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Value-conflicts and Institutions

Babels of confusion

Modern man, it often seems, is divided man. There are no universally agreed goals, no wholly comprehensive systems of values: 'the modern mind is divided – in tension'. Again and again there are attempts to resolve the tension by suggesting a rejection of high technology and reversion to a simpler, more rural way of living. But many of the finest achievements of western culture are the products either of high technology or of the virtuosity values that have impelled it. One thinks of the idealistic engineering of medieval cathedrals, the work of Renaissance artist-engineers, the constructions of Brunel and Eiffel, and the marvels of microelectronics or of space exploration. To disown all that would be both Luddite and Philistine. But to assert the importance of meeting basic human needs, and using technology to that end, is an inescapable obligation. To recognize the necessity for an environmental consciousness and concern for conservation is almost equally vital. But those who advocate a rural lifestyle and rejection of modern technology do not have the answer. Neither, at the opposite extreme, do those who advocate 'total (and implicitly totalitarian) materialism . . . Each of these simple choices has failed'.[1]

One of the most sensitive of all writers on engineering, L. T. C. Rolt,[2] has described how conflicts of this sort developed for him during an apprenticeship with a firm of locomotive builders and in a diesel-engine factory. His enjoyment of the work and his interest in things mechanical was wholehearted. His account amply illustrates many facets of what I have called virtuosity values – especially the aesthetic appeal of machines, craftsmen's 'feel' for their work, and the enjoyment of an elemental mobility in the still novel automobiles of the

1920s and 1930s. Yet there were often conflicts with other values. When the locomotive works closed down and craftsmen were thrown out of work, he saw the commercial world 'robbing such men of their only real asset and source of true satisfaction – their skill'. This experience, coupled with what he saw of the smoky squalor of the industrial towns, led him to exclaim that accountants, with their narrow economic values, were 'unable to see that their financial logic made brutal nonsense in human and natural terms'.

Working as an agricultural engineer in the Wiltshire countryside, Rolt found these conflicts lessened. Later, he discovered in the canal system of midland England, 'the one work of engineering which so far from conflicting in any way with the beauties of the natural world positively enhanced them'. Yet he felt increasingly with Thomas Traherne that man's world was, 'a Babel of confusions: invented riches, pomps and vanities'.

The same conflict is a recurrent theme in the literature of the industrial world. America's tradition of pastoral writing vividly portrays the intrusion of other values for which 'the railroad was a favourite emblem', and the locomotive, 'associated with fire, smoke, speed, iron and noise, is the leading symbol.' Leo Marx[3] points to 'tension between the two systems of value', pastoral and industrial, persisting through a century and more. He argues that Thomas Jefferson's ideal for America was a pastoral one; the continent would be a non-industrial land of farmers and husbandmen with the goal of 'sufficiency, not economic growth'. Yet at the same time, Jefferson was 'devoted to the advance of science, technology and the arts'; he enthused over steam engines, and in government did much to create conditions that would favour the development of industry. This 'doubleness of . . . outlook', far from being a handicap, gave him political strength, and is part of Jefferson's continuing significance: he expresses 'decisive contradictions' in our culture. The question of how we deal with these contradictions is central to the ethical discipline we need in technology, as the last chapter suggested. Its bearing on individual behaviour and on the institutions which manage technology is the theme of this chapter.

How do the decisive contradictions arise? Stephen Cotgrove[4] argues that values tend to 'cluster' around different aspects of experience; thus while an industrialist may operate mainly with 'material values', especially in his day-to-day life in the business world, in other circumstances – at home especially – he may turn to quite different pages in his mental 'gazetteer' of values. Nearly all of us do this, and nearly all of us feel acute discomfort and conflict, Cotgrove suggests, when we find values from one page of the gazetteer invading another. He cites situations where art or sex is commercialized as showing how parts of experience normally governed by non-material values may be encroached on by material or economic considerations. In a similar way, when L. T. C. Rolt saw craftsmen unemployed and human skills casually discarded, this for him was an instance where a human attribute was being judged inappropriately on the basis of economic values.

