16. Miriam Solomon, letter to Brian Martin, 20 January 1992.

17. A penetrating examination of this area is given by Kelvin W. Willoughby, *Technology Choice: A Critique of the Appropriate Technology Movement* (Boulder: Westview Press; London: Intermediate Technology Publications, 1990). See also Godfrey Boyle, Peter Harper and the editors of *Undercurrents* (eds.), *Radical Technology* (London: Wildwood House, 1976); David Dickson, *Alternative Technology and the Politics of Technical Change* (London: Fontana, 1974); Romesh K. Diwan, "Total revolution and appropriate technology," *Gandhi Marg,* Vol. 4, No. 7, October 1982, pp. 631-645; Romesh Diwan, "Appropriate technology: political and economic obstacles," *Gandhi Marg,* Vol. 5, No. 2, May 1983, pp. 65-74; Ivan Illich, *Tools for Conviviality* (London: Calder & Boyars, 1973); George McRobie, *Small is Possible* (London: Jonathan Cape, 1981); Willem Riedijk, *Technology for Liberation: Appropriate Technology for New Employment* (Delft: Delft University Press, 1986).

18. Ken Darrow and Mike Saxenian (eds.), *Appropriate Technology Sourcebook: A Guide to Practical Books for Village and Small Community Technology* (Stanford, CA: Volunteers in Asia, 1986), p. 7.

19. These examples are taken at random from Darrow and Saxenian, ibid.

20. Johan Galtung, Peter O'Brien and Roy Preiswerk (eds.), *Self-Reliance: A Strategy for Development* (London: Bogle-L'Ouverture, 1980).

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Chapter 7

The built environment

by Helen Gillett, Brian Martin and Chris Rust

Architecture and town planning have a big impact on the willingness and capacity of people to engage in nonviolent struggle.[1] By the design of workplaces, people may find it easy to get together to talk or they may find it easier to remain separate. For example, if there is an attractive and convenient place to eat lunch, workers are more likely to get together then; if not, they are more likely to eat separately. Similarly, the design of housing and layout of streets have a big impact on communication patterns, such as whether people speak to their neighbours or visit other people's homes.

Cultural traditions play a big role in social behaviour, but town planning and architecture are quite influential. In high-rise blocks of apartments, without convenient communal facilities, there is little sense of community. In typical US suburbs, the dispersed physical layout encourages families to mostly interact with themselves and perhaps a few neighbours. In the Israeli kibbutzim, by contrast, the buildings are originally designed to foster high social interaction, for example in the communal child rearing. At intermediate possibility is "co-housing," found for example in Denmark, which combines private living quarters with some collective facilities such a dining hall.[2]

Transport systems have an important impact on the capacity for nonviolent struggle through their effect on community solidarity. The automobile is a major problem in this regard, since a dispersed, car-dependent society tends to separate people from each other, putting them in suburbs remote from work, shops and leisure. Freeways are notorious for breaking up communities. Automobility for those with access to cars reduces mobility for those without, causing social inequality and reducing social solidarity. The transport modes most likely to foster a sense of community are those which cater for everyone, including children, the poor and people with disabilities. This means walking and low-priced public transport.[3]

In facilitating nonviolent resistance it is desirable that members of a community interact and communicate with each other in a manner that produces a "sense of community" which also facilitates organisation of their defence. One way in which the built environment is likely to aid this is through the provision of "meeting places." A number of public arenas can be meeting places, including footpaths and pavement cafes, market squares, shopping malls, community centres and town halls, fair and sporting grounds, gardens, parks (especially those containing water sites), playgrounds, and commons. Though many cities incorporate such places in their layout, the number, location, design, and style of public spaces influence community solidarity.

To achieve this, meeting places should be abundant enough to be easily accessible by members of the community, preferably within a short walk by local residents. The provision of meeting places in this way could make high density housing much more enticing. Suburban housing blocks tend to emphasise individuals more than communities. Where space considerations limit housing to high rise apartment buildings, meeting places (similar to office tea or staff common rooms) could also be contained near, and open to, the stairwell of each building floor or level.

A preference for higher density housing is echoed by Edmund Fowler when he discusses deconcentrated housing. Higher density housing environments foster neighbour interaction, which can cause tensions and culture clashes, but also can be valuable toward solving social problems. In contrast, physically segregated communities lead to diminished social and political skills and responses, and hence reduced civic participation. Contact between people is greater with mixed land use and building age, and short blocks with concentration of use. Under such combination of private and public life, residents tend toward "looking after their street," and developing networks of trust and confidence. These conditions deter vandalism and similar problems. Unfortunately contemporary urban environments are "justified" by supposedly "objective" economic indicators, such as household incomes and the number of owner-occupied houses, though, Fowler argues, servicing and supplying deconcentrated housing costs more.[4]

Though meeting places may be instrumental toward nonviolent struggle, when they are in the hands of private developers, they may be a hindrance to social action. Owners of enclosed shopping centres may control such things as opening hours, entry and exit locations, who can lease shops, what notices can be put on public display, and even who uses their centre. Likewise, whole sections of the community can be similarly affected if private developers are given the go-ahead to control walled suburbs or apartment blocks with security entries. Town planners and other relevant authorities need to keep these points in mind if they wish to use meeting places and town layout to promote community solidarity.

The rise of consumerism and the growing affluence of western societies have enabled vast numbers of people to leave the inner city areas for the perceived peace, security and clean air of the suburbs. Instead of living with the everyday problems encountered in these inner city areas, such as poverty, crime, and pollution, and perhaps doing something about them, many could now afford to simply escape them. The ultimate form of escape is to be able to buy into one of the walled, permanently patrolled security estates which are becoming increasingly common.

Another problem associated with many contemporary meeting places arises out of public space "misuse" by street gangs and vandals. One possible way to help solve this problem is offered by Colin Ward under the term of "unmake." This concept suggests that, instead of providing youths with just traditional meeting places such as playgrounds and parks, more subtle meeting places such as safe "construction sites" or "adventure playgrounds" are needed to redirect the energies of would-be trouble-makers. The trick to this idea seems to be the nonobvious association with conformity and intervention of authority.[5]

Closely related to design for nonviolent struggle is design to reduce crime, something that has been studied and implemented in cities in a number of countries. Factors that reduce crime, and the fear of it, include lighting, sightlines, activity generators and visibility by others.[6] It seems plausible that many of the approaches used to improve safety in public places will also help build community interactions and a sense of individual security that will enhance the capacity to wage nonviolent struggle.

John Turner argues that a key issue is whether people build, control or manage their own housing. He provides many examples from both rich and poor countries. When housing is centrally planned, specified and built, it is likely to be more expensive, wasteful of resources, hard to adapt and socially inappropriate. Expensive, centrally built housing is vulnerable to vandalism. Centrally controlled housing is more susceptible to takeover by an aggressor. When people choose and manage their own styles of housing, they are likely to be more satisfied with it, even when it is materially far poorer than centrally provided housing.[7]

Autonomy in housing is linked to greater flexibility, which is good for nonviolent strug-

gle. The skills that people develop from building, controlling and managing their own housing provide resilience in the face of attack. People will know what to do in case housing is destroyed or services such as electricity and water are interrupted.

As mentioned in the previous chapter, having a surplus of housing is a good idea for a community wishing to defend itself nonviolently. If some dwellings are destroyed, then there are places for occupants to stay. More importantly, though, a surplus of housing should mean that no one need be homeless. A society that ensures housing for everyone is less likely to be divided socially. Generally speaking, community solidarity is greater when there is greater equality. This applies to housing as much as to anything else.

There are numerous examples of people taking control of their own destinies and creating the type of neighbourhood or community in which they desire to live. Urban renewal programs, formulated and imposed from above, have generally been very expensive and spectacularly unsuccessful. Fowler lists several examples of people living in run down, depressed, inner city areas successfully instigating their own urban renewal programs. These range from the establishment of community gardens to the renovation of derelict buildings—whereby the inhabitants contribute labour rather than capital, which is generally in short supply—to secure an improved standard of living. These cooperative efforts can generate a genuine sense of community. The renewed sense of pride in their environment and themselves reduces crime rates and other social problems.[8]

This chapter has provided a number of examples of the sorts of building design and town planning that seem likely either to hinder or help nonviolent resistance. A key factor is community solidarity. Designs that foster cooperative interaction are the most helpful ones, whether the points of congregation are inside office buildings, in co-housing complexes, at street corners or in village squares.

Notes

1. This chapter is adapted from Helen Gillett, Brian Martin and Chris Rust, "Building in nonviolence: nonviolent struggle and the built environment," *Civilian-Based Defense*, Vol. 11, No. 3, Fall 1996, pp. 1, 4-7, which also describes military influences on the built environment.

2. Kathryn McCamant, *Cohousing: A Contemporary Approach to Housing Ourselves* (Berkeley, CA: Habitat Press, 1988).

3. Donald Appleyard, *Livable Streets* (Berkeley: University of California Press, 1981); Ivan Illich, *Energy and Equity* (London: Calder and Boyars, 1974); K. H. Schaeffer and Elliot Sclar, *Access for All: Transportation and Urban Growth* (Hasmondsworth: Penguin, 1975).

4. Edmund P. Fowler, *Building Cities that Work* (Montreal: McGill/Queen's University Press, 1992). Fowler discusses a number of issues along these lines; see also Jane Jacobs, *The Death and Life of Great American Cities* (New York: The Modern Library, 1969).

5. Colin Ward, *Connexions: Violence—Its Nature, Causes and Remedies* (England: Penguin Education, 1970).

6. Gerda R. Wekerle and Carolyn Whitzman, *Safe Cities: Guidelines for Planning, Design, and Management* (New York: Van Nostrand Reinhold, 1995). I thank Nichole Dusyk for suggesting this reference. Designing the built environment to reduce crime does not preclude efforts to address poverty, discrimination and social policies that create crime.

