9

Cultural Revolution

Democracy and information

Two principal issues have emerged from previous chapters, one intellectual and the other political. The intellectual issue concerns the way value systems inform world views, and how they support beliefs about resources, the arms race, the Third World and technology itself. The political issue concerns the totalitarian nature of many of the institutions which control technology; it is associated with the difficulty encountered at almost every level, of opening any real dialogue between experts and users, technocrats and parliamentarians, planners and people. On the government level, the growth of bureaucracy 'has tended to shunt parliament away from the centre of political life. The executive apparatus functions increasingly without adequate political control.'[1] That has led to a widespread sense of political impotence, and some loss of faith in elected government, and so to the growth of protest movements concerned with the environment, the arms race and nuclear energy.

In both Europe and America, the feeling that totalitarian institutions were taking over was forcibly expressed in the unrest of the late 1960s (especially 1968) and the early 1970s, and in response to this there have been many modest reforms. In several countries, legislators have improved their ability to scrutinize bureaucratic action and technology policy (in Britain, since 1979, through strengthened Parliamentary select committees). There have also been moves to reduce the secrecy that surrounds many decisions; citizens' rights of access to some categories of official information have been recognized in law, first in the Scandinavian countries, then by the American Freedom of Information Act (1967), and later in West Germany (1973) and France (1978). In addition, there have been deliberate efforts to open up

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

public debate on nuclear energy. In Sweden, from 1973, the government encouraged the formation of study circles to examine the nuclear issue, and some eight thousand of these local citizens' groups became active. In Britain, a National Energy Conference was held in 1976 as part of an effort by the minister responsible, Tony Benn, to widen the scope of public discussion. In Austria, there was an extended campaign to inform the public on the nuclear energy issue which ended in 1978 with a referendum that halted the nation's nuclear programme.

A study of these developments, commissioned by the European Economic Community, has led Jean-Jacques Salomon to put forward an optimistic vision of technology as a European enterprise, carried forward in an increasingly co-operative spirit by an informed, participating public.[2] This is a liberal vision firmly rejecting all determinist concepts and emphasizing technology as a social process, just as open to democratic control as any other social process – if people will appreciate it this way. To secure that appreciation, Salomon advocates more education in science for everybody, and better training for the professionals with regard to the social and economic aspects of technology. His hope is for a healing of the divide between the two cultures based on science and the humanities.

This is a progressive vision, but too much is claimed for the more open decision-making procedures as they so far exist, and the intellectual issues concerning differing world views and values remain largely untouched. Salomon recognizes that there are important value-conflicts that cannot be resolved simply by making more information available, but argues that when vigorous debate takes place and there is open participation, perceptions are broadened; expert opinions then no longer appear exclusively technical, but are seen to involve subjective judgements and political preferences as well as technical fact. Dorothy Nelkin has described controversies concerning an airport extension and a nuclear energy plant in the United States, where open debate in itself exposed the values built into the experts' technical assessments.[3] There is thus a case for saying that the development of procedures for participation is by itself forcing a change in intellectual perspectives; professionals are forced to abandon the esoteric and sacred land of scientific facts for the real world, where facts and values are mixed.

This may be partly right, but may also lead to a complacent view of what participation can achieve. Despite the recognition that facts are always entwined with value judgements, there is still an assumption that only one kind of technical information is at issue, and that the way

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

to promote public participation in technology policy is to ensure the information is widely shared and debated. But any knowledge at all presupposes a world view, and the problem about sharing information is that where world views are in conflict, there will be little agreement about what kinds of knowledge are relevant and valid. Thus one problem at present is that although the framework for debate has opened a little, not much real dialogue takes place – because the different viewpoints that need to interact are not recognized. For example, when technologists submit information to parliamentary committees or public inquiries, they have been known to suggest that their particular proposals are the only rational answer to the problem in hand, and that any other would be 'irrational' or even 'illegitimate'. At the same time, a public inquiry may be conducted on the assumption that the very diverse evidence heard can all be related to a single frame of reference. Often this is done by imposing economic reference points on everything, perhaps by assigning a money value to a botanically unique habitat[4] or an ancient church.

At other inquiries, one may observe a public demonstration of the intellectual habit we noted earlier where available information is simply not perceived and is effectively destroyed in order to achieve a coherent view. This seems to have happened at the inquiry into Britain's Windscale nuclear reprocessing project in 1977 where evidence that did not fit a particular concept of 'technical fact'[5] was given little weight. As in Dorothy Nelkin's case-studies, the inquiry evidence certainly exposed the values built into technical arguments. But in the absence of any concept of how to accommodate dissident values, the debate was rather like a discussion between the blind and the deaf – people who perceive different kinds of reality and have no way of discovering how they interconnect.