Technology-practice, I have suggested, encompasses a great variety of human experience, technical, organizational and cultural; it encompasses also the contrasts we have noticed between women's and men's experience. Many different clusters of values are associated with this range of experience, not all of them compatible. Thus individuals feel conflict, and society as a whole is periodically divided by controversy about issues relating to technology.

What matters most both for society and for the individual is not necessarily which values come out on top, but how conflicts are handled. Here two strategies make a particularly telling contrast. The first is to make one set of values dominant. Competing claims made by other values may then be subordinated to this master value or set of values. If the conflict cannot be fully resolved in this way, it can usually be kept under control by adopting a compartmentalized style of thinking in which rebel values are kept to a narrowly defined part of life. This leads to a tough-minded, fundamentalist attitude in which few compromises are made.

J. K. Galbraith points out that technological virtuosity is one of the master values of western society and that other goals are separated from it. Thus there is no acceptable way 'to measure the advantages of space achievements against help to the poor . . . the absolute virtue of technological advance is again assumed'.[5]

An opposite strategy, representing a different kind of ethical discipline, is characteristic of people who are ready to live with a situation in which different values pull different ways. Such people are prepared to tolerate ambiguity and look for compromise. The individual with this style of thinking lets a range of values coexist in his mind, and constantly makes cross references to check one against the other. Somebody who is tolerant of ambiguity in this way will not see issues as stark choices between black and white, but between different shades of grey; in politics, he or she will not be attracted by the extremes either of right or left, but will be somewhere near the centre. Critics will say of such people that they are all things to all men, wanting to have everything both ways.

It was such tolerance of ambiguity that was so characteristic of Jefferson's attitude to technology; one cannot cancel out either his ardent devotion to the rural ideal, nor his deep interest in science and technical progress. Deep 'ambiguities lie at the centre of his temperament' and all his commitments involve striking polarities. He admired simple, unworldly, rural lifestyles, but sought high office and cultivated the high arts. The way to understand this, Leo Marx argues, is to see the controlling principle of Jefferson's thought not as 'any fixed image of society. Rather it is dialectical'. It lies in a constant redefinition of his ideal, 'pushing it ahead, so to speak, into an unknown future to adjust to ever-changing circumstances'.

It is precisely this kind of dialectic, I suggest, that we need in thinking about modern technology. We have already encountered it in the discipline of reversal – the practice of periodically turning round conventional attitudes and looking at the world in terms of basic needs and low-status occupations. We have encountered it also in the argument that views of progress in technology should not be fixed in linear images, but subject, like Jefferson's ideal, to constant redefinition and redirection.

However, there is a good deal of evidence that many scientists and engineers have an opposite cast of mind – that they tend to be intolerant of ambiguity. They like to tackle problems which have definite solutions, and feel ill at ease with open-ended questions. 'I'm not fond of debate . . . I prefer analysis', said one leading technologist welcoming a report on a nuclear energy project 'for its lack of ambivalence'.[6]

Similar attitudes have often been noted by educationists[7] among students who show an aptitude for science and technology. These individuals enjoy mathematical problems but very often dislike writing essays, not necessarily because of any lack of literary ability, but primarily because an essay is open-ended. There are no precise rules, and no unambiguous right or wrong answers. This makes sense, because engineers need to avoid open-ended situations in their work. Commitment to being practical and making things work means identifying a viable solution to the problem in hand and concentrating on that. To explore too many alternatives will often mean dissipating effort without getting results. Thus while a good scientist must be able to produce original ideas, a 'good engineer is a person who makes a design that works with as few original ideas as possible'.[8]