7. John F. C. Turner, *Housing by People: Towards Autonomy in Building Environments* (New York: Pantheon Books, 1977).

8. Edmund P. Fowler, *Building Cities that Work* (Montreal: McGill/Queen's University Press, 1992).

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Chapter 8

Countering attack

A population, even one using no violence itself, is vulnerable to attack using conventional, biological, chemical, nuclear and other weapons. A well-designed system for nonviolent struggle therefore must also incorporate civil defence, namely protection against military attack. There is a large literature on civil defence, especially against nuclear attack. This can include fallout shelters, stockpiles of preserved food, emergency plans, drills, backup systems for electricity and water supply, etc. In only a few countries, notably Sweden and Switzerland, is civil defence planning carried out in a systematic and comprehensive fashion, for example to the extent of having some factories underground to survive attack. Most civil defence planning is carried out by governments; in few countries today is there much popular participation in planning or genuine enthusiasm for civil defence preparations.

In wartime, civil defence measures are taken most seriously. Most civilians are willing to use air raid shelters and to observe blackouts. In a society organised for nonviolent struggle, some such measures also make sense. However, many peace activists have been hostile to civil defence preparations—especially planning to survive nuclear attack—because they are part of a wider military mobilisation of society. The logic goes like this: a government may be more willing to threaten or launch a nuclear attack if the country's population is protected by civil defence and able to survive a counterattack; therefore, civil defence preparations should be opposed since they make the likelihood of nuclear war greater. In short, civil defence preparations by an armed state can be provocative and increase the possibility of war.

The situation is quite different for a society that renounces the means for warfare. Civil defence preparations then are clearly only a means for increasing survival in the face of attack, not for preparing for war. As noted in chapter 6, using self-reliant systems is a highly effective way to increase the chances of survival. Adding civil defence to self-reliance in energy, water, agriculture and the like makes a lot of sense.

There is another aspect to the peace movement's hostility to civil defence: it undercuts the common belief in the movement and the wider society that nuclear war is not survivable. In peace movement circles it has long been an article of faith that global nuclear war would mean at least the destruction of "civilisation" and possibly the extermination of the human species. On the other hand, most civil defence and military planners believe that nuclear war—while being a major and perhaps unprecedented disaster—could be waged without killing the majority of the world's population or destroying the capacity of societies to continue functioning. My own view is that the civil defence and military planners are probably right. Peace movement exaggerations of the consequences of nuclear war may serve to make people more worried in the short term, but can actually be paralysing and certainly make it more difficult to mobilise people for the long-term struggles to build alternatives to the military system. Needless to say, these views are controversial.[1] My main point here is that supporters of nonviolent struggle should be willing to consider taking and adapting ideas from the field of civil defence without being put off by its usual associations with military planning.

As noted before, most civil defence planning is undertaken by governments. Furthermore, it is designed against "foreign" aggression. What is really needed for nonviolent struggle is defence against any aggressor, including the government itself. It should be no surprise that governments do not spend much time helping their populations develop the means to resist and survive the government's own repressive acts. Nor is there much study of this. There is much to learn from people's improvised resistance to attack.

The best study I know of this sort is Barton Meyers's article "Defense against aerial attack in El Salvador,"[2] which gives many specific insights. To survive bombing from El Salvador's air force, both civilians and guerrillas developed and used a range of methods. No sophisticated warning systems were available, so people had to develop their own skills in detecting and identifying aircraft. When spotter planes were seen, people froze in place so they wouldn't be seen; any moving target was subject to attack. When the spotter plane changed course, people would seek shelter, sometimes setting off a firecracker to warn others.

Concealment was widely used. Leafy trees were grown next to houses to hide them. Houses that were partly destroyed were left unrepaired to hide the fact that they were still being lived in. At the sound of aircraft, fires were quickly doused; alternatively, underground ovens were used with long tunnels to absorb smoke. Radio transmissions were not used by guerrillas to avoid being intercepted. Peasants wore dark clothing to avoid detection. They grew crops whose colour was not readily noticeable from the air and crops that were hidden by other plants.

Shelters were built and disguised. Natural features, such as forests and ravines, were also used for shelter. Guerrillas built extensive tunnel systems. In areas subject to frequent attack, shelter drills were carried out. When the government army invaded following air attack, guerrillas often would lead an evacuation of the population, returning later.

The guerrillas, in the face of heavy air attack, dispersed their forces to groups of 4 to 15 fighters spread out over hundreds of meters. Larger units would have been more vulnerable to air power. The dispersed fighters were concentrated only for attacks or briefly at night. Another tactic was to deploy the guerrillas very near to government troops, where aerial attack might harm the government's own soldiers.

As well as methods of surviving attack, other techniques of struggle were used, such as broadcasting reports of deaths or injuries of civilians due to air attack. Such human rights appeals were highly effective, and would be even more so in the context of a purely nonviolent resistance.

There is a great need for many more studies like that of Meyers, as well as a need to circulate the findings to people who can use them. Unfortunately, the contemporary field of disaster studies has neglected the study of war as a disaster. One factor behind this may be that most war disasters occur in poor countries whereas disaster studies are largely carried out in the rich countries which sponsor and provide weapons for these wars.[3]

As well as knowing how to respond to aerial attack, there are many other areas in need of investigation, including firearms, landmines, biological agents, chemical weapons and nuclear weapons. A first step would be to provide basic technical information that is accessible to nonspecialists and which can be used to provide a realistic assessment of dangers and possibly to expose uses of the weapons.[4]

Yet another entire field is "repression technology," which includes instruments of restraint, intimidation, torture and surveillance, ranging from plastic bullets, chemicals such as mace, leg irons, thumbscrews, drugs for causing trauma, assassination rifles, batons, electroshock equipment, telephone taps, vehicle identification, and execution chambers. There is a large industry devoted to producing and

selling such technologies, yet very little in the way of analysis.

Repression technologies can be used by police as well as military personnel. While some of these technologies are designed to kill, others are intended to hurt or restrain people without killing them. These are referred to as "nonlethal weapons."[5] Some of these nonlethal weapons are designed to disable lethal weapons and their support systems, such as bugs to put in fuel to eat away linings, hydrogen embrittlement of weapons, antitraction technologies, supercaustics, combustion modifiers and computer viruses. These could be used, in principle, as part of nonviolent sabotage. However, the larger category of nonlethal weapons is aimed at personnel and are designed for riot control or counterinsurgency.

The term "nonlethal" can be misleading, since these weapons can kill on occasion, such as when rubber bullets enter the brain through an eye or when chemical sprays trigger a fatal allergic reaction. The term "nonlethal" serves a political function, suggesting that the weapons are a more peaceful alternative to lethal ones. In practice, nonlethal weapons typically serve as a supplement to lethal ones, especially in circumstances when deaths would boomerang on the side causing them. For these reasons, the term "repression technologies" is frequently more appropriate.

Steve Wright, a leading authority on repression technologies, believes there is considerable insight to be gained about how to respond to them, for example by contacting people who have been sprayed by riot control chemicals and finding out practical ways of avoiding or minimising the effects.[6] For example, he suggested that

> The scientific material on riot agents often includes advice on decontamination which could be applied. There is also the work on IRA [Irish Republican Army] countermeasures which contains a vast store of possible technology which could be used without their violent ethos. This includes material on interception of signal intelligence material using adapted black and white televisions; blocking of surveillance devices using field animals; detection of helicopters and SAS squads using stolen NATO infra-red binoculars; etc.[7]

Yet there has been almost no systematic effort devoted to investigating such techniques. Information about responses remains fragmented and dispersed. Then there is the wider task of opposing these technologies at a political and economic level, by exposing their effects and uses and organising to stop them. Only a relatively few researchers and activists have taken up this vital task.[8]

When an aggressor is seen to use violence against a population that has no weapons, public outrage is likely to be enormous. Hence, attacks on civilians are often disguised or denied. This points to the need for systems to monitor, record and disseminate information showing where the attack comes from and what the consequences are. (This is similar to the medical issue of detecting and verifying torture.) It may be—contrary to my arguments above—that not seeking protection may be more effective in exposing the unscrupulousness of the attackers. But how many people should be willing to risk or sacrifice their lives in such an endeavour?[9] Does it make sense to refuse protection when the attacks come from high-altitude bombers whose crews can't even see their human targets? Perhaps measures to protect against attack could be available to those who want to use them, while volunteers take more heroic stands. More examination is needed of this challenging issue.

Another important topic is the effect of repression, including torture, on those who are not direct victims. When fear is induced, this can weaken nonviolent struggle. Further investigation is needed into how to overcome the psychological effects of repression, including the potential role of technology in achieving this.[10]

Notes

1. See Brian Martin, "Critique of nuclear extinction," *Journal of Peace Research*, Vol. 19, No. 4, 1982, pp. 288-300; Brian Martin, "How the peace movement should be preparing for nuclear war," *Bulletin of Peace Proposals*, Vol. 13, No. 2, 1982, pp. 149-159 (revised versions of these articles appear in Brian Martin, *Uprooting War* (London: Freedom Press, 1984), chapters 15 and 16); Brian Martin, "Politics after a nuclear crisis," *Journal of Libertarian Studies*, Vol. 9, No. 2, Fall 1990, pp. 69-78. See also Michael Curry, "Beyond nuclear winter: on the limitations of science in political debate," *Antipode*, Vol. 18, No. 3, 1986, pp. 244-267; Barry Richards, "Civil defence and psychic defence," *Radical Science 15*, 1984, pp. 85-97.

2. Barton Meyers, "Defense against aerial attack in El Salvador," *Journal of Political and Military Sociology*, Vol. 22, Winter 1994, pp. 327-342. I thank Mary Cawte for pointing out this reference.

3. Barton Meyers, "Disaster study of war," *Disasters*, Vol. 15, No. 4, December 1991, pp. 318-330.

4. Examples of useful sources of this sort are Christopher T. Carey, "Defense against the poor man's nuclear bomb: biological protection and decontamination," *American Survival Guide*, Vol. 20, No. 6, June 1998, pp. 32-33, 58-59 and 68; Hugh D. Crone, *Banning Chemical Weapons: The Scientific Background* (Cambridge: Cambridge University Press, 1992).