In this respect, commentators[6] have noticed a sharp contrast in concept between the Windscale inquiry and the roughly simultaneous Canadian inquiry into the proposed Mackenzie Valley pipeline, cited previously in chapter 5. Here, Judge Berger's report pointed out that at least three different sets of values had a bearing on the question – values concerned firstly with the northern frontier, secondly with lifestyle and land, and thirdly with wilderness and environment. Having recognized these values, Berger was then able to suggest an agenda for decision-making, indicating that value-conflicts and claims about land should be resolved before a decision about the pipeline could be taken.

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

Among the European experiments with widened forms of participation, those which seem to have come nearest to making allowance in their procedures for fundamentally different scales of value may perhaps be found in The Netherlands. Six universities there have opened science schops to provide expert advice – and counter-expert advice – to citizens and community groups worried about environmental issues. At government level, proposals for major physical development projects are discussed by advisory groups representing several mutually opposed points of view, and government ministers must reply to their comments before a parliamentary decision is taken.[7] The concept of counter-information implied by this is perhaps the idea we most badly need, to make clear the point that there is no uniquely correct information. Basic observations and measurements can be factual and neutral, but interpretations, future projections, plans and designs never are – neither is the decision about what to observe and measure. All these are rooted in world views and values, and where the latter differ, the same facts will have different meanings (p. 65). Agreed facts about rising carbon dioxide levels in the atmosphere have different meanings for different specialists and there is no agreement about whether there is a major problem here. Agreed facts about pollution or nuclear accidents are reassuring to some people, alarming to others. Counter-information relates partly to different interpretations of the same data; partly, though, it can compensate for the way experts are trained not to perceive, or to ignore some categories of readily available information (pp. 36 and 152).

Even taking a limited view based on economic efficiency, governments, in their own interest, need to listen to 'multiple voices' and take account of 'multiple public views'.[8] The public interest is only rarely unitary; so the exercise of rationality is 'a more complex and variable process than any conceivable amalgam of "expert" inquiries'.[9]

All this is illustrated in a more restricted but equally clear way by the evaluations of household appliances carried out by some consumer organizations. Such research is based on values and assumptions different from those motivating the manufacturers of the equipment, and sometimes generates information that is new to them.[10] Yet quite a number of people feel that the values of the consumer groups are themselves too narrowly related to efficiency, safety and price, and that not enough consideration is given to the relevance of products for low-income groups, or to their environmental impact. Thus it has been said of the British Consumers' Association, publishers of *Which*? maga-

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

zine, that they are sometimes just as dogmatic and inflexible as any bureaucracy, 'representing only a narrow range of middle class consumer society'. Among other comments is the suggestion that there could be a *Counter-Which?* magazine to assess products less on the basis of technical efficiency than with regard to the environment, social welfare, the Third World, and so on.[11]

Institutions and education

The task of creating more open and democratic forms of technology-practice cannot be limited to establishing procedures through which public opinion may influence policy and planning. There are issues on which people do not want to participate actively but where it is still very desirable for decisions to accommodate widely different points of view arising from different values and frames of reference.

One subsidiary controversy at the Mackenzie Valley inquiry was connected with the engineering design of pipelines laid in arctic soils, and arose from a phenomenon known as frost heave. Calculations and experiments had been done to check the magnitude of the forces this generated, but the results were in dispute. Even on this specialist problem, then, there were conflicts of information and counter-information. Judge Berger noted that: 'Much of the specialist knowledge and expertise that is relevant to these matters is tied up with the industry and its consultants. This situation is untenable . . . Government cannot rely solely on industry's ability to judge its own case.'[12] On a matter such as this, public participation is barely relevant, but decisions still need to be based on diverse and independent research activity.

Berger thus strongly urged the Canadian government 'to make itself more knowledgeable in matters involving major innovative technology'. Much the same advice could be given to the British government in relation to its nationalized industries. On energy matters, for example, the Atomic Energy Authority has for long been in a privileged position in advising the Department of Energy. There is an especial need for its influence to be countered by a strong, independent energy agency concerned with energy use, consumer interests and conservation. There is also a case for devolving much more responsibility to the regional electricity boards in order to diversify innovation, and to encourage initiatives like those of Midlands Electricity (chapter 8).