What this boils down to is that the most effective engineers are often unusually singleminded, capable of being strongly committed to the task in hand, and able to keep emotional problems from affecting his work by compartmentalizing one broad area of life from another. A remarkable instance of this singleminded approach is seen in the career of Wernher von Braun, who in adolescence dreamed about space travel and rocket engineering, and forty years later was a leading participant in the American programme which placed men on the moon. At every decisive point in his career, from his student days in Berlin, he took the path that would best allow him to pursue his dream. One can admire this commitment, yet feel it showed an almost inhuman disregard for more ordinary concerns. In the 1930s, he worked on rockets for the German army, seeing this as 'a stepping stone' into space. In 1942, after the initial flight tests of V-2 rockets, he almost forgot the war in his enthusiasm for the first excursion into space by a man-made object. He was reported as saying that the V-2 was 'not intended as a weapon of war',[9] and as a consequence, was briefly arrested by the Gestapo. Even as Germany faced final defeat, he was calculating that his chances of continuing with rocket research would be best if his team were captured by American forces rather than by the British or Russians, and managed to arrange this outcome. But when he got to the United States, he was disappointed that the Americans were interested only in rockets as weapons and found that he had to 'evangelize' for the idea of space exploration as a real possibility.

The technocratic master value

Wernher von Braun's vision of how man could venture into space was one about which many people could feel some excitement. The vision of the nuclear scientists was more esoteric but no less intense, and many of them too have participated in research on weapons as a 'stepping stone' towards the realization of technical ideals. Herbert York has described how he was 'strongly motivated and inspired . . . to participate in the hydrogen bomb programme' of the early 1950s, not least because of its 'scientific and technological challenge'. But in York's later, regretful opinion, the effect of the programme was that 'the last good opportunity to base American foreign policy on something better than weapons of mass destruction' was missed.[10]

Technical idealism also had a role in Edward Teller's opposition to the nuclear Test Ban Treaty of 1963. He was partly motivated by 'a passionate desire to explore to the end the thermonuclear technology that he had pioneered'.[11] To do this, experimental explosions would continue to be necessary. Others opposed the treaty because it would stop the development of a nuclear-powered space vehicle on which they were working. These were motives mainly of scientific curiosity and enthusiasm for technological virtuosity, and not especially warlike. But the singleness of mind that gives such goals higher priority than a nation's interests or the welfare of mankind can also seem alarming. One has the same feeling about Von Braun: what is one to make of a man who, while his country is still at war, is preparing to offer his services to one of its enemies?

Among those involved in the early phases of the nuclear arms race, the most outstanding exception to all this was Robert Oppenheimer. As enthralled by nuclear science as anybody, he was also deeply troubled about atomic weapons and sought to delay the hydrogen bomb programme while avenues for arms control were explored. Unlike many of the other technologists, his mind was not compartmentalized so that social conscience and technical creativity were kept apart. For the singleminded Teller, this ambiguity in Oppenheimer's attitude and the conflicting values that informed his actions 'appeared . . . confused and complicated. To this extent . . . I would like to see the vital interests of the country in hands which I understand better.'

With Teller and Von Braun we see another explanation of the technological imperative complementing those suggested in chapter 5: it is not just that they were men with enthusiasm for technological virtuosity. It is also that this became a master value to the point of obsession. We are all impressed by technological achievement at times and appreciate the aesthetic qualities and sense of mobility associated with some machines. Virtuosity values may thus be values we all share. What sets these men apart is rather the way they built virtuosity into an overall value system, using an ethical discipline whih preserved their central aims from any sort of compromise.

In previous chapters, I have mentioned fictional characters who illustrate particular values – Odysseus, Faust, Captain Ahab. What they had in common was that they were all on a quest or mission which can be seen as a singleminded pursuit of a narrowly defined goal. None of these can be represented as technologists, but the compulsions and disciplines of much technology-practice seem to reflect the same sense of mission; Von Braun's forty-year pursuit of his space-flight vision was itself outstandingly a quest. Von Braun – or a century earlier, Brunel –

might have made clear his undeviating purpose in Ahab's words: 'The path to my fixed purpose is laid with iron rails, whereon my soul is grooved to run . . . Naught's an obstacle, naught's an angle to the iron way.'[12]

In moderation, these attitudes may lead to a determination and decisiveness that we reluctantly admire. But they may also lead to obsession and irresponsibility, and in Ahab's case, to 'monomania' and near madness. In western society, economic growth is said to be a master value, and this too is something about which one has very mixed feelings. It has in many ways been a goal whose pursuit has brought benefit. But when it leads to a singleness of mind which is willing to 'cut down the last redwood, pollute the most beautiful beaches, invent machines to injure and destroy plant and human life', then one must agree that to have 'only one value is, in human terms, to be mad'.[13] It is not that any particular master value – growth or virtuosity – is wholly mistaken, but simply that by itself it is inadequate and incomplete. A multiplicity of values are a prerequisite for a balanced life.