5. John B. Alexander, *Future War: Non-Lethal Weapons in Twenty-First-Century Warfare* (New York: St. Martin's Press, 1999); Malcolm Dando, *A New Form of Warfare: The Rise of Non-Lethal Weapons* (London: Brassey's, 1996); Nick Lewer and Steven Schofield, *Non-Lethal Weapons: A Fatal Attraction? Military Strategies and Technologies for 21st-Century Conflict* (London: Zed Books, 1997); David A. Morehouse, *Nonlethal Weapons: War Without Death* (Westport, CT: Praeger, 1996).

6. Steve Wright, letter to Brian Martin, 29 March 1994.

7. Steve Wright, letter to Brian Martin, 17 September 1993.

8. Steve Wright, "The new technologies of political repression: a new case for arms control?" *Philosophy and Social Action*, Vol. 17, Nos. 3-4, July-December 1991, p. 31-62; Steve Wright, *An Appraisal of Technologies for Political Control* (Luxembourg: European Parliament, 1998). The Campaign Against Arms Trade, among others, has targeted the repression trade. See for example "Campaigner's guide to the internal repression trade," *Peace News*, March 1996, pp. 7-10.

9. The dilemmas involved when nonviolent resisters "accept casualties" are dealt with by Gene Keyes, "Heavy casualties and nonviolent defense," *Philosophy and Social Action*, Vol. 17, Nos. 3-4, July-December 1991, pp. 75-88.

10. I thank Andreas Speck for this point.

Brian Martin, *Technology for nonviolent struggle*
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Chapter 9

Research methods

The content of science and technology for nonviolent struggle—that is, the fields studied, the ideas and the artefacts developed—is different in a range of ways from the content of military science and technology, as illustrated in previous chapters. There is also another and perhaps more profound difference involved. To effectively serve the purposes of nonviolent struggle, there must be fundamental changes in the method of doing science and of testing technologies.

To talk of "scientific method" immediately raises images of formulating hypotheses and undertaking experiments to test them. A common view of scientific method draws on Karl Popper's idea of conjectures and refutations, in which the constant aim is to falsify existing theories.[1] There are also many other images associated with "scientific method," including objectivity of the scientist, rejection of deceit, open publication of results, and principles such as Ockham's razor (finding the hypothesis that requires the fewest arbitrary assumptions).

It is appropriate to talk of "images" associated with "scientific method" because, on closer scrutiny, "scientific method" turns out to be a convenient myth. It is a myth because the way science actually proceeds often bears little resemblance to the official principles of "scientific method."[2] For example, scientists seldom reject an established theory because there is evidence that contradicts it, although this is what is specified by Popper's falsificationism. When careful experimenters found an aether drift that should have falsified the special theory of relativity, the results were simply assumed to be wrong and ignored for decades. The much touted trait of scientific objectivity is scarce on the ground: many scientists, particularly elite scientists, are passionately committed to their pet theories and will go to amazing lengths to maintain their views in the face of disconfirming evidence.[3] The subjective aspects are quite apparent to most practising scientists.

"Scientific method" is a *convenient* myth because it portrays science as above and beyond the ordinary failings of normal society, in which personal biases, corruption, vested interests, and social structures are seen to play a significant role. Why should science be different? The "scientific method" promises to transmute the activities of fallible humans into Truth. Without the blessing of "scientific method," science becomes simply one more human enterprise, with all the possibilities for serving the purposes of either domination or liberation. That of course is a central theme in this book. Science can be shaped to serve either violent or nonviolent methods of struggle—just as it can be shaped to serve commercial, democratic or other values—and in practice it has been massively shaped to serve violent ends.

So how would the practice of science be different with priorities for nonviolent struggle? If the usual idea of "scientific method" is a myth, then it is necessary to describe what actually goes on in the doing of science. For my purposes here, only a broad description is necessary. Most scientific research is undertaken by full-time professional scientists, most of whom are employees of governments, corporations or universities. The practice of science is something that happens among these profes-

sionals in laboratories or on field trips. Very seldom are non-scientists involved in the doing of scientific research, except as the subject of experiments.

In the case of military research, the end product is usually a piece of technology or occasionally an idea such as a behavioural technique. Technologies are tested by engineers in laboratories and then by military personnel in special facilities. The ultimate test is in war. Note that in the applied end of military R&D, the process moves out of the hands of the engineering professionals and into the hands of military professionals. The rest of the population is normally not involved. There are exceptions, though, such as fallout shelters for survival of nuclear attacks. Building fallout shelters makes little sense unless people are willing and able to use them, and this requires education and training of the entire population.

There are also many cases where skills and experience are relevant to both civilian and military tasks, as in the case of pilots who can fly either civilian or military aircraft and electrical engineers who can set up either civilian or military power systems. In the case of rifles, some civilians have an indirect input into military design, since they use the weapons, or related ones, for nonmilitary purposes such as hunting. Nevertheless, as a rough generalisation it can be said that military R&D is largely an in-house process, with minimal involvement by people other than military scientists, engineers and personnel. This is because the military enterprise—at least in the form it has taken in western high-technology professionalised forms—does not require active participation by the rest of the population. In the case of fuel-air explosives, for example, no "members of the public" are involved, except as casualties.

Nonviolent struggle is quite a different proposition. It is founded on popular support and involvement. Although not everyone has to participate, a considerable level of participation is essential to its success. Whereas most combat soldiers are young, fit men, anyone who wants to, regardless of age, sex or abilities, can participate in some form of nonviolent action.[4] Therefore, science and technology for nonviolent struggle, if they are to be effective, must be developed with the active support and participation of the ultimate users of the ideas and artefacts. This means that the "method" of doing science needs to involve more of the population.

Testing a method of nonviolent action usually means a field test with a large cross-section of the population. This might be planting fruit and nut-bearing trees to make communities more self-sufficient in food or designing factories so that they can be safely and easily shut down if taken over by an aggressor. The implication is that R&D for nonviolent struggle, to be effective, would require close liaison with numerous community groups, from local gardeners to factory workers. The equivalent of soldiers testing out a new rifle would be a community testing of a new communication procedure.

Consider, for example, radio systems. Military radio systems need only be tested within the military itself. Radio for nonviolent struggle needs to be tested by all who are likely to use it. If cheap, reliable and easy-to-use short-wave systems are to be introduced throughout the society, then extensive tests need to be carried out with all sectors of the population, including groups such as children and people with impaired hearing. The military can develop radio systems and then recruit or train specialists to operate them. Radio for nonviolent struggle, by contrast, needs to be useable by all. Therefore, the design and development phases require input from likely users. In other words, the development process must be responsive to a wider section of the population than is the case for military technology.

Military and nonviolence R&D are alike in that science and technology are never developed solely in the minds of intellectuals or in remote labs: there is always a process of social interaction, including the motivation, funding, training and applications for R&D. Where

these alternatives differ, in this regard, is in the social groups of greatest significance to the R&D process.

The so-called scientific revolution was made possible by combining theoretical work, carried out by gentlemen philosophers, with practical skills possessed by the much lower status artisans. Modern science thrives on the theory-practice interaction. Currently it is shaped predominantly by links with the state, corporations and the military. An alternative direction would be created by forging links with grassroots social action and life. In a sense, this would be an extension of the original scientific revolution, expanding the constituency of scientific and technological production beyond professional scientists and engineers and their primary patrons to the general public.

The difference in the development process can be pictured in the following way. For military R&D, scientists, engineers and military testing are somewhat insulated from other influences. "External" social influences on military science and technology exist, to be sure—examples include strategic policy, competition for funding, and influence of the peace movement. But a key "social influence" is actually the very organisation of the R&D as a professional, in-house enterprise.

In a more participatory process of R&D for nonviolent struggle, there would be no clear distinction between researchers and the rest of the population. Of course, some people may be much more active than others in the process of technological innovation. But in this model, such innovation depends vitally on interaction and cooperation with a wide cross-section of the population. Furthermore, this interaction and cooperation is likely to lead to contributions by others—those who in the military model would be simply users of the technology. This participatory model of R&D undermines the special role and status of professional scientists and engineers as the exclusive holders of expertise about science and technology.[5]

There are some precedents for this sort of participatory R&D. Citizen groups in Japan—often with participation by some scientists—have investigated environmental problems, using simple techniques such as talking to people about local health problems and testing for the presence of radioactivity by observing specially sensitive plants. Such an approach was more successful in determining the cause of Minamata disease—due to mercury pollution in the ocean—than heavily funded teams of traditional scientists using sophisticated ocean sampling and computer models.[6]

Many parts of the women's health movement—most prominently, the Boston Women's Health Book Collective—have reassessed available evidence and drawn on their own personal experiences to provide a different perspective about women's health, one that is less responsive to the interests of drug companies and medical professionals and more responsive to the concerns and experiences of women themselves.[7]

AIDS activists in the US, concerned about the slow and cumbersome processes for testing and approving drugs to treat AIDS, developed their own criteria and procedures and tried them out with drugs, some of which were produced and distributed illicitly. Their efforts and political pressure led to changes in official procedures.[8]

These examples show that nonscientists can make significant contributions to the process of doing science, and in some cases do better or cause changes in establishment approaches. However, the issue is not a competition between scientists and nonscientists, but rather promotion of a fruitful interaction between them. Scientists, to do their jobs effectively, need to bring the community "into the lab" and nonscientists need to learn what it means to do research. In the process, the distinction between the two groups would be blurred.

A good case study of the two models is the debate over encryption of digital communication described in chapter 5. The military model was embodied, literally and figuratively, in the Clipper chip, designed by the US National

Security Agency so that authorised parties could decipher any encrypted messages. Clipper was designed in secrecy. It was based on the Skipjack algorithm, which remained a secret. Clipper and related systems were planned for installation in telephones and computer networks essentially as "black boxes," which people would use but not understand. If Clipper had been a typical military technology, such as a ballistic missile or fuel-air explosive, it would have been implemented in military arenas with little debate (except perhaps from peace activists) and certainly little public input into the choice of technology.

At first glance, the participatory alternative to Clipper is public key encryption, widely favoured by computer users. But rather than the alternative being a particular technology, it is more appropriate to look at the process of choosing a technology. Encryption has been the subject of vigorous and unending discussions, especially on computer conferences. Different algorithms have been developed, tested, scrutinised and debated. This has occurred at a technical level and also a social level. Various encryption systems have been examined by top experts, who have then presented their conclusions for all to examine. As well, the social uses and implications of different systems have been debated. Last but not least, lots of people have used the encryption systems themselves. The contrast to Clipper is striking.