More important, though, is the need for more public interest research

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

by independent bodies, especially bodies representative of minority and environmental interests, and of low-income groups. As we have seen, such research is already done in science shops and by some consumer groups. In addition, very valuable studies have been made by Greenpeace on chemical waste dumping in the North Sea, by Friends of the Earth on nuclear power, and by World-Watch on deforestation. But beyond the campaigning style of these latter, often aimed mainly at producing short, polemical publications, there is need for public interest studies with a long-term commitment. The Stockholm International Peace Research Institute (SIPRI) is a good example, and public interest research on arms control is perhaps a more urgent need than anything else. We have already seen how the arms race is sustained by phoney intelligence, and counter-information is needed to off-set this. Another example is the Political Ecology Research Group, which since 1976 has specialized on nuclear energy questions, providing an independent consultancy service which is used by a wide variety of people – local community groups, broadcasting media, the Union of Concerned Scientists (of the United States), and the Lower Saxony State Government (in Germany).[13]

One topic on which public interest research can be particularly important is food, drugs and chemicals. Government regulation of the relevant industries is often fairly tight, but is limited by national boundaries, and is evaded when corporations transfer their activities from one country to another. Thus as tobacco advertising is increasingly restricted within the industrialized countries, sales campaigns in the Third World intensify. Agricultural chemicals which are restricted, 'on safety grounds in the rich countries are freely available in the poor, where the risks are greatest'.[14] A drug which is sold in Africa and Asia as a medicine for children, and vigorously promoted there by an American corporation is known to be 'of no value to children – may actually harm them – and the marketing procedures would be forbidden by law in the US'.[15] The public interest group exposing this scandal – Social Audit – also points to abuses in British sales of milk powder, vitamin pills and hair-care products. The size of the problem is illustrated by one country's attempt to control it. In 1982, Bangladesh announced a ban on 1,500 different drugs, of which 237 were described as harmful and the rest as unnecessary.

One query that has been raised is, how far can one go in encouraging research oriented to many different viewpoints before the result is confusion? Raymond Williams, for example, suggests that in a socialist

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

country committed to central planning, it might be reasonable to suggest that 'there should never be less than two independently prepared plans'.[16] For people used to linear modes of thought, this sounds like a recipe either for disaster or complete paralysis. But if there is to be any democracy in decision-making, alternatives have to be explicit and fully researched. This is a prerequisite for choice. And it need not lead to confusion if alternative views interact in a dialectic of mutual adjustment. If this were recognized, in nations of whatever political complexion, public interest research and critical science would be seen to have a validity and importance in their own right, and would attract support from research councils and foundations. As it is, such work is mainly perceived as a form of opposition to private corporations and government, and thus gains little support from official quarters.

In his vision of a co-operative European commitment to technology based on public participation and a free flow of information, Jean-Jacques Salomon does not fully confront this issue. But he does comment usefully on the importance of better education in science and technology, not only for the citizen but also for the professional. In particular, he makes the point that unless professional technologists are more aware of the socio-economic implications of their work, they will remain locked in illusions of value-free technical rationality, believing that there is only one right answer to every problem. And holding those views, they will not understand how public choice and participation in decision-making can ever make sense.

One may see in detail how the idea of value-free rationality has been perpetuated simply by looking at the textbooks from which many among the present generation of engineers were taught. Most are strongly directed towards the concept of technology as a problem-solving discipline capable of finding 'optimum solutions' and 'right answers' to strictly technical problems. For example, the textbooks from which I was supposed to learn soil mechanics[17] discussed the design of embankments, dams, foundations and highways almost entirely without giving examples of real dams or highways, so questions of context and socio-economic background could never arise. Textbook writers also favoured a very formal style which emphasized the internal logic of the subject. Their model seemed to be Euclid's geometry, with its definitions and axioms, and its logical build-up of theorem upon theorem. An example which follows this pattern very closely, taking Newton's laws of motion as its axioms, is a text on 'mechanical technology' used in teaching technicians for the Ordinary

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

National Certificate.[18] In this work, the abstraction employed in the effort to seem totally rational and value-free is taken to such extremes that no real machine is mentioned, and engine components such as fly-wheels are referred to only as 'rigid bodies'.

Thought about in this way, technology is quite literally neutral – one might even say sterile. Not surprisingly then, some engineers speak of their formative years as a mind-dulling, disabling experience; it is they who have used the term tunnel vision[19] and in one extreme case, have talked about the need for an engineers liberation' movement.[20] Samuel Florman refers to the stultifying influence of engineering schools in America, where 'the least bit of imagination, social concern or cultural interest is snuffed out under a crushing load of purely technical subjects'.[21]

In many respects, these problems are now better handled. Better textbooks are available. New professional journals discuss technology-practice and its social context, and in Britain, enhanced or enriched engineering degree courses include an extra year of study with emphasis on management and business studies, longer periods of industrial experience, and in some universities, much more design and project work. Elsewhere, there are new courses on science, technology and society (STS).

But this is only a beginning. The additional training in management studies does not automatically mean that engineers have a more rounded, interdisciplinary approach. It may mean that they simply learn fragments of two disciplines without adequately making connections between them. In fact, a central difficulty for the teacher or textbook writer is that if he discusses social context and organization as a sociologist would, he loses touch with real nuts and bolts and practical technology. But if he presents the technical content of a problem in a conventional manner, there is no satisfactory way of bringing in the organizational aspect at all. In other words, bridges are not built between the two cultures simply by tacking extra subjects onto a conventional technical education. The whole philosophy of such training has to be rethought, textbooks and all, in order to present an integrated vision of technology-practice rather than a tunnel vision focused only on its technical aspects.