Thus my arguments in favour of user/need values are not aimed at turning the service of basic human need into a master value and withdrawing moral sanction from high technology. That would merely replace the tough-minded pursuit of virtuosity with the equally unbalanced drives of do-gooders. What is more essential is tolerance of a wide range of values, and a determination to make creative use of the tensions between need-oriented, nature-conserving and virtuosity-related goals.

Such tolerance comes hard to many working technologists, not only because they do not want divergent sets of values distracting them from the job in hand, but also because they are heirs to a conventional wisdom which is designed to minimize ambiguity and the debate it can lead to. Thus the conventional wisdom implicitly encourages the idea of a master value such as economic growth; it encourages an unambiguous approach to problem-solving also, frequently favouring a technical fix approach because this may avoid the messy complications of a more human solution, and is often within the capability of a self-sufficient, specialist profession.

Within this conventional wisdom, beliefs about progress are also very clear-cut; it is regarded as unambiguously logical and linear, occupying a single dimension of forward advance. And it is anticipated that future needs will line up with the direction in which technological imperatives are leading. So when experts present forecasts that appear to be dishonestly biased, there is often no dishonesty at all – such projections are a straightforward interpretation of a particular view of progress and its imperatives. For those who are intolerant of ambiguity, there is little room for debate about the future: there is only one way forward and the expert knows best where to look for it.

Thus we see that all the varying aspects of the conventional wisdom described in previous chapters fit together. They form a complex which we can describe as a technocratic value system; they give rise to what is often called a 'technocratic' outlook that is singlemindedly insistent on an unambiguous view of progress, of problem-solving, and of values. The word 'technocratic' is appropriate because this is a world view which leaves very little room for democracy in decisions affecting technology. Any idea about choice of technique (or altered priorities, or public participation in decision-making) introduces a note of uncertainty which is fundamentally unacceptable to those who take this view. To them, there cannot be any rational alternative technologies because there is only one logical path forward. To them, critics of technology are always opponents, never reformers. Yet engineers and other experts need to be continually challenged by reforming critics as a reminder that the virtuosity values which tend to capture their enthusiasms may be in conflict with those of society.

In medicine, for example, the technical interest of highly specialized treatments or operations diverts doctors from more essential but more basic work. One critic argues that, to keep some sort of balance, we must limit the tendency for medicine to become an 'ever more complex technology . . . We must keep it and its advocates, doctors and commercial entrepreneurs, under control.'[14] Similar comments about nuclear arms have already been quoted: Zuckerman has called for 'a control of research and development' of a kind, 'which has not existed hitherto'.[15]

Totalitarian institutions

In some branches of technology, the tendency for experts to pursue goals of their own that diverge from the wider aims of society reflects the incompatibility between virtuosity values and other goals – between technology as an end in itself, justified in 'cultural terms', and technology 'as a means to other ends'.[16] The conventional wisdom is that technology chiefly serves economic purposes. Galbraith stresses that technological virtuosity is only a subsidiary goal of industry. To ensure its survival and expansion, every industrial concern must first achieve economic success. More generally, technologists are portrayed as 'servants of power'.[17]

But very large sectors of high technology in America and Europe have escaped the economic constraints normal in private industry, and are to be found in government-supported or subsidized defence, nuclear energy and aerospace industries. In these circumstances, if technologists are servants of power, the situation is nonetheless quite different from industry. By clothing goals related to technological virtuosity in the language of military necessity or political prestige, and by pointing to spin-offs for the economy, it is easier than in industry to influence decision-making. But the history of the arms race and nuclear energy, and the comments of some politicians on the handling of information by scientists and civil servants,[18] suggests that behind the economic and military arguments that serve to disguise their virtuosity-oriented drives, these people sometimes use their specialized knowledge in ways that make them hijackers of power, not its servants. Even in private industry, where this is less likely to occur, the development of some products owes much to the hunches and singleminded backing of an individual staff member, who works for favourable decisions at every stage in its development. Such individuals, referred to as product champions, were identified in one study for some 40 per cent of all innovations examined.[19]

