Science, Technology and Society—An Introduction

There can be no doubt that we are rapidly moving towards a global society, spanning the whole earth. Yet this global society derives its unity not from philosophy or religion, but rather from something much more profane—namely from technology. It is technology that is leading to the homogenisation of all forms of social interaction and communication, irrespective of their historical and cultural provenance. It is technology that is creating a shared horizon for economic productivity, just as it is technology that permits the limitless accumulation of public wealth. Technology is *the* salient social activity of human beings as a species and, as an activity, is both cumulative and linear, irrespective of its consequences for human happiness. Only technology can provide a global, postmodernist entity, with the unifying power needed to transcend the chaos and heterogeneity characteristic of our age.

Bourgeois society combines *technology*, as the medium by which we interact and engage (through work) with nature, with the *social form* in which this is done—meaning the capitalist *economy*. Viewed in this way, 'technology' is in the first place a 'natural' analytical category, for not only does it point to the self-referentiality of nature, but it is also concerned with humans as a species and hence as part of the natural world. It is an allusion to the physical act of reproduction *in* nature and to what could be described as the 'substantial', as opposed to the 'social', aspects of human labour. While the *social aspects* of man's reproductive activity in bourgeois society can be traced back to the profit motive, in other words to quantifiable economic factors, the *substance* of human labour has to do with qualitative factors, as communicated through technology. These days, more than ever before, the form and substance or social and natural aspects of human labour can be distinguished only at the analytical, conceptual level. In reality, they have long since become enmeshed.

Formal rationalisation and *communicative behaviour* are bourgeois society's most important coordinative mechanisms after the *market*. Communi-

cation and formal rationalisation have a constructive function. Unlike communication, however, formal rationalisation takes human behaviour, rather than orientation, as its starting point. Both reduce insecurity and complexity. Whereas in the early phase of bourgeois society, security was obtained by rigorously constricting the scope for action, in the late phase, the same end was achieved by consensus-building instead. Communication now creates and reproduces the consensus that was once the norm. This transformation of the coordinative mechanisms is reflected in the sociological canon too. While originally, in the works of Max Weber, for example, the talk was primarily of formal rationalisation rather than communication, this began to change as the 20th century progressed. The shift away from a science of action and towards a science of communication, as represented—at least in the German-speaking world—by Niklas Luhmann and Jürgen Habermas, was a sociological response to the transformation of society's coordinative mechanisms and as such analogous to the early 20th century, when classical sociology began to concern itself with the ever increasing rationalisation of social relations.

If, for example, we wanted to explain when, why and how which technologies prevail, then our analysis would have to take account of the regulatory impact of not just economic and political factors, but also that of social experience and the cultural orientation of those individuals who are involved in the development and dissemination of technical innovations. The sociologist, Bettina Heintz, has conducted just such an analysis, taking computer development as an example.

Technological innovations not only have a transformational impact on society, but are also caused and even necessitated by that same society. Just as socio-historical organisational principles and forms of communication leave their stamp on technical artefacts, so the same can be said of computer development. The late 1970s saw the emergence of computer architectures that marked a qualitative departure from the sequential von Neumann architecture, with its hierarchical control structure. Alan Turing derived his machine concept from an analysis of human cognition, using as a model the partially mechanised human, as had been generated by the process of formal rationalisation. If, in the 1930s, the experience associated with the process of formal rationalisation did indeed have an

influence on the manner in which Turing designed his machine and John von Neumann put it into practice in his computer architecture, then today's computer architectures, which rest on design principles of a very different quality (parallelism, decentralisation, coordination by 'communication'), can be interpreted as indicative of a transformation of the social modernisation process. If nothing else, it is at least clear that technical factors alone cannot be held responsible for this. What is decisive, or so Bettina Heintz believes, is that the change now taking place in the social modernisation process is causing more importance to be attached to those forms of communication that serve as a vehicle of understanding. These are opening up a new sphere of experience, as is evident from the manner in which today's computer designers create their machines.

Because 'technology' represents a social relationship, it contains the same power imperatives as the society out of which it evolves. It is not the use of technology, but rather the technology itself, the mechanical system as the manifestation of an idea, that exercises power—methodically, scientifically and in a premeditated and manipulative manner. As such, it can never be neutral. Far from being imposed on it as an afterthought from without, the power imperatives it epitomises are rather a constituent part of its construction. Technology's social impact, such as unemployment and health hazards, are less a result of the technology itself than of the social decisions that find expression in this technology. In other words, the technology that helps shape and influence social relations is actually informed by social decisions. Once established, once the genie is out of the bottle, however, technology develops a kind of counter-dynamism of its own and it is then that it has a reforming influence on the very society in which it has its origins.

Technology is a socio-historical project, a historical blueprint of future realities, a historically specific form of organising social behaviour. Technology is a projection of what society and the interests dominating it intend to do with both people and things. The issue is nothing greater, nor indeed anything less, than the shaping of society's future. The way in which a given society organises its members' lives is bound to include a basic choice between two historical alternatives, both of which are determined by that society's material and intellectual heritage. The choice it-

self anticipates particular ways of transforming both man and nature and opts for one at the expense of the other. Once this choice has taken hold of the underlying institutions, it has a tendency to become exclusive and to dictate the development of society as a whole. To the extent that the blueprint evolves, however, it will shape the entire universe of language and behaviour, of society's intellectual and material culture. Nor is that all: to the extent that man develops technology as a reflection of himself, so, it could be said, man actually creates himself.