One way of overcoming these problems may be found through the new design disciplines which have developed within technology itself. They have led to renewed emphasis on design as part of the training of engineers, and several authors make the point that this helps to tie

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

course content to a social background.[22] Apart from that, however, the design disciplines and the soft systems approach which goes with them can have an influence on the overall structure of teaching. An example is the Open University's very wide-ranging foundation course in technology, which has a mainstream component dealing with issues in technology, and tributary components providing basic teaching in mathematics, materials, chemistry, electricity, and so on.

The aim of presenting an integrated vision of technology which some of these approaches illustrate has been at the centre of my own work for the last dozen years. That needs to be mentioned, because it is this work which has led to the somewhat personal view of technology put forward in this book. Apart from some teaching on the course just mentioned, formative experience has included project work with engineering students; exposure to courses on design technology and agricultural engineering; and multidisciplinary editorial work on subjects ranging from public standpost water supplies[23] to human ecology.[24] In all of this, it has seemed particularly important to find ways of breaking through professional boundaries, to develop broader insights in collectively written texts,[25] and to think about extending the same multidisciplinary approach to field surveys and planning.[26]

Three short practical manuals can also be mentioned as tributaries which have fed the mainstream of the present book.[27] Taken together, they could almost form a companion volume, illustrating what the concept of technology-practice may mean in specific applications, and applying the notion of technology as the management of process to specific problems of husbandry and maintenance. The manuals were also written with the defects of conventional textbooks in mind; where the latter are narrowly technical, the manuals attempt a unified view of how the technical and organizational aspects of water supply or nutrition projects are related; and where textbooks are deliberately abstract, the manuals quote identifiable case-studies from Brazil and Botswana, India and Zaire. Through the case-studies rather than by analysis, the users' viewpoint is brought in, forcing one to notice how technology-practice depends on ordinary people, not just experts, and how experts from different disciplines need to collaborate: engineers with social workers, doctors with horticulturists. The contribution of these small booklets is modest indeed, but I do claim one thing for them: that they show how the philosophy of technology presented in this book may have practical application; it is not just a literary formulation.

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

Frames of reference

Previous paragraphs suggest a random list of recommendations for minor reforms in technology-practice based on a strengthening of public interest research and improvements in technical education. But these suggestions have implications that run counter to the conventional wisdom. They indicate a plurality of approaches rather than one right answer. They present technical fact and engineering design as expressions of world views and values, not of neutral rationality. Thus for any of these reforms to be carried through with conviction, and for it to have the desired effect, there must be a fairly fundamental shift in the frame of reference we use when thinking about technology and the world in which it is applied. This might entail a fairly small adjustment, like the change in conversational subject of Dahrendorf's analogy (chapter 2). But it may prove to be a sufficiently radical change to merit description as a change in levels of awareness, an awakening to new insights, or even a cultural revolution. In the philosophers' jargon, it might be seen as the adoption of a new paradigm – a new pattern for organizing ideas.

Such terms are relevant because, as was suggested earlier (p. 29), the most fundamental choices in technology are not those between solar and nuclear energy, appropriate and high technique. They are choices between attitudes in mind. We may cultivate an exploratory, open view of the world, or we may maintain a fixed, inflexible outlook, tied to the conventional wisdom, in which new options are not recognized.

This need to pose choices about attitudes, including world views and the concept of technology itself, makes it particularly appropriate to talk about cultural revolution. And although I do not employ this term in quite the same sense as socialists do, for this is clearly a non-socialist book, there is still much to be learned from that direction. Socialists talk about revolutionary awareness. We require this especially with respect to awareness of the possibilities for future progress and choice in technology. Moreover, we require it to be an awareness that is shared by everybody because, as Aldo Leopold says, 'all men, by what they think about and wish for, in effect wield all tools'.[28] Or as the socialist writer Raymond Williams[29] has put it, the 'cultural revolution insists . . . that what a society needs, before all . . . is as many as possible conscious individuals'. This, he makes clear, is a first requirement for countering the trend towards technocratic decision-making.

Williams defines the central task of a socialist cultural revolution as,

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

'the general appropriation of . . . the intellectual forces of knowledge and conscious decision', for the service of the community; he sees it also as a more 'effective response to . . . general human needs, in care and relationships, and in knowledge and development'. One thinks of the improvements in health achieved in Kerala (chapter 4), partly through the openness of local democracy, and partly through a widening of literacy, and a growing awareness among women especially of what they can do to help themselves. In both respects, this is 'the general appropriation of knowledge'. And as Williams says, the 'cultural revolution . . . will be deeply sited among women or it will not, in practice, occur at all'. Many professionals in technology, I have argued, have tended to be diverted away from the service of basic needs and good husbandry through their greater interest in technological virtuosity. The potential contribution of women – and of insights from some non-western communities – lies in the fact that they represent areas of life where technological virtuosity has not yet become dominant.