Von Braun and the early nuclear weapons scientists were product champions on a grand scale. But their significance lies also in the new institutions for the management of technology that grew up around the projects they led – institutions whose mission-oriented structures reflected the personal questing sense of these men. The chief examples were, of course, the German centre for military rocket development, opened at Peenemünde in 1936, and the American atomic weapons programme located at Los Alamos. Their descendents in the modern world include NASA, numerous weapons laboratories, and the Atomic Energy Commissions of nations as diverse as the United States and India, France and Argentina.

We saw in chapter 2 how the first industrial revolution originated with an organizational innovation – the factory as an institution for controlling a workforce. The new wave of industrialization which originated just before and during the Second World War also depended on organizational innovation, affecting particularly the way research and development are done. There was a rapid development of existing industrial laboratories and experimental stations as well as the mission-oriented nuclear and aerospace projects.

In these institutions, scientists and engineers had a new prominence, and the question again arises as to whether they were still servants of power. Several interpretations are possible, but many people have noted that the administration of some of the new institutions has become so intertwined with departments of government and the civil service that technical experts have, at the very least, become identified with decision-making power.

However, to understand the role of the technical experts, a distinction between two sorts of power may be helpful. The politician's business is power in society. In itself, this is probably of little interest to most technologists. What they want is not a generalized power over people, but power over specific projects, and power to exclude people from interfering with them. In one psychological test, when aspiring scientists were asked to sketch a street scene, they tended to omit people, preferring lunar landscapes.[20] Similarly, an ideal factory would be an automated one that employed no workers. In other fields, too, the world of the technical idea is often a self-contained one, involving neither lay participation nor co-operation with other experts. Indeed, departmental, specialized interests sometimes seem so strong that experts are prepared to overlook risks to world peace in this interest – or, like the German rocket experts in 1945, to work for any country which would support their projects. It is when their idealized worlds are threatened that technologists are tempted into the manipulation of knowledge and through that, into hijacking power.

Of course, there are many situations where 'people problems' and the user sphere must inevitably intrude upon idealized technical thinking. Then experts may be tempted to believe that technical rationality can still be achieved through use of a systems approach, or by planning on a sufficiently comprehensive scale. During the 1930s and 1940s, scientific socialists and humanists talked enthusiastically about large-scale planning. In one of the most revealing of their comments, C. H. Waddington cited the German autobahns and the Tennessee Valley Authority (TVA) as good examples of how rational planning could be conducted. These examples, he thought, illustrated a trend towards totalitarian organization, and he argued that this was an inevitable and desirable part of technical development.[21]

Waddington published these remarks in 1941, in the middle of a war against fascism. Thus he could not avoid noting that totalitarian systems were getting a bad name. But the objectionable features he freely admitted in Nazi and even Soviet regimes did not seem inevitable. What we needed to do, he argued, was to work out how 'to combine totalitarianism with freedom of thought'. Several other authors during the 1940s commented on the same trend, J.D. Bernal favourably, and George Orwell with vehement criticism. These writings are of significance not only because of the frankness with which they discuss totalitarianism, but also because this was a formative period for the new technological institutions, and pressures of war exacerbated the totalitarian tendency.

Although the origins of these organizations are linked with scientific discovery, they also represent a merging of science and technology and changes in the accepted standards of professional behaviour among scientists and engineers. Teamwork was essential, and so was secrecy. Significantly, however, the habit of secrecy persisted in peacetime, and in non-military programmes. In no country which now has a nuclear programme was the decision to embark on it taken openly and with democratic, parliamentary approval. That was understandable in war. But in the United States, the Atomic Energy Commission (AEC), proceeded throughout its early years with a cloak of secrecy surrounding even civil energy projects. One of its officers, Herbert Marks, warned that if this continued, the atomic energy programme would lose touch with the American social ethos, so that 'when the forces of criticism finally begin to operate with their customary vigour, they will produce drastic upheavals'.[22]