Even the more participatory process used in developing and assessing encryption is still limited to a small part of the population. This is inevitable, since not everyone can be involved in looking at every technology. The point is that the process is *relatively* open: there are far more people who have investigated cyptography in relation to public key encryption than could ever be the case with a government-sponsored technology such as Clipper. The other important point is that the participatory process requires informed popular acceptance of the technology, rather than imposition through government pressure. The best indicator of the participatory process is a vigorous and open debate involving both technical and social considerations.

The case of encryption shows that participatory R&D does not eliminate the role of expertise. What it does reduce is the automatic association of expertise with degrees, jobs in prestigious institutions, high rank, awards, and service to vested interests. Expertise has to be tested in practical application. Just as an athlete cannot claim current superiority on the basis of degrees or past victories, so an expert in a process of participatory R&D cannot rely on credentials, but is always subject to the test of current practice.

These comments on participatory R&D are inevitably tentative. By their very nature, participatory systems are shaped by the process of participation itself, so what they become is not easy to predict.

Notes

1. Karl R. Popper, *Objective Knowledge: An Evolutionary Approach* (Oxford: Clarendon Press, 1972).

2. Henry H. Bauer, *Scientific Literacy and the Myth of the Scientific Method* (Urbana, IL: University of Illinois Press, 1992); Paul Feyerabend, *Against Method: Outline of an Anarchistic Theory of Knowledge* (London: New Left Books, 1975).

3. Ian I. Mitroff, *The Subjective Side of Science: A Philosophical Inquiry into the Psychology of the Apollo Moon Scientists* (Amsterdam: Elsevier, 1974).

4. Obviously, not everyone is able to participate in *every* form of nonviolent action. For example, using a short-wave radio to send messages requires certain skills and technology. But virtually everyone can participate in petitions, rallies, boycotts, strikes and other forms of noncooperation. On participation by people with disabilities, see Brian Martin and Wendy Varney, "Nonviolent action and people with disabilities," *Civilian-Based Defense*, Vol. 15, No. 3, Year-End 2000, pp. 4-16.

5. There is a considerable literature on citizen participation in technological decision making. See for example Malcolm L. Goggin (ed.), *Governing Science and Technology in a Democracy* (Knoxville: University of Tennessee Press, 1986); Alan Irwin, *Citizen Science: A Study of People, Expertise, and Sustainable Development* (London: Routledge, 1995); Frank N. Laird, "Participatory analysis, democracy, and technological decision making," *Science, Technology, & Human Values*, Vol. 18, No. 3, Summer 1993, pp. 341-361; Brian Martin (ed.), *Technology and Public Participation* (Wollongong: Science and Technology Studies, University of Wollongong; http://www.uow.edu.au/arts/sts/TPP/, 1999); James C. Petersen (ed.), *Citizen Participation in Science Policy* (Amherst: University of Massachusetts Press, 1984); Richard E. Sclove, *Democracy and Technology* (New York: Guilford Press, 1995); Leslie Sklair, *Organized Knowledge: A Sociological View of Science and Technology* (St. Albans: Paladin, 1973); Langdon Winner (ed.), *Democracy in a Technological Society* (Dordrecht: Kluwer, 1992). However, most of this writing sees citizens as involved in decision making but not actually doing research. On science *by* the people, see Brian Martin, "The goal of self-managed science: implications for action," *Radical Science Journal*, No. 10, 1980, pp. 3-17; Brian Martin, "Anarchist science policy," *The Raven*, Vol. 7, No. 2, Summer 1994, pp. 136-153; Richard Sclove, "Research by the people, for the people," *Futures*, Vol. 29, No. 6, 1997, pp. 541-549. Relevant here are the diverse experiences in participatory action research, though such "people's research" is far more likely to be in fields of social analysis rather than science and engineering. See for example Stephen Kemmis and Robin McTaggart (eds.), *The Action Research Planner* (Geelong, Victoria: Deakin University, 3rd edn, 1988); Robert A. Rubinstein, "Reflections on action anthropology: some developmental dynamics of an anthropological tradition," *Human Organization*, Vol. 45, No. 3, Fall 1986, pp. 270-279; William Foote Whyte (ed.), *Participatory Action Research* (Newbury Park, CA: Sage, 1991); Trevor Williams, *Learning to Manage our Futures: The Participative Redesign of Societies in Turbulent Transition* (New York: Wiley, 1982).

6. Jun Ui, "The interdisciplinary study of environmental problems," *Kogai—The Newsletter from Polluted Japan*, Vol. 5, No. 2, Spring 1977, pp. 12-24.

7. Boston Women's Health Book Collective, *Our Bodies, Ourselves* (Boston: New England Free Press, 1971 and several later editions).

8. Steven Epstein, 'Democratic science? AIDS activism and the contested construction of knowledge,' *Socialist Review*, Vol. 21, April-June 1991, pp. 55-64.

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Chapter 10

Technology policy for nonviolent struggle

The basic idea of technology for nonviolent struggle is straightforward. Actually bringing this alternative about—doing relevant research and developing, testing and implementing relevant technologies—is much more difficult. In this chapter I discuss priorities for moving towards technology that serves nonviolent rather than violent struggle.

The term usually used when discussing priorities of this sort is "policy," in this case technology policy. The idea of policy, though, has come to refer primarily to decisions and implementation by governments. Governments are certainly important players in R&D, but not the only ones. After discussing priorities, I look at what can be done by three particular groups: governments; scientists and engineers; and community groups.[1]

Before beginning, it is worth emphasising that there are enormous institutional and conceptual obstacles to promoting nonviolent struggle.[2] Many government and corporate leaders would do everything they could to oppose development of grassroots capacity for nonviolent action, since this would pose a direct threat to their power and position. Furthermore, the idea of popular nonviolent struggle is extremely challenging to many people given standard expectations that the "authorities" or experts will take care of social problems, including defence. Therefore, to talk of technology policy for nonviolent struggle may seem utopian. But if alternatives are ever to be brought about, it is important to talk about them now. Without vision and dialogue, there is little hope of building a nonviolent future.

Priorities

The traditional idea of technological advance was the "linear model": first there is scientific research; the results of the research are applied, thereby producing a technological application; finally, the technology is taken up in the marketplace. Among those who study technological innovation, this simple model is pretty much discredited. Innovation seldom happens this way.

Another model is "market pull." There is a demand for a certain product or service. This encourages technologists to search for a suitable solution; sometimes this involves doing directed research.

In practice, the process of innovation is usually complex. It involves market incentives, new ideas coming out of basic research, economic and psychological commitments to current systems, and the particular agendas of interest groups such as politicians, government bureaucracies, corporate elites, and various pressure groups. Nevertheless, the usual models of innovation focus on several key players: government and the market and their relation to R&D. The "market" is constituted by those who buy and sell the product in question.

For weapons, the market has only a partial relevance, since a large fraction of production is carried out by governments for their own use. In most capitalist economies, corporations are heavily involved in weapons production, in which case the major purchasers are governments. Technology policy for military defence is therefore primarily concerned with government funding, regulation and promotion of the process of innovation.

Technology policy for nonviolent struggle is different in a fundamental way, aside from the obvious difference between nonviolence and violence. As outlined in the previous chapter, the very method of doing R&D for nonviolent struggle needs to involve all interested members of the community, since they are the ones who will be on the "front line" in carrying out nonviolent action. The immediate implication is that the highest priority should be put on measures that involve as many people as possible and minimise dependence on groups with special skills or resources. Accordingly, I now outline four ways of promoting technology for nonviolent struggle, in order of priority.

1. Implement currently available technologies

This includes things such as expanding access to computer networks, teaching workers how to shut down and start up factory equipment, promoting use of self-reliant energy systems, and running simulation exercises in neighbourhoods and workplaces. Such measures do not require any new technologies, much less any research. However, they would have a strong indirect influence on R&D. When people learn how to use existing technology, they often have ideas about how it could be improved, adapted or replaced. The key point here is to link the use of the technology to the goal of nonviolent struggle.

For example, when users of computer networks think about how to communicate in an emergency, they are likely to ask "what if?" questions. What if an aggressor coerces the system administrator? What if messages are intercepted and read? This is likely to lead to pressure for better security, such as standard use of encryption, and contingency measures for an emergency. This in turn could readily stimulate research in particular directions.

When workers think about how to resist a takeover of their factory, initially they may want to know how to protect themselves or how to make sure the aggressor can be resisted with the least risk to anyone's life. Once they learn more about how the factory operates, they may have ideas about reorganising production, accounting systems, work arrangements and the like, all of which could make the workers better able to resist an attack. This in turn would likely lead to a number of puzzles for engineers.

Thus, to set top priority on implementing currently available technologies is likely to lead directly to demands for finding and implementing different technologies. The biggest advantage of this approach, though, is that it can generate support for further measures. Rather than do research in isolation from the application and hope that people find it relevant to technology, this approach uses implementation as a way to mobilise knowledge and skills.

The fundamental assumption is that since popular involvement is the foundation for successful nonviolent struggle, popular involvement is also the foundation for the promotion of science and technology for nonviolent struggle.

2. Search out and disseminate existing ideas

Examples here include radios operating on very low power, medical techniques for diagnosing the use of torture, and plants that can be readily grown locally for food. These are areas in which technologies or techniques are available but not widely known. There are lots of radios available that operate using mains electricity or conventional batteries, and there are factories to produce such radios. By contrast, there are few micropower radios available and relatively few people who know how to build them. Similarly, some researchers have developed techniques for diagnosing particular types of torture, but very few medical practitioners or others know about these techniques, much less how to apply them.

From the point of view of any group promoting nonviolent struggle, it is first necessary to search out these sorts of ideas. Then they need to be tested. Assuming they are

useful ideas, they need to be publicised in the right quarters. Testing and publicity are interactive. The results of testing can be the basis for publicity, whereas publicity can lead to testing by others, or to awareness that others have already developed the same technique.

The next stage is to begin to implement these technologies. That takes us back to priority 1.