To speak about cultural revolution is inevitably to recall the China of Mao Zedong during the late 1960s. It is now usual to decry the events of this cultural revolution, but they are still a relevant example. Mao was disturbed by three widening divisions in Chinese society – between town and country, between worker and peasant, and between mental and manual labour. He hoped to bridge these gaps by making education more practical, by sending students and professional people to work in agriculture, by training peasants as barefoot doctors, and by encouraging dialogue between workers and management in factories. My concern is with some very similar divisions in western technological society, and especially the division between the expert sphere and the user sphere. Many aspects of the Chinese approach are pertinent to this, but whereas Mao sought to bridge the gap by rapid change involving brutal compulsion, I share Williams's view that what we are concerned with is a long revolution based on educational development as well as ideological campaigning.

In this context, it is worth remembering that other crucial phases in the development of western technology arose out of experiences of awakening to new possibilities, some of which may justly be called cultural revolutions. I earlier cited the voyages of Columbus and his contemporaries; the scientific revolution of the seventeenth century can also be looked at in this way. Among more directly relevant examples are the new ideas about economics and production that

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

developed in the eighteenth century and contributed to the organizational innovations of the first industrial revolution. Mary Douglas describes this phase as a 'realization which transfixed thoughtful minds in the eighteenth century and onwards . . . that the market is a system with its own immutable laws'.[30] There was a boldness of illumination about the way this idea was grasped and analysed, and for people engaged in trade and industry, a sense of revelation about the new potential open to them. Reading the correspondence of James Watt's associates and other early industrialists,[31] one may still feel their sense of discovery and see how a shift in awareness concerning socioeconomic organization fed ideas into factory development and engineering innovation.

The cultural revolution that we may find occurring today will also involve the exhileration of discovering new insights. In the 1970s, one could sense this among advocates of the use of solar energy and renewable resources. Today there are other new enthusiasms, such as that which, in 1982, gave Britain more microcomputers in schools and homes, and more telextext users per head of population than any other nation. Such things are bound to change perceptions of technology, and to awaken new awareness of the possibilities open to us, but perhaps only in trivial ways.

A more fundamental aspect of current industrial change is the impact on employment. Between 1971 and 1981, Britain lost 1.3 million jobs in ten major industries ranging from automobiles and chemicals to mining and textiles. By 1990, these same industries could lose another 0.5 million workplaces. But new microelectronics industries seem likely to create less than 0.1 million new jobs by 1990,[32] and the only other major prospects for expanded employment are in the arms industries and construction. Whether the consequences of reduced employment is social unrest, or whether instead there is an erosion of the work ethic and a growing feeling that it no longer matters if one has a job, then either way, the change in perceptions of industry and technology must be vast.

But the central preoccupation of any modern cultural revolution must surely be centred on what one university engineer has described as 'the mainspring of technological misdirection'.[33] This is the impulse to go on inventing, developing and producing regardless of society's needs. The result is that we create systems of organized waste in electricity supply, consumer goods and food production, and above all, in the arms race.

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

But conventional world views disguise much of this and make it seem logical and necessary; they hide the real nature of the technological imperative. Thus the most important part of any cultural revolution – the biggest shift in perceptions and paradigms – could be a reconstruction of world views so that the irrationality of our present pattern of technological progress is no longer hidden. Before pursuing this point, though, we ought first to ask whether a fundamental change in the technological imperative is possible, even if we were more aware of how that imperative is conventionally disguised?

Some authors advocate change that seems too radical to be credible. They portray western man as an 'unbound Prometheus',[34] crazy about science and machines, and pursuing his white whales of technological achievement wildly and obsessively. They see the historical roots of this attitude in the Judaeo-Christian tradition, with its work ethic and its teachings about man's dominion over nature. And they conceive cultural revolution as a turning away from this outlook to something more contemplative and gentle, drawing on eastern types of wisdom, and on Buddhist insights.

One does not have to be a slavish adherent of the conventional wisdom to take alarm at any such suggestion of a wholesale rejection of western thought. It might involve the rejection of liberal values also, and of enlightenment and reason, and even of the basis of modern advances in health and welfare. To advocate anything that could involve this seems as absurd as the more extreme aspects of the nineteenth century's romantic reaction against industry.