One function of secrecy has been to reinforce linear, mission-oriented thinking by ensuring that ideas, innovations and doubts can only be expressed through the institution's own bureaucratic channels, and not in the press, Congress or Parliament. This protects the central goals of the institution from abiguity or uncertainty by making sure that criticisms or divergent, perhaps irrelevant, inventions are compartmentalized by bureaucratic procedure. The same procedures also ensure that no individual carries unique responsibility, thus encouraging people to feel that it is not incumbent on them to raise questions. All this, of course, goes wrong when doubts or counterproposals are raised at the very top of these organizations – when an Oppenheimer begins to entertain ambiguity about weapons which he simultaneously finds technically sweet and morally repugnant.

One result of this tendency is that errors, once made, are reinforced as often as they are questioned; conversely, technical innovation may be suppressed. The totalitarian bureaucracies of British technology have functioned particularly badly in these respects. In the nuclear power industry, and in decisions about the Concorde airliner, procedures were apparently designed to avoid the consideration of too many points of view; secrecy was enforced to an extent which made it difficult to learn from past mistakes. In addition, David Henderson has noted a peculiar British taste for decorum and administrative tidiness which seeks to avoid duplication – often, just at the point where a duplicated assessment or evaluation could provide an essential cross-check. In British aviation and nuclear programmes, the remarkable result has been that expert advice is obtained only from 'interested parties to a decision . . . decorum precludes any serious attempt to make use of alternative sources of advice'. To counter this trend, Henderson argues for new and independent institutions that would evaluate public projects from non-government points of view.[23]

Institutionalized ambiguity

All the foregoing applies only to one sector of technology-practice. There are many small firms and even academic laboratories which are in no way bureaucratic, and where an open-ended approach to innovation may be found. There are many individual engineers whose outlook is more flexible than those I have described, and there are concerned scientists swimming against the tide. But the compatibility between the singleminded individual with his master value and the bureaucracy with its focal task seems both striking and significant. It poses a question about whether these similarities arise because individuals internalize the values of the institutions within which they live and work, or whether, perhaps, they help to shape institutions in accordance with their own goals.

Sociologists tend to depict the values of the individual as developing to fit him (or her) to the community in which he has to live, and they talk about the way in which values are then used to legitimize institutions. Marxists tend to say that values stem from social and economic conditions, and that the key to change is thus reform in socioeconomic structures.[24]

By contrast, it is possible to see values as fundamental to the individual – as the personal criteria we apply to the world we look out on. Some psychologists and others quote evidence to show that the individual's value system is partly the outcome of his temperament. The kinds of institution he seeks to work for are then those into which his personality traits fit in a congenial way.[25] This gives scope to the view that institutions develop at least partly under the influence of individuals' values and actions.

The emphasis of much that is written about technology is on institutions rather than individuals. That is often valuable, but it is only half the picture. My concern is with the other half, and my approach here is deliberately non-sociological and non-Marxist, not for the sake of disagreeing with these types of analysis, but in order to take some account of very basic personal values that are rarely considered, and to think, very simply, about the ethical disciplines that are entailed in resolving value-conflicts.

So far we have examined mainly the tough, singleminded approach which subordinates everything to a master value. However, there is also the quite different habit of thought described by words such as dialectic or reversal. Thus Thomas Jefferson is said to have derived his vision from conflicting values – pastoral on the one hand, and intellectual and technical on the other – and to have let both inform his actions. Significantly, then, this shaper of democratic institutions, unlike the shapers of totalitarian programmes mentioned earlier, did not have a master value or quest with a fixed goal. Instead, his goals were progressively redefined in the light of events, and as values interacted.[26] This dialectical style of thinking, with its reversals of viewpoint and redefinitions, is precisely the opposite of the singleminded approach, allowing options to open and directions to change instead of seeing progress only in linear terms.

It is apparent then, that both in the thinking of individuals and on broader policy levels, the tough, singleminded approach is basically inflexible. The institutions of free speech, congresses and councils, by contrast, are designed for the very purpose of allowing a dialectical process to take place within society, not only so that people's rights can be safeguarded, but so that continued adjustment of goals is possible.