3. Adapt existing technology

This includes modifying factory design so that workers can control production more easily (shutting it down or gearing it up), developing short-wave radio sets so that they can be used as public phones, and designing dams and power plants so they are less susceptible to sabotage. The basic idea here is to use existing technology but to modify it to better serve the purposes of nonviolent struggle.

In the case of factory design, this might mean introducing a crucial piece of equipment—such as a special computer chip—that can be easily destroyed, thereby rendering the factory useless for a period of time until a replacement could be reconstructed. Depending on the factory, this might be straightforward or difficult, but in either case it means a modification of the existing design rather than redesigning the factory from scratch.

In the case of short-wave radio, existing sets would need modification for use as public phones, to make them simpler to use, relatively resistant to weather and mishandling, etc. Again, the aim is to adapt the technology for nonviolent purposes.

Adaptation of this sort is not necessarily easy. It can pose difficult technical challenges. It also must involve prospective users. The workers must be involved in the factory redesign process, otherwise the new system may turn out to be useless or even counterproductive. A public short-wave radio system has to be tried out by the sort of people who would actually use it. In the testing that is an essential part of the adaptation of the technology, many suggestions for improvement and new ideas are likely to arise. The whole process should be an interactive and iterative one.

If a modification of technology turns out to be effective, then it becomes worthwhile to tell others about it. It becomes an "available" technology that others may want to use. This takes the process back to approach 2, searching and disseminating existing ideas.

In reality, there is a lot of overlap between these two approaches. An existing technology can seldom be transplanted directly from one situation to another. Adaptation is usually required. Even factories producing the same product using the same method are designed in somewhat different ways. The workers have different skills and experiences. This means that equipment designed for one factory is likely to need modifications in order to work effectively in another. Similarly for short-wave radio. From one community there may be differences in climate, language, common knowledge, treatment of public facilities and so forth. Factors such as these need to be taken into account in designing and implementing any system.

4. Develop new technologies

Examples here include new varieties of crops that do not rely on artificial pesticides or fertilisers, new communication systems that are resistant to centralised control, and new styles of architecture to facilitate ease of construction and to foster community solidarity. The challenge to develop new technologies to serve nonviolent struggle could require scientific investigations. For example, crop planning for self-reliant communities might lead to puzzles in mathematical ecology somewhat different from the standard ones. Introducing computer chips and sensors in walls, appliances and so forth—called ubiquitous computing—might, in some circumstances, be valuable for nonviolent struggle. How could it be done in a way that gives no power to any group trying to control the population? Just as whole branches of current theoretical work in various disciplines have evolved from the puzzles deriving from

practical problems, so it is likely that the practical problems of nonviolent struggle would give rise to numerous theoretical investigations.

Compared to using or modifying existing technologies to serve nonviolent struggle, developing new technologies requires much more effort and gives less guarantee of success. Even more important than this, though, is participation in trying out technology. Implementing existing technology involves the users immediately. Their responses are essential for making the technology actually serve the purposes of nonviolent struggle. Developing new technology, by contrast, is seldom a community-based enterprise. It often requires specialised skills. Therefore it is best done in the context of widespread support for nonviolent approaches rather than as the vanguard of nonviolent struggle. Without popular involvement, new technologies are likely to simply sit on the shelf, untested and unknown.

This set of priorities may suggest that I am hostile to new technologies. Quite the contrary. If, in the long term, nonviolent methods become established as the only viable way to struggle, then new technologies are likely to be fundamental to this process. In a society built around self-reliant communities with numerous technological systems by which people can undermine aggressors, violence will be widely seen as counterproductive. So long as technological systems exist that allow centralised control—which includes everything from weapons systems to centrally controlled communication systems—the dangers of domination will persist. So in the long term the development and implementation of new technologies to serve nonviolent struggle are essential.

However, this does not mean that developing new technologies is the best approach in the short term. In present-day societies, violence and centralised control are pervasive and relatively few people are dedicated to developing nonviolent alternatives. The idea of science and technology for nonviolent struggle is virtually unknown. In this situation, the first priority is to generate greater involvement in the idea and practice of nonviolence. Concern about new technologies is more a distraction than an aid in this, given that there are numerous existing technologies that can serve nonviolent struggle most effectively.

I have talked so far about priorities for introducing technology for nonviolent struggle. I haven't actually said *who* will do the introducing. In my view, there is no single correct answer. Various groups can be involved, ranging from governments, corporations, engineers, workers and nonviolent activists.

Government

If even a single government devoted significant resources to the promotion of technology for nonviolent struggle, it would have an enormous impact.[3] It could, among other things:

- sponsor projects to implement available technologies;
- finance searches for suitable technologies that are not widely known;
- organise simulations of social defence;
- publish writings and advertisements about nonviolent struggle;
- endorse the development of contingency plans for nonviolent resistance;
- promote measures for self-reliance in various fields;
- encourage inclusion of the theory and practice of nonviolent action in schools;
- disseminate ideas about nonviolence to other governments;
- offer support—moral, human and material—to nonviolent groups opposing repression in various parts of the world;
- develop plans for nonviolent resistance within government bureaucracies;
- set up institutes for research into nonviolence.

Governments have two great advantages when it comes to promoting nonviolence: legitimacy and resources. Legitimacy is perhaps the most important. If just one government in the world decided to promote nonviolent strug-

gle, it would provide an example and inspiration to people everywhere. The resources controlled by governments are important too: money, workers, laws, policies. These resources are used now to sustain military systems. Clearly the same resources would have a giant impact if devoted instead to nonviolent struggle. But legitimacy is vital in the use of resources too: laws will be obeyed only if most people consider them legitimate; government employees can easily strangle policies if they do not think them legitimate.

The great power of government, via legitimacy and resources, is the reason why so many groups look to government to solve their problems. This applies to peace movements as well as many others. Many of the campaigns of peace movements over the decades have been aimed at changing goverment policy. Intense lobbying is carried out; rallies are held to demonstrate the strength of public commitment; demands are made for government action, such as a "nuclear freeze" or an end to foreign intervention. But in most cases these efforts have had little success. Governments are seldom responsive to peace movements and have seldom shown any interest in nonviolent struggle. There are several reasons for this.

Most fundamentally, states and militaries are sustained by each other, as noted in chapter 2. The foundation of state power is a monopoly over what is considered legitimate violence, exercised by the military and the police. Even when the threat of foreign aggression is negligible—as in geographically remote countries such as Fiji or New Zealand—military establishments are maintained and fear of enemies is fostered. Militaries are far more likely to be used internally, against the people who are supposed to be defended, than against foreign aggressors. This is most obvious in the case of military dictatorship.

Since the military is an integral, indeed essential, part of the state, it is inherently unlikely for the state to fully endorse popular nonviolent struggle as an alternative to the military. Popular nonviolent struggle might, after all, be used to challenge the status quo.

This assessment of the link between the state and the military is useful at a general level, but it gives too mechanical a picture. The state is not a unified entity: it contains the government (elected or otherwise), the legal system and various state bureaucracies to run or regulate functions such as welfare, education, industry and transport, among others. It is quite possible for different sectors of the state to promote different goals. Some governments have sponsored studies of social defence; some teachers in government schools have developed peace studies; some government departments have promoted self-reliance; and so forth. It is certainly possible for parts of the state to sponsor nonviolent struggle.

The problem is that nonviolence has a very low profile compared to military approaches. The military is well and truly entrenched, partly because of its structural relation to state power.

Peace activists often hope to sway political leaders by the logic of their arguments. This seldom has much impact, since politicians are much more influenced by power considerations. After all, the threat of global nuclear war has never been enough by itself to persuade politicians to implement nuclear disarmament.

Peace activists also try to apply pressure to political leaders through letter-writing, rallies, mobilisation of voters and civil disobedience. This has a much greater impact than just logical arguments. Nevertheless, there are limitations in the strategy of applying pressure. Political leaders are subject to other pressures, such as lobbying by supporters of the military. Promises are easy to make and easy to break. When community activists seek to get the government to take action, they do not take control of the agenda themselves. Their effort is to get someone else (the government) to take action, not to take action themselves.

Finally, even when governments do take action, they are not likely to promote a process of community mobilisation. They are more

likely to sponsor research, which may just delay the day when action occurs. They are likely to provide support for figureheads—such as prominent investigators—rather than for community-level activists.

The experiences with government sponsorship of research into social defence illustrate the above generalisations. Supporters of nonviolent action have devoted much effort to persuading governments to investigate social defence. Occasionally there have been successes. The governments of Denmark, Sweden and the Netherlands have sponsored studies.

The experience in the Netherlands is instructive.[4] In the late 1970s, a small radical party was part of a coalition government. A member of this party was made science minister, and Johan Niezing, Professor of Peace Research at the Free University of Brussels, was his chief scientific adviser. Niezing has long been committed to social defence, not for idealistic reasons but because it seems to him to be the most pragmatic alternative to the horrors of military methods.[5] As a result of Niezing's influence, one of the conditions for continuing the coalition was the acceptance of proposals to fund ten social defence research projects. A committee, chaired by Niezing, was set up to oversee the ten projects. But then there was a change of government. Funding was dramatically reduced so that there was enough for just one project.[6]

The one project was a study coordinated by Alex Schmid of Leiden University. Schmid and his collaborators concluded that an invasion by a determined military power (specifically, the Soviet Union) could not be stopped by nonviolent means.[7] In retrospect, now that the Soviet threat to western Europe has collapsed in the wake of the largely nonviolent 1989 revolutions in Eastern Europe, this analysis seems quite shortsighted. Thus ended a promising possibility for sustained research on social defence.

(Schmid went on to set up the Interdisciplinary Research Project on Root Causes of Gross Human Rights Violations, with the Dutch acronym PIOOM, at the University of Leiden. This is a vitally important social science enterprise, whose core funding remains precarious.)

The Niezing committee was disbanded in 1987; its original proposals, having been updated and augmented by Giliam de Valk, were published in English in 1993.[8] Niezing himself played a key role in ensuring that this publication took place.