The point is taken, but yet there remains the problem of unrelenting drives in technology that make many of us secretly want an arms race, that make us thrill to the risks of advanced nuclear technology, or which draw us into adventure on the frontiers of environmental conquest. Some eastern cultures demonstrate an avoidance of these particular obsessions, and might help us find a new balance in western thought without necessarily abandoning any part of it. The point here is that there is a doubleness in western attitudes and a dialectic between opposed points of view. Beside the half of us that is fascinated by high technology, there is another half already partially in tune with Buddhism. Beside western man, with his virtuosity drives, there is also western woman, seemingly less enthralled by such impulses. Beside Bacon's comments on science as dominion over natures, there is also Bacon's more insistent view that knowledge should be applied in works of compassion, and 'for the benefit and use of life'. Beside the heroic

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

engineers who have built 'cathedrals, railroads and space vehicles to demonstrate the adventuring spirit of man', there have also been engineers who saw their vocation as a social and humanitarian one, like 'John Smeaton, who stressed "civil" engineering as opposed to the military branch (and) William Strutt, who attempted to create a technology of social welfare applicable in hospitals and homes'.[35]

For those inclined to find all the faults of western civilization in its religious tradition, we may note that the same doubleness of vision is to be found there as well. Beside Christ the King, celebrated by daringly engineered cathedrals, motivating crusades and colonial conquests, there is also Jesus the carpenter, healing the sick, concerned for the hungry, and washing his followers' feet. The challenge we ought to recognize in eastern religions, or in the basic-needs economies of Kerala and Sri Lanka, is a challenge to tip the balance in the West's traditional dialectic from conquest and virtuosity towards a point where we can perhaps feel our kinship with Buddhism, and where the work of women and craftsmen, of meeting needs and caring, becomes much more important.

It is worth making these points in terms that refer to religion and may seem rather literary, because our vision and values, even in this calculating, atheistic age, find their power to move us partly through rhetoric and symbolism. It sometimes seems that it is the most hardheaded engineers who talk most freely about their work as cathedral-building. And in the most urgent of our technological dilemmas, the nuclear arms race, women have altered the whole atmosphere of debate by actions that are both heroic and symbolic. A small party of women camped at the gates of a US Air Force base in Britain throughout one of the coldest winters on record to protest against cruise missiles, and sustaining their protest into a second winter, make clear that it is not sufficient just to look at the issue simply in terms of power politics and technology. A similar awareness was generated on a more restricted scale by the Scandinavian women who carried their protest across Russia in the summer of 1982. Identical protests by men would have commanded much less respect in Britain, and would probably not have gained entry to Russia. When women take the lead, it is widely if intuitively recognized that their action represents a distinctive set of values, and not just the immaturity of some overgrown student cause.

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

World views and waves of progress

The question of nuclear weapons illustrates nearly all the key issues I have tried to tackle in this book. Not only is this a field where technological imperatives and virtuosity drives have an ample scope, but there are also many questions to be asked about the roles played by professional technologists and by totalitarian organizations. Scientists' pressure groups, defence bureaucracies and large-scale industry wield power almost beyond political control. President Eisenhower warned against it; retired defence experts such as Herbert York and Solly Zuckerman have repeatedly raised the alarm; but the only thing that seems ever to move it is sustained, persistent, continuous, vociferous, peacefully disruptive public campaigning. One may regret the use of extra-parliamentary tactics, but faced with a totalitarian military-industrial system that makes its decisions in an extra-parliamentary way, the people have only this resort if they are to exercise their proper sovereignty.

It has been said that during the last decade, most really big initiatives have come from the people: governments have followed where people have led. With regard to environmental concerns, or ending the Vietnam war, or progress in women's rights, 'what was politically opposed or neglected became so strongly supported by ordinary people that governments were led to treat it as good politics'.[36] Similarly, nuclear energy in the United States has 'been made uneconomic by . . . public protest'.[37] Some such claims can even be made with regard to the limited Test Ban Treaty of 1963. George Kistiakowsky records Britain's early resistance to any such agreement.[38] But Britain had a strong Campaign for Nuclear Disarmament which publicized the dangers of fall-out from nuclear tests; not least because of this pressure, the British government eventually played a constructive part in the negotiations.

But to say all this is not to advocate unilateral disarmament nor even a nuclear freeze. It is merely to point out what difficulties face the public in getting its voice heard; and I mention it as a particular instance where the questions raised earlier about the role of dialogue in technological issues ought to be applied. In order to go beyond this and form an opinion about what level of defence is required, we have to consider another point that applies generally to most technology. This is that the world view we use in deciding what kinds of technique to use

Pacey, Arnold. *The Culture of Technology*.
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

is a view which must include perspectives on human organization and their international context as well as specific concepts of technology.

In the age of Columbus, a shift in awareness came to many Europeans as a result of the discovery of a new continent, and due to the circumnavigation of Africa and the expansion of trade with Asia (chapter 2). In today's world, we perhaps need the altered frames of reference that could come through rediscovering these same continents. That would mean ceasing to lump them together in the ugly portmanteau concept of the Third World. Then instead of seeing these countries as full of backward people living a 'soup kitchen' existence, we might find that much may be learned from them, especially from the non-industrialized but culturally rich countries.