Although the institutions of free speech encourage a great variety of values to coexist, they depend very much on a common view about how value-conflicts should be dealt with, and in this respect, they depend on a very definite value system. We may describe it, indeed, as a 'democratic' value system, in contrast to the technocratic one mentioned earlier (page 127). The implications of a democratic approach in this context are a stress on diversity, flexibility and participation. The latter does not just mean formal public participation in decision-making (which will be discussed in chapter 9); it also refers to a style of innovative activity in technology whereby new insights arise from the interaction of different interests and ideas (discussed in chapter 8).

Diversity and flexibility may be interpreted in terms of encouraging small firms rather than very large ones. Diversity may also be thought of as favoured by community enterprises, and by regional or municipal forms of public ownership rather than by a centralizing form of nationalization. But equally, flexibility may mean that a nation walks on two legs, with a few large-scale enterprises operating alongside many smaller ones. There should be a corresponding diversity in manufacturing techniques, energy supplies and agriculture. With regard to all these things, the approach to avoid is the one that looks for a single, standardized right answer. Whether standard solutions of this sort are conceived in terms of an all-electric economy, or a narrowly technical green revolution throughout the Third World, they invariably lead to gross distortions.

With a more diverse and flexible approach in technology, a more responsive attitude to public participation and democracy in decision-making ought to be possible. But for decisions to be intelligent as well as democratic, the idea of diversity has to be applied to research, and also to sources of information and advice. The tendency to think that there is always one best answer to any technical problem has led to a strongly entrenched assumption that only one kind of research is possible. Yet it will be argued in chapter 9 that there is a need for much more in the way of public-interest research. This should question – but not displace – the orthodox research carried out in official research laboratories and by industry.

In thinking about these issues, we may well conclude that the problem with control over technology-practice in western society is that no nation is wholly democratic and free; everywhere there are totalitarian institutions which have gained control of large sectors of technological endeavour, and which limit diversity and participation unnecessarily. If the 1940s and the extremities of war provided the circumstances to allow many of these totalitarian technological institutions to take off, the 1950s, and particularly the later years of the Eisenhower administration (1953–61) saw the first recognition at a high political level of the totalitarian threat of the political process.

Eisenhower's final address to the nation as president, given on television in January 1961, is famous for its warning against the military-industrial complex. More specifically, he also warned of the danger 'that public policy could itself become the captive of a scientific-technological elite'. It was with regard to arms control that Eisenhower had experienced the problem most keenly: 'I lay down my official responsibilities in this field with a definite sense of disappointment,' he said.

The day after his broadcast, people were asking whether Eisenhower had turned against science. He emphasized – as he had already done on television – that he was in favour of scientific research, 'and feared only the rising power of military science'.[27] In 1958, after America's first satellite had been put into orbit by a military rocket development under Von Braun, Eisenhower had insisted that NASA be set up as a civilian space agency. It should be entirely open in its work, so as 'to have the fullest cooperation of the scientific community at home and abroad', and to ensure 'that outer space be devoted to peaceful and scientific purposes'. But that is another ideal frustrated: of twelve satellites placed in orbit by NASA in 1980, ten were for the Defense Department.

One way of expressing the issues raised by the technology-based bureaucracies, and by the big multinational companies, is to say that nations which are nominally democratic are finding that large sectors of decision-making have been taken over by totalitarian institutions. Looking at the economic role of these institutions, Ralf Dahrendorf has argued that as economic growth no longer makes sense as a master value, we need to think of an 'improving society' rather than an expanding one, and an 'economy of good husbandry'. As he sees it, the institutions of an improving society have to be 'public, general, and open'. But he is not just arguing 'for the simple reconstruction of representative government as we have known it in the past'. In confrontations with large organizations, we are always likely 'to find elected assemblies on the shorter arm of the lever'. Thus, to balance things up, we need informed and organized publics.[28]

It is striking that such a commentator at least recognizes the problem, but something still needs to be done about it. In Europe, an important lead is being given by the political ecology movement of France and Germany. There is a tendency among its supporters to identify the growing totalitarian sector in western society not just with large corporations or with the military-industrial complex, but more generally with the knowledge-based power of the technocracy.