These problems with getting governments to take action serve as a warning. It may be worthwhile to seek government support for nonviolent struggle, but it is wise to be aware of the difficulties. For example, at the United Nations, the most powerful governments obstructed a study of military science and technology at every stage. The study was endorsed by the General Assembly, but hamstrung by committee members (selected by governments) who were military officers or just ignorant. The study was held back by governments' refusals to provide information or their antagonism to critical comment, and was continually stalled at the publication stage.[9] The difficulties that could confront active efforts to develop technology for nonviolent struggle—which might, after all, be used against government repression—can be imagined.

In summary, government support for nonviolent struggle offers the immense advantages of legitimacy and resources. But in most cases there is likely to be great difficulty in gaining any support in the first place, due to the close connection between the military and the state. Furthermore, seeking government support has the disadvantage of trying to get others to take action rather than doing it oneself. Finally, governments are likely to sponsor research that is removed from the community.

All these features are apparent in the Dutch experience. The Netherlands government had ample resources to investigate and promote social defence, but the major political parties were not interested. It was only by a quirk of politics that government funds were allocated to social defence. The money was cut back at

the first opportunity and in any case was devoted to research rather than community action. Even so, the funding gave considerable credibility to social defence and the proposals from the Niezing Committee are a valuable resource for future research and action.

Scientists and engineers

Many scientists and engineers are in a good position to develop science and technology for nonviolent struggle. There are a number of reasons why they haven't done so already. As described in chapter 2, most funding for science and technology comes from governments and corporations. Defence is seen as a matter for the military, and military R&D is a key driving force for science and engineering. This emphasis on military priorities filters through to civilian R&D: military priorities influence the disciplines that are most favoured and the technical problems that are seen as most significant. As high-status professionals whose privileges depend on claims to special expertise, scientists and engineers are seldom encouraged to get involved in social movements or, more importantly, to redirect their work so that professional skills become easily taken up by community activists. There is much more prestige to be gained by taking up the most esoteric theoretical challenges or constructing and using highly sophisticated technical apparatus.

If scientists and engineers were to take up practical problems in nonviolent struggle, they could have an enormous impact. They bring two great resources to bear: skills and legitimacy. Their skills are of great practical relevance in some cases, such as designing telecommunications systems or building renewable energy systems. In other cases their skills are not directly relevant to nonviolent struggle in any obvious way, but even so, the involvement of scientists and engineers would have great impact because they are the people with the greatest social legitimacy as experts in science and technology.

The basic ideas of sustainable agriculture or short-wave radio are known to many people. Applying these ideas to nonviolent struggle is not so difficult, at least at the basic level. But if an agricultural researcher or electronics engineer were to get up and say that these approaches have merit for nonviolent struggle, this would have a great impact. Scientists and engineers have credentials and often an institutional affiliation that gives them credibility.

Some scientists and engineers, especially those working at universities, have considerable freedom to choose their research topics. They are in a good position to undertake projects in support of nonviolent struggle.

I have already described some of the reasons why scientists and engineers have not already taken up this sort of work and advocacy. Many of them are heavily funded by the military or respond to research agendas shaped by military priorities. More generally, they are trained to be professionals and discouraged from building links with community groups.

But the social structures of science and engineering are only part of the problem. The very idea of science and technology for nonviolent struggle is hardly known. The peace movement for the most part has only been *against* technology, namely technology for war. The alternative to bombs and missiles is seen as civilian priorities such as hospitals, public transport and housing. The idea of "peace conversion" or "economic conversion" is to convert military production into production for "human needs," which means everything from food and clean drinking water to clothing and books. The idea that technology could be used to support a nonviolent method of struggle has not been on the peace movement agenda.

Some scientists and engineers have played a strong role in peace movements, sometimes forming their own organisations. They have used their skills to push for disarmament, for example to argue that a nuclear test ban could be adequately monitored with seismic detection capabilities. Sometimes they have tried to organise boycotts of military R&D, most

notably in the case of the Strategic Defense Initiative, commonly known as star wars, as discussed in chapter 2.

Many scientists and especially engineers have devoted their skills to goals such as sustainable agriculture, renewable energy technology, and community communication. They have worked with community activists to develop alternatives that empower communities rather than elites.

Thus there is an undoubted capacity and willingness of some scientists and engineers to use their skills and prestige to improve and promote nonviolent struggle, if only this alternative were brought to their attention and seen as a viable option. There are several ways in which this could happen. One, perhaps least likely, is that governments begin to fund nonviolence R&D. Another is that a few scientists and engineers take up the issue on their own initiative. Finally, popular support for nonviolent struggle would create a context favourable for involvement by professionals.

In summary, scientists and engineers bring two great strengths to the development and promotion of R&D for nonviolent struggle: their skills and their legitimacy. On the other hand, they face a number of obstacles, including employment and funding from governments and corporations oriented to military approaches, and their professional status which inhibits building links with community groups.

Community groups

Compared to governments and to scientists and engineers, most community groups have few resources and little legitimacy. Nevertheless, in some ways they face the fewest obstacles in the task of developing and implementing technology for nonviolent struggle.

The category "community group" encompasses a range of organisations, including sporting clubs, service organisations such as Rotary, environmental groups, women's groups, church groups and trade unions. Just about any voluntary organisation could be included. Even some businesses and government-funded bodies might be included as community groups, as in the case of some small local businesses and libraries. In these cases it is usually the clients who make something a community organisation, in the sense that it is based on voluntary participation from members of the local community.

The concept of "community" is easy to criticise. Is there really such a thing as "community," over and above the activities of individuals? Do community groups really represent local constituencies in any fair way? Is there a "community" to be defended? Is it worth defending?

Here, community groups are taken to be relatively small organisations or groupings of people that are mostly voluntary. Whether they in some sense represent the "community" is not the central issue. The point here is not to idealise them but to comment on their strengths and weaknesses in promoting technology for nonviolent struggle.

Although few community groups have either large resources, legitimacy (for waging nonviolent struggle) or a concentration of specialist technical skills, they do have one enormous advantage. They are located at the point where nonviolent struggle can be waged. Therefore, they can proceed to develop skills and make preparations without waiting for anyone else. Theory and practice are much easier to integrate.

An environmental group, for example, could make an assessment of local dependencies in energy, transport and agriculture. How well could local people survive if liquid fuel supplies were cut off? Could they get to work? Could enough food be supplied and distributed? Could they keep warm enough in cold weather? To answer these questions, it would be necessary to do an inventory of local resources, travel patterns, transport links, contingency plans and so forth. With information in hand, it would then be possible to make suggestions for improving self-reliance, such as improving

insulation, fostering telework (working locally and using telecommunications to keep in touch with the main office), planting local vegetable gardens, etc. Obviously, any such programme of study and action would require gaining information and support from local residents.

A local club, such as Rotary, Apex or Lions, could make a study of local networks and organisations, and develop plans for resistance. This would involve liaison with many different groups, from lawyers to supermarket employees and from librarians to hairdressers. What can each group do? What might they be willing to do? How can they reach agreement? What are the warning signs that urgent preparations should begin? What systems of communication and decision making should be set up? Is it worth running a simulation?

The workers at a local radio station could make plans for action in the face of an attack. This might include preparing tapes to be broadcast in an emergency, training both workers and outsiders in use of the station's equipment, setting up plans for broadcasting from alternative premisses, building links with other radio stations and communication media, and running simulations.

In each of these cases, and others, there is much that can be done with existing skills and resources. Furthermore, in most organisations there are likely to be some people with specialised skills. As soon as initial plans are made, an obvious next step is to search for information about what others have done, including information about relevant technology. This leads directly into the process of adapting existing technology to the tasks at hand. If there are difficulties in the process, local skills may be sufficient to overcome them. Alternatively, or in addition, help can be sought from engineers or others in order to tackle special problems.

Thus, when community groups prepare for nonviolent struggle, it is natural for them to begin with implementation of existing technology. In other words, they are likely to proceed with what I argued is the first priority. Unlike governments and professional researchers, there is little incentive to undertake research that is unconnected with immediate practical problems. Nevertheless, the process of tackling these practical problems will inevitably lead to challenges requiring R&D.

For community groups, preparation for nonviolent struggle need not be an abstract enterprise aimed at resisting a hypothetical invasion. There are more immediate concerns available. For example, many environmental groups use nonviolent action to oppose logging, stop freeways and so forth. Furthermore, building community self-reliance in energy, transport and agriculture is very much a part of a programme to replace current systems in order to reduce or eliminate their harmful impacts.

What about service groups such as Rotary? They can do community networking to gain support for valued projects. Another motivation is to provide skills about community networking to other groups, for example in countries under dictatorial rule.

Community radio stations can come under threat themselves, for example if they challenge powerful vested interests. Being prepared to defend against a hostile attack makes sense even if foreign invasion is remote.

Community groups need not be naive practitioners. At least some members of some groups will have knowledge of methods of scientific and social analysis. They can search available literatures, develop protocols for testing ideas and evaluating outcomes, and learn from the results of investigations and projects. Furthermore, the very process of doing community group projects will develop the skills of participants.

In summary, although community groups do not have large resources or great legitimacy, they are in a position to directly undertake the investigation and implementation of technology for nonviolent struggle. They are likely to tackle the most feasible projects first, rather than getting sidetracked into esoteric research.

Conclusion

I have outlined here what I consider to be the highest priorities for technology for nonviolent struggle, which generally are the implementation of currently available technologies first and research into new developments last. Then I commented on the strengths and weaknesses of action by three groups: governments, scientific and engineering professionals, and community groups. There are also other groups that can take action, such as corporations and various international organisations. Valuable initiatives are possible from any of these. In each case it is helpful to be aware of the opportunities and likely difficulties.

There is a more fundamental question: how is action by any of these groups to be promoted? After all, there are only a few isolated initiatives for social defence around the world. There is no simple answer to the question. Action ultimately begins with individuals and small groups who decide the issue is worthy of development. As long as military priorities are dominant, including the assumption that defence means military defence/offence, the investment of major resources into nonviolent struggle is unlikely. But it is possible for the climate of opinion to change. When this occurs, there will be plenty of things to do. Until then, those who are committed to the nonviolent alternative can only do the best they can, in the knowledge that their efforts can help to create a new climate of opinion.