If such voyages of rediscovery were ever to reach the Soviet Union, they would certainly confirm that this nation presents a special and serious danger, and that it cannot make sense for the West to carry out any sort of extensive, one-sided disarmament. But we may also discover that the Soviet threat has been partly induced by the West's own policies, and that Russia has been encouraged to behave dangerously by being perpetually distrusted, vilified and spoken of openly as the enemy even in the absence of war.

The West has strong vested interests whose prosperity depends on preparation for war, and the problem we may need to recognize is that in some respects, the United States and Russia need each other, and manipulate each other's hostility in order to justify their commitments to virtuosity-oriented technology. Field Marshal Michael Carver points to the type of reconstruction of ideas required if we are to move away from this situation by quoting the former US ambassador in Moscow, George F. Kennan.[39] The behaviour of the Russian leadership, he says, is partly 'a reflection of our own treatment' of them. If we continue to view the Russians as implacable enemies, dedicated to 'nothing other than our destruction – that, in the end, is how we shall assuredly have them'. To view Soviet Russia as eaten up with an absolute malevolence is to allow 'intellectual primitivism and naiveté' to distort our own frame of reference. A first step in revising our views would be to seek a better understanding of Russian civilization, not just in terms of ideology, but by considering its history, traditions and national experience, noting, perhaps, the marked continuity between Tsarist and Soviet ways.

As 1982 ended, the Soviet Union, under a new leader, made proposals for arms control and reduction which seemed serious and

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

far-reaching. Thus there may be new opportunities to undertake voyages of exploration and understanding. If so, we ought to remember that a major obstacle in previous negotiations has been a secret wish in our own culture to perpetuate a technological arms race. This has been vigorously expressed by the lobbying of some scientists, for example.

Thus along with the responsibility to understand Russian civilization, there is also a responsibility to better understand our own. In part, that means removing the disguises we use to hide the real reasons for much of our technology. We are told, for example, that some of the earliest nuclear weapons were made because 'it would have been contrary to the spirit of modern science and technology to refrain voluntarily from the further development of a new field of research, however dangerous'. So when the utilitarian or military purpose of the work was overtaken by events, that did not mean the project's cancellation. Instead, new grounds were found 'for the political and moral justification of its continuance'.[40] It is this business of inventing reasons to justify research and invention that has created many aspects of the world view we now take for granted. It has been my main purpose to get behind these invented reasons and expose the virtuosity concept of technology which they so often conceal.

But in a short, exploratory book, many parts of the argument are inevitably left incomplete. This is particularly regrettable where the more positive, constructive themes are concerned. One of these is the possibility of articulating the values of end use and basic human need more fully, so that they have greater influence in shaping future technology. Here, the most important point stressed is the role played by women, but a point left unexamined is the connection that ought to exist between need-oriented values and environmental concerns.

More fundamental, however, is the suggestion that the very concept of technology itself is open to revision. In chapter 3, I quoted Zuckerman as saying that technologists have made the world more dangerous simply by doing what they conceive to be their job – especially regarding the development of weapons. If this is so, cultural revolution needs to be carried to the point where these experts conceive their jobs differently, and understand technology differently also. Many people have recognized the problem, and some relevant ideas are in circulation, often under the banner of appropriate technology. But much of the discussion has been incoherent, even rhetorical, and to get beyond this stage and begin to explore new styles for western technology, we need to go further in questioning ideas of what tech-

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

nology is about. Is it mainly about making things? Or is it about managing the natural processes of growth and decay in which we are involved? Given that a balance is needed in engineering between construction and maintenance, and in medicine between cure and prevention, where should that balance be struck? How should we use the concept of technology-practice, with its ideas about the interaction of technical and organizational innovations?

It would be wrong to claim that questions of this sort can lead to a concept so comprehensive as to displace entirely the more conventional view of technology as a quest to innovate and venture, to construct and develop. Again we need to think dialectically: this is not a matter of defeating one concept by another, but of tipping the balance away from the virtuosity concept towards the process view.

Freeman Dyson[41] sees the options in technology as 'a choice of two styles, which I call the grey and the green'. If the grey style is typified by physics, plutonium and bureaucracy, the green is represented by biology, horse manure and community. But he adds that we cannot simply replace all the grey high technology by a green approach and more appropriate technology. We cannot suppose that the ideology of 'Green is beautiful' will save us 'from the necessity of making difficult choices'. If human needs are to be met, we require both grey and green; if they are to be met in a civilized, humane way, we require a continuous, active dialogue, not the one right answer offered by either of the opposite points of view. Nuclear energy is not the one right answer required if all human needs are to be supplied, but neither is its total abandonment.