The institutions responsible for energy supply – especially nuclear energy – are regarded as being some of the strongest technocratic organizations. So within a comprehensive view of knowledge-based power in technology, the political ecologists have found the chief focus for their action in campaigns against nuclear energy. They 'reject the model of society which is implicit in the way nuclear power stations are run and the way they affect the wider society'. By this they mean the totalitarian structure of the nuclear industry, its secrecy, the extreme security arrangements that necessarily surround it, but above all, 'the technocratic power which is imposing an all-nuclear policy [in France] with a minimum of public debate'.[29]

Many people who have opposed nuclear energy are 'defensive protestors', who react to nuclear installations as objects which pose particular threats to health, and specific problems about waste. These are real problems, but are not necessarily worse than health and waste hazards in chemical industries. Thus after the power plant accident at Harrisburg (Pennsylvania), which galvanized defensive protestors everywhere into new emphasis on the dangers of nuclear energy, little was done by the political ecologists to capitalize on the event. Fear alone, they felt, could not usefully add to understanding of the central issue, technocratic power, and the use of risk as a proxy issue might divert attention from it.

In tackling the underlying institutional problems of technology, political ecology is clearly a radical movement, but it rejects the traditional radicalism of the Left, and is out of sympathy with the tough-minded forms of Marxism. On a practical level, there has also been difficulty over tactics: the violence used by some Left groups at anti-nuclear demonstrations in France and Germany has appalled the nonviolent ecologists, who have found it easier to work with feminist groups and one of the French trade unions. They have also worked with groups interested in self-management in industry, and in Brittany they helped with a local plan for energy and technology – *Projet Alter-Breton*.

On a theoretical level, too, there is difficulty in co-operating with the traditional Left so long as this maintains its 'devout faith' in central planning, large-scale organization and 'the scientific and technological revolution' which was supposed 'to bring social progress'.[30] This latter kind of socialism sees its problems in terms of economic institutions and the need to change relations of production, but in carrying out its programmes, it tends actually to reinforce the totalitarian use of knowledge. Some Marxists are beginning to recognize this and argue that more emphasis must now be given to the role of knowledge, and hence to 'cultural revolution . . . directed to the appropriation of . . . the intellectual forces of knowledge and conscious decision'.[31]

Penetrating Marxist jargon is always difficult, but if 'cultural revolution' means challenging the conventional wisdom of the experts, then there may be common ground here not only with political ecology, but with the arguments of this book. If cultural revolution involves fostering dialectic and reversal to bring need or user values into balance with the values of high technology, that again will give us common ground. If it means challenging the organizations that depend on an ideology of linear progress and the technical fix, then that common ground may be extended. I leave these questions open, and go on in the next chapter to explore dialectic and dialogue in the practice of technology.

8
Innovative Dialogue

Two kinds of innovation

Sometimes one hears over-simple distinctions made between high technology and supposedly more appropriate forms. The point usually is that appropriate technology is employed to serve human needs directly, whilst high technology is concerned with high performance and complexity for its own sake; it is motivated by prestige and virtuosity, and seems sometimes only to produce 'toys' for scientists or politicians (p. 113).

Something of this view has been implied by previous pages, but as a warning against taking such distinctions too far, this chapter classifies technology in a different way. It links together real toys produced at the level of appropriate technology (figure 9) and techniques which are certainly concerned with basic needs, but which have all the complexity and sophistication of high technology (figure 8). The diagrams themselves are symbolic.

My concern in coupling together these sharply different examples of innovation – toy automobiles and a futuristic power plant – is to pursue a paradox left unresolved by the previous chapter. Modern technology is nothing if not innovative, yet bureaucracy – especially if it is any sense 'totalitarian' – would hardly seem to provide the right atmosphere for original, inventive thinking. Given the growth of bureaucracy in the modern world, how is it that innovation continues to flourish?

One answer is that a wide range of innovations arise outside bureaucratic institutions – which is partly where figures 8 and 9 come in. Another answer, though, is that some forms of innovative development do prosper within a bureaucratic context. Where institutions