Notes

1. Conventional technology policy literature is not deployed in this chapter. It is almost entirely oriented to top-down decision making and provides few insights about policy making for a participatory system such as social defence. Issues such as the suppression of innovation by vested interests, the influence of managerial control, worker opposition and social movements are almost entirely absent from the conventional policy literature. Innovation from the grassroots, or more generally any innovation that is noncommercial or a challenge to state interests, is given virtually no attention. Some typical sources that fit this characterisation are Rod Coombs, Paolo Saviotti and Vivien Walsh, *Economics and Technological Change* (Basingstoke: Macmillan Education, 1987); Richard R. Nelson (ed.), *National Innovation Systems: A Comparative Analysis* (Oxford: Oxford University Press, 1993); J. E. S. Parker, *The Economics of Innovation* (London: Longman, 1974); Ray Rothwell and Walter Zegveld, *Reindustrialization and Technology* (Harlow: Longman, 1985). I thank Rhonda Roberts for helpful comments on these points. See Rhonda Roberts, "Managing innovation: the pursuit of competitive advantage and the design of innovation intense environments," *Research Policy*, Vol. 27, 1998, pp. 159-175.

2. I thank Ellen Elster for emphasising this point.

3. For a vision of government policy for socially beneficial technology, see Michael Goldhaber, *Reinventing Technology: Policies for Democratic Values* (New York: Routledge & Kegan Paul, 1986). What is lacking in Goldhaber's otherwise stimulating picture is a feasible process for moving towards such a policy.

4. This account, based on discussions with Johan Niezing, is adapted from Brian Martin, "Impressions of the Dutch social defence network," *Nonviolence Today*, #34, September-October 1993, pp. 16-18; *Civilian-Based Defense*, Vol. 8, No. 6, Winter 1993-94, pp. 2-5.

5. Johan Niezing, *Sociale Verdediging als Logisch Alternatief: Van Utopie naar Optie [Social Defence as a Logical Alternative: From Utopia Towards Option]* (Assen, Netherlands: Van Gorcum, 1987).

6. One way that this cutback was justified was on the basis of a critique of the Niezing committee proposals by social scientist Koen Koch. For Koch's views, see Koen Koch, "Civilian defence: an alternative to military defence?" *Netherlands Journal of Sociology*, Vol. 20, No. 1, 1984, pp. 1-12.

7. Alex P. Schmid, in collaboration with Ellen Berends and Luuk Zonneveld, *Social Defence and Soviet Military Power: An Inquiry into the Relevance of an Alternative Defence Concept* (Leiden: Center for the Study of Social Conflict, State University of Leiden, 1985). I reviewed it in *Civilian-Based Defense: News & Opinion*, Vol. 4, No. 4, May 1988, pp. 6-11.

8. Giliam de Valk in cooperation with Johan Niezing, *Research on Civilian-Based Defence* (Amsterdam: SISWO, 1993). The proposals were sketched in chapter 4.

9. Ulrich Albrecht, "The aborted United Nations study of the military use of research and development: an editorial essay," *Bulletin of Peace Proposals*, Vol. 19, Nos. 3-4, 1988, pp. 245-259. I thank Mary Cawte for finding this reference.

Brian Martin, *Technology for nonviolent struggle*
(London: War Resisters' International, 2001)

Appendix

Theories of technology

This book is based on the idea that technologies can and should be developed and chosen because they are helpful for nonviolent struggle. This in turn is based on a number of assumptions about the nature of technology.

In chapter 2 on militarised technology, I argued that the military influences the development of technology in a number of ways, including through funding, applications, employment and suppression of challenges, plus via deep structures including the state, capitalism, bureaucracy and patriarchy. In later chapters, I outlined a variety of actual and potential technological developments that would be of special value for nonviolent struggle. In making these arguments I have assumed that:

- technology is shaped by a range of social factors;
- any given technological system is more useful for some purposes than others (e.g. military versus nonviolent struggle);
- it is possible to influence the process of technological development to serve desirable social goals.

It would be possible to attempt to justify these three assumptions through a set of abstract arguments. My approach, however, has been to build an argument—with plenty of examples—based on these assumptions and to implicitly justify the assumptions by demonstrating the insights available. In this appendix I continue this strategy by outlining some common approaches to studying technology and seeing whether they provide useful ways to tackle the topic of technology for nonviolent struggle. This will illuminate some of the shortcomings of certain approaches and help clarify my approach.[1]

Essentialist approaches

An "essentialist" approach to technology assumes that it has essential or inherent features. Common essentialist views are that technology is good, bad, neutral or inevitable.

Some people think that technology is inherently good. Military technology provides the best example that it isn't. Bullets and bombs kill. People who are killed by bullets and bombs would not see these artefacts as good—not good for them, anyway. It is difficult to argue that weapons of mass destruction are inherently good. In fact, it was the development of nuclear weapons that made many technologists realise that not everything they produced was of benefit to humanity.

When people think that technology is inherently good, they usually make an implicit assumption: the only choice is between present technology—all of it, including stereos, baby bottles and biological weapons—and no technology at all. If it is assumed instead that it is possible to make choices about technology, namely to have some artefacts but not others, then the idea that "technology is good" collapses. It should be obvious that the technology-is-good model is of no value in analysing problems with military technology or developing technology for nonviolent struggle.

A contrary view, held by a few, is that technology is inherently bad. This idea is similarly flawed. After all, some technologies help at least some people: wearing glasses helps some people to see better, even if the produc-

tion of the glasses causes pollution and unpleasant work conditions. It is only possible to argue that technology is inherently bad if there is no choice between technologies.

Many people are attracted to the idea that technology is inherently neutral, believing that it is either good or bad depending on the way it is used. This is the so-called use-abuse model: technology can be either used (for good purposes) or abused (for bad purposes). It is certainly true that many artefacts can be used for both good and bad purposes. For example, a computer word processor can be used to produce lists of dissidents who are to be arrested or killed, or it can be used to produce articles proclaiming the value of dissent. Computers often make tasks easier, but they also can lead to people losing their jobs. But does this mean that all artefacts are neutral?

An alternative perspective is that particular artefacts are easier to use for some purposes than others. For example, if you want to clean your hands, soap is more helpful than a newspaper or a candle. After all, artefacts are designed for particular purposes. Of course, they might be used for other purposes. A toothbrush is designed for cleaning teeth, but it can also be used to clean shoes or even for painting. But a toothbrush is not very helpful for sweeping the street or eating peas. This point should be obvious: any particular artefact is not equally useful for all purposes.

In this sense, artefacts are not neutral. A pair of dice might be said to be neutral if all possible rolls from 2 to 12 are possible. But the dice would be called biased if they gave 12 half the time. In this sort of sense, artefacts are biased. They potentially can be used for many different purposes, but they are much easier and more likely to be used for certain purposes.

This applies clearly to military technologies. A nuclear explosion can be used to heat a house or fry an egg, but this is neither the intended nor a convenient use of the technology. Thumbscrews are designed and used for torture. Their actual use as paperweights or parts of a sculpture, or their potential use for medical operations, hardly makes them neutral in any practical sense.

The idea that technologies are neutral is usually maintained by taking a broad perspective. For example, it can be claimed that computers are neutral because they can be used for beneficial or harmful purposes. But this only means that sometimes they can be used for beneficial purposes and sometimes for harmful ones. It doesn't mean that these applications are equally easy or likely. Nor does it mean that the benefits and harm are spread around equally.

To pierce the illusion of neutrality it is only necessary to take a closer look, for example at the computer built into the nose cone of a cruise missile, enabling the missile to use altitude readings to assess where it is and to adjust its course as necessary. The computer is designed to help the missile reach its target and destroy it. This computer is not neutral. The idea of neutrality may be attractive to people because it removes the necessity to think carefully about the values built into the design, choice and use of technology.

The idea that technology is neutral provides no leverage for analysing technology for nonviolent struggle. After all, if technology is neutral, that presumably means that any technology can be used for nonviolent struggle and there is no obvious means for choosing between technologies.

Sometimes it seems like technologies have a will of their own. The telephone and the automobile have spread throughout society and no one seems able to stop their use. What is called "technological determinism" can be interpreted in various ways. It can mean that once a new technology is developed—such as guns or nuclear weapons—it has an inherent momentum leading to its widespread use. It can mean that there is general pattern of technological development that is inevitable, such as the use of steel, electricity or computers.

Simple interpretations of technological determinism don't stand up to scrutiny.[2] There are plenty of technologies that have been

developed but have never become dominant, such as housing with passive solar design, supersonic transport aircraft, microfiche publishing and cryonic suspension. How can it be said that technology determines its own development when so many technologies are failures? One answer is that some technologies are "better" and hence more successful. But this provides a circular argument, at least when the way to determine whether a technology is better than another is to see whether it is more successful. Technological determinism provides a convenient excuse for ignoring the human choices, especially the exercise of power, in development of technology.

Technological determinism provides no help in analysing technology for nonviolent struggle. It assumes that military technologies are dominant due to their own inherent properties; nonviolent alternatives have not been successful and hence may be ignored. My entire analysis is based on a rejection of technological determinism and an endorsement of the view that social choice is the basis for technological development and that that choice should become more participatory.

However, by adopting the topic of technology for nonviolent struggle, it is hard to avoid sounding like a technological determinist at times. Because the focus is on technology, it is possible to create the impression that by adopting a suitable technology, the cause of nonviolent struggle is automatically advanced. My view is that development and use of technology is always a social process and, as such, is one of a number of social locations for promoting or waging nonviolent struggle.

Social shaping of technology

Rather than assume that technology has intrinsic properties—being good, bad, neutral or inevitable—another approach is to assume that technology is a product of society and reflects or embodies its origins in various ways. This general approach can be called "social shaping of technology." It proceeds by examining social influences on the nature of technology.

An extreme version of this approach is to claim that large-scale social structures almost entirely determine technology, for example that capitalist society leads to technology that serves capitalists.[3] This can be called "determined technology" or "social determinism" and is the converse of technological determinism. This approach provides an antidote to technological determinism but isn't particularly helpful when it comes to developing alternative technologies. If the structure of society determines technologies, then advocating alternatives to current technologies seems futile since it doesn't change the process of social determination. In other words, this approach assumes that the only way to change technologies is to change the fundamentals of social structure. My analysis assumes the contrary, that technology is one potential avenue for intervening to change society as well as technology itself.