If this sounds like fence-sitting, let it be said that I personally not only lean toward environmental causes, but have a low-energy, near-vegetarian lifestyle which scarcely requires nuclear energy for its support. But those are my own preferences, and it would be wrong to insist that this kind of lifestyle is the only satisfactory outcome of a decision-making process in which a great diversity of people and organizations must participate. One of the best of many reports on the energy question insists that the first priority in this sphere is open, pluralistic debate – otherwise 'projects may come to be decided either by financial overlords on what are believed to be purely economic grounds, or by scientists and engineers on grounds of "technical sweetness" '.[42] The one right answer and the simple formula are always suspect, whether economicaly motivated or technically sweet, whether monetarist, socialist, or antinuclear. Individually, we must live

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

by the light of our own awareness, while valuing a plurality of view in the community. Openness, democracy and diversity are what will save us, not some environmentalist blueprint, nor any technocractic plan. Again Mao Zedong was right in theory if clumsy in practice, for he spoke about walking on two legs, that is, combining different approaches, including both complex techniques and community enterprises.

One possible interpretation of the context of these debates is that we have experienced four waves of industrial revolution during the last two centuries, and that the recession of the early 1980s is the pause which heralds a fifth (chapter 2). During the recession, technical innovation is proceeding apace, and there seems a good chance that ultimately some cluster of institutional and technical developments will fall into place to provide a new pattern for growth. One may even see, again with Freeman Dyson, what techniques could be involved: 'We shall find the distinction between electronic and biological technology becoming increasingly blurred'. Both deal with the fundamentals of information. In both, solar energy can he harnessed particularly effectively. Both allow us to fulfil many of the needs of industrial society using much less energy and other resources than we do now.

The prospects seem good, but a fifth wave of industrial change is not to be beneficiently achieved simply by letting innovation in microelectronics and biology run its course. There are choices to be made about the social and cultural aspects of new and evolving forms of technology-practice, about the institutions which manage technology, and about how the new techniques are applied in the user sphere. In looking at the possible options, attention may turn to the nations of the Pacific rim, where some of the new technology is currently being developed, and where much of its hardware is manufactured. These nations seem to have had remarkable success, but one may feel that theirs has become an excessively materialist culture, over-emphasizing economic values. Confronted with this criticism from a westerner, one Japanese retorted: 'better a materialist culture than a weapons culture'.[43]

Perhaps, though, we can do better than both through a humanitarian stress on need-oriented values, not just as a cosy idealism, nor as a search for 'one right answer', but as a strengthening contribution to a continuing dialectic. For three centuries, people have been turning to Francis Bacon for ideas about the goals and methods of science and technology; and as we have seen, Bacon was motivated by a 'love of

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

God's creation . . . pity for the sufferings of man, and striving for innocence, humility and charity'.[44] He felt that knowledge and technique should be perfected and governed in love; and that the fruits of knowledge should be used, not for 'profit, or fame or power . . . but for the benefit and use of life'.

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228

Notes

CHAPTER 1 Technology: Practice and culture

1 M. B. Doyle, *An Assessment of the Snowmobile Industry and Sport*, Washington DC: International Snowmobile Industry Association, 1978, pp. 14, 47; on Joseph-Armand Bombardier, see Alexander Ross, *The Risk Takers*, Toronto: Macmillan and the Financial Post, 1978, p. 155.

2 R. A. Buchanan, *Technology and Social Progress*, Oxford: Pergamon Press, 1965, p. 163.

3 P. J. Usher, 'The use of snowmobiles for trapping on Banks Island', *Arctic* (Arctic Institute of North America), **25**, 1972, p. 173.

4 J. K. Galbraith, *The New Industrial State*, 2nd British edition, London: André Deutsch, 1972, chapter 2.

5 John Naughton, 'Introduction: technology and human values', in *Living with Technology: a Foundation Course*, Milton Keynes: The Open University Press, 1979.

6 Charles Heineman, 'Survey of hand-pumps in Vellakovil . . .', unpublished report, January 1975, quoted by Arnold Pacey, *Hand-pump Maintenance*, London: Intermediate Technology Publications, 1977.

7 Leela Damodaran, 'Health hazards of VDUs? – Chairman's introduction', conference at Loughborough University of Technology, 11 December 1980.

8 Quoted by Peter Hartley, 'Educating engineers', *The Ecologist*, **10** (10), December 1980, p. 353.

9 E.g. David Elliott and Ruth Elliott, *The Control of Technology*, London and Winchester: Wykeham, 1976.

CHAPTER 2 Beliefs about progress

1 Derek J. de S. Price, *Little Science, Big Science*, New York: Columbia University Press, 1963, pp. 10, 29.

2 Anthony Wedgwood Benn, 'Introduction', *The Man-Made World: the Book of the Course*, Milton Keynes: The Open University Press, 1971, p. 13.

Pacey, Arnold. *The Culture of Technology.*
E-book, Cambridge, Mass.: The MIT Press, 1983, https://hdl.handle.net/2027/heb01153.0001.001.
Downloaded on behalf of 18.226.200.228