A more moderate approach involves examining the interaction of social and technical factors on the development and choice of technology. For example, there have been studies of compression versus absorption refrigerators, numerically controlled machine tools, light bulbs and electricity systems.[4] This approach has been used in a number of studies of military technology, some of which were mentioned in chapter 2. It is valuable for analysis of actual technologies and also for opening up the possibility that other technologies might have been developed if different forces had been influential.

One of the most cited examples of social shaping of technology is the low bridges, designed by Robert Moses for New York, which allegedly prevented the twelve-foot high buses from passing underneath and hence prevented those relying on public transport, especially blacks and poor people, from easily visiting beaches.[5] This example has been frequently used to show how social values, in this case racism, can be built into artefacts, in this case bridges. Its pedagogical value seems to arise

from it being neither too complex nor too simple, and having an obvious bad guy. Military technology provides plenty of examples that are almost too simple. Weapons are designed to kill and destroy. Detailed examples can be produced by the dozen. Brightly coloured landmines are designed to attract the attention of children. Tumbling bullets are designed to cause horrific exit injuries. One can speculate why scholars haven't raised these sorts of examples more often. Perhaps the social shaping is too obvious.

Although the social shaping approach is quite valuable, it has some limitations as actually applied. Most social shaping analyses look at rejected alternatives that are fairly similar to their successful rivals, such as the AR-15 rifle that was rejected in favour of the M-16. Postulating comprehensive wide-ranging alternatives is unusual, possibly because it requires too much of a jump from the historical record. Certainly there have been no discussions of technology for nonviolent struggle, nor even much study of the field of appropriate technology, which would seem a natural area for analysis.

More fundamentally, the social shaping approach deals with the social influences on technology and says little about the actual technologies that exist or might exist. For example, it is all very well to analyse the social forces shaping military and civilian communication systems, but what guidance does this give for assessing which such systems would be useful for nonviolent struggle? The social shaping approach is restricted by its focus on influences *on* technology, which leaves out the effects *of* technology. The next stage in the development of this theory is to look at the ways that society and technology co-shape each other.

Various more focussed theoretical frameworks, such as labour process theory,[6] can be applied to technology within the general ambit of the social shaping approaches. A different angle on technology is provided by "actor-network theory," which is based on getting rid of the dichotomy between humans and artefacts.[7] In this approach, anything potentially is an "actor": a scientist, a scallop, a mechanical door-closer, a bullet. The task of the social theorist is to "follow the actors," namely to watch what they do without making assumptions about them in advance, and to observe their networks, namely to see how they create, destroy and rearrange relationships between themselves. One advantage of the actor-network approach is that it gets away from the essentialist assumption that social structures such as the state are ordained categories for understanding social reality.

There have been a number of criticisms of actor-network theory.[8] It tends to overlook groups such as women and the unemployed who are not prominent in networks associated with technological innovation. Actor-network theorists often seem to smuggle in concepts of social structure that they supposedly have jettisoned.

More importantly, social constructivists seem to restrict their efforts to explaining existing technology, not taking any stance on whether it is good or bad for humans nor saying how to go about changing it.[9] Since actor-network theory builds on actors—including artefacts—that exist, there is no theoretical warrant for examining technology that might be designed in a social system putting a priority on nonviolent struggle, especially since social structural analysis, including the concept of the military, is avoided.

Biased technology

A useful framework for analysing technology for nonviolent struggle is to think of artefacts as non-neutral, biased, political or selectively useful.[10] In other words, they are easier to use for some purposes than others. A key aim of a social analysis of technology then is to find out which purposes a technology can be most easily used for, and why.

Most technologies developed by the military are biased, or selectively useful, for killing and

destruction. This obviously is because the aim of most military science and technology has been to develop more lethal and destructive weapons.[11]

It is quite possible to kill or incapacitate someone without technology. For example, a suitable blow from the hand at the back of the neck can do this. Mass killing can occur without technology, but it is much easier—and more tempting—if technology designed for killing is available. Spears, axes, bows and arrows, rifles and explosives make killing easier. Admittedly, they can be used for killing animals and other less lethal purposes, but in many cases they have been specially designed for battles.

The idea of biased technology obviously is incompatible with the idea of technology as good, bad or neutral. On the other hand, the idea of biased technology is quite compatible with the social shaping perspective. One would expect that when the military influences the development of an artefact—such as designing a radar system or grenade—it is likely to be selectively useful to the military. But there are no automatic connections. It is necessary to examine actual technologies, not just the social shaping process, to determine which groups can most easily use them. The Internet had military origins but has turned out to be highly useful for communication between antiwar activists.

Another way to describe this approach is to say that technologies embody social values or social interests. The idea of embodiment suggests that technologies take on the values of the interest groups crucial to their development and in turn are likely to be selectively useful to these same interest groups. For example, nuclear technology was developed by scientists and engineers working in the service of governments and militaries. Some of the key characteristics of nuclear weapons and nuclear power are high potential danger and large scale, both generating a need for high security and centralised control. These features make nuclear technology selectively useful to the military and the state.

The idea of biased technology is quite common among those who examine technological alternatives, such as appropriate technology. But it has never been the centre of popular or scholarly perceptions. The most common popular perceptions of technology seem to be that it is neutral, good or bad. The social study of technology has focussed on social shaping approaches; in the past couple of decades, social analysis of the impacts *of* technology has not been nearly as common as analysis of social influences *on* technology. There is not even a good name for the view of technology as biased. To talk of biased technology certainly counters the idea of neutral technology, but it suggests that there is something wrong with it: in a general sense, being biased is not seen as a good thing, even if it is biased in favour of harmony or biased against torture. Also, to talk of biased technology suggests that bias could be removed, which is not possible—the question is which way technology is biased, and in whose interests. The meanings of alternative terms such as embodiment or selective usefulness are not immediately obvious.

Whatever its name, though, this perspective is quite useful for analysing technology for nonviolent struggle. This appendix began with the assumption that it is worthwhile to analyse technologies, including yet-to-be-developed technologies, according to their value to a system for nonviolent struggle. Working backwards, it is possible to judge theories of technology to see how well they serve this purpose. Ideas that technology or technologies are inherently good, bad, neutral or inevitable are not helpful at all. Ideas of social shaping have more potential, but are not well adapted to looking at alternatives to what exists. Most useful is the idea that technologies embody social values and are selectively useful for certain purposes. It should not be surprising that this has been the framework implicitly used throughout this book!

Notes

1. I thank Sharon Beder for helpful discussions about theories of technology and Stewart Russell for helpful discussions and a thorough reading of this chapter. For overviews and critiques of approaches in studies of science and technology, see David J. Hess, *Science Studies: An Advanced Introduction* (New York: New York University Press, 1997); Sheila Jasanoff, Gerald E. Markle, James C. Petersen and Trevor Pinch (eds.), *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage, 1995); Sal Restivo, *Science, Society, and Values: Toward a Sociology of Objectivity* (Bethlehem, PA: Lihigh University Press, 1994).

2. For a critique of technological determinism, see Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge, MA: MIT Press, 1977). For differing views by historians, see Merritt Roe Smith and Leo Marx (eds.), *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press, 1994).

3. One of the few works that comes close to this view is David Dickson, *Alternative Technology and the Politics of Technical Change* (London: Fontana, 1974).

4. Donald MacKenzie and Judy Wajcman (eds.), *The Social Shaping of Technology: How the Refrigerator Got its Hum* (Milton Keynes: Open University Press, 1985).

5. Langdon Winner, "Do artifacts have politics?," *Daedalus*, Vol. 109, No. 1, Winter 1980, pp. 121-136. For a critical perspective, see Bernward Joerges, "Do politics have artefacts?," *Social Studies of Science*, Vol. 29, No. 3, June 1999, pp. 411-431.

6. The classic work, much criticised but immensely influential, is Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974).

7. Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch (eds.), *The social construction of technological systems: New directions in the sociology and history of technology* (Cambridge, Mass.: MIT Press, 1987); Michel Callon, John Law, and Arie Rip, *Mapping the dynamics of science and technology: Sociology of science in the real world* (London: Macmillan, 1988); Brian Elliott (ed.), *Technology and Social Process* (Edinburgh: Edinburgh University Press, 1988); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open University Press, 1987); Bruno Latour, *The Pasteurization of France* (Cambridge, Mass.: Harvard University Press, 1988); John Law (ed.), *Power, action and belief: A new sociology of knowledge?* (London: Routledge and Kegan Paul, 1986).

8. Olga Amsterdamska, "Surely you are joking, Monsieur Latour?" *Science, Technology, & Human Values* Vol. 15, 1990, pp. 495-504; Pam Scott, "Levers and counterweights: A laboratory that failed to raise the world." *Social Studies of Science*, Vol. 21, 1991, pp. 7-35.

9. Langdon Winner, "Upon opening the black box and finding it empty: social constructivism and the philosophy of technology," *Science, Technology, and Human Values*, Vol. 18, No. 3, Summer 1993, pp. 362-378. See also Stewart Russell, "The social construction of artefacts: a response to Pinch and Bijker," *Social Studies of Science*, Vol. 16, 1986, pp. 331-346, a critique of another constructivist approach called "social construction of technology."

10. There are no central references on this approach. Some representative works are David Elliott and Ruth Elliott, *The Control of Technology* (London: Wykeham, 1976); Ivan Illich, *Tools for Conviviality* (London: Calder and Boyars, 1973); Richard E. Sclove, *Democracy and Technology* (New York: Guilford Press, 1995); Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press, 1986).

11. Harvey M. Sapolsky, "Science, technology and military policy," in Ina Spiegel-Rösing and Derek de Solla Price (eds.), *Science, Technology and Society: A Cross-disciplinary Perspective* (London: Sage, 1977), pp. 443-471 makes this point nicely, commenting that, in the shadow of weapons development, there is some work "in repairing battle wounds, in making rations more tasty, and in preventing machinery from rusting" (p. 459).