Man's technological autocreation of himself and his world, however, should not be construed to mean that it follows some predefined plan. Because what we are talking about here is the reconstruction of man himself, with all his imponderables, his autocreation cannot possibly be preceded by such human cognition as might constitute a plan or even prior knowledge. The age of the great novels, of the great historical movements and social utopias is over—or so we are frequently told. As profane as it may sound, man's future depends on nothing less than his own production and reproduction. It is the totality of scientific and technical possibilities that we ourselves are continuously creating, transforming and changing that will determine how our increasingly technological civilisation proceeds. Our knowledge of the future, to the extent that it can be relied upon at all, rests largely on the seemingly material legitimacy of things. It is of course possible to draw up plans and objectives for some of the *isolated* processes that make up our technologically driven reconstruction of the world, just as it is possible to deploy technology as a means to an end. This is what led to Gehlen's thesis, that it is the means that determine the end of this process. The logical conclusion to be drawn from this, however, namely that technology is bound to have a controlling influence over humans, does not bear closer scrutiny—at least not when formulated in such generalised terms. As Schelsky—for once in agreement with Herbert Marcuse—explicitly pointed out, technology is not an entity in its own right with an existence independent of man, but rather is man himself, manifested as science and labour. To describe technology *as a whole*, therefore, as a means to an end, would mean ignoring the fact that technology, by its very nature, is a manifestation of man himself.

Technology is not an autonomous power. It is the product of a social process—a process driven by interests and objectives. Technology is not predetermined by unilateral development perspectives, but rather exists as a much wider range of possibilities and alternatives, some of which are eventually ruled out, jettisoned or disregarded. Others are selected and given priority as a result of social decisions made by those with the power to make a choice. That technology that ultimately prevails is bound to bear the stamp of those who made it.

Received wisdom has it that technological development is driven by economics. Motivated by greed and guided by reason, (bourgeois) man is constantly expanding the scope of his intervention (initially with the aid of tools) in nature. The depth and breadth of this technological intervention—no matter whether measured in spatial or temporal terms—, however, and its consequences, have increasingly given rise to doubts concerning the environmental and social controllability of economic mechanisms. To the extent that certain technologies have already overstepped the risk dimensions built into the profit calculations of private enterprise, socially motivated investment decisions have had to be made increasingly on the basis of political rather than market factors. That such decisions were politically motivated does not necessarily mean that they were democratic or even wise, but only that economics, even if it has not quite lost its primacy, has nevertheless lost much of its relevance for the investment decisions of the future. In such a historical situation, however, communication as a vehicle of understanding acquires an importance that it is unlikely to relinquish for many years to come.

The importance of communicative behaviour as a coordinative mechanism in late bourgeois society is increasing at the expense of the traditional principles of formal rationalisation and the market. This process is apparent in the way in which the role traditionally played by science is changing radically. Not only is science being instrumentalised for external objectives, but it is now also intervening directly. In other words, we are no longer talking about the mere 'application' of the latest theoretical findings in certain problematic areas of society, i. e. of the putting into practice of a general theory *after* it has been formulated. What we are witnessing now is the scientisation of certain aspects of society *sui generis*.

This in turn is causing the theories developed for *specific* areas to be expressed in increasingly *generalised* terms and in science, with a view to their relevance to external objectives.

The emergence of the so-called secondary sciences such as environmental research, cancer research, noise research, fusion-oriented plasma physics, is gathering momentum at an astonishing rate. One could even paraphrase Marx's eleventh Feuerbach thesis and say that until now, scientists have merely interpreted reality and have tried, by a process of abstract distillation, to formulate the laws governing it. Now, however, they are at last beginning to transform that reality directly. Instead of discovering truths, they are making them—by producing that which is to be discovered. The distinction to be made between 'science' as a social subsystem and society as a whole is becoming increasingly blurred. And just as science is an integral part of certain areas of social activity and can be harnessed for external objectives too, so society is orienting its everyday activities increasingly towards those knowledge-yielding and problem-solving strategies which, strictly speaking, belong to the functional sphere of all rational, scientific endeavour. There is virtually no aspect of our lives that has not become an object of reflection, of the communication of systematic knowledge and formalised learning processes, that has not, at the very least, become an object of some form of 'consultancy'. 'Research' is no longer a truth-bound pursuit, tied exclusively to a specific institution. These days it is above all pragmatic and hence a 'business' like any other. As those affected by collective 'experiments', ordinary people are becoming fellow researchers. Science and research policy, until now a highly specialised and bureaucratically administered field, has become an object of public interest, which is why these days, every socially relevant group, whether a trade union, professional association, grassroots initiative or political authority, has long since had recourse to its own 'house scientist', whose job it is to take appropriate action as required by the occasion or the task in hand. The scientific expert is no longer an unassailable authority who provides truths and makes objective judgements. These days, he has to forfeit all the more of his authority, the further systematic doubt exceeds the boundaries of traditional science. Once every expert opinion can be matched by a counter-opinion, it becomes

clear that expert opinions, like all other opinions, are determined by value systems. That scientific opinions are no longer sacrosanct, but are instead a product of the here and now means that systematic doubt, as a structure-bearing principle, is no longer a prerogative of scientific discourse. In almost all social subsystems, the internalisation of norms and values is being displaced by reflection in the light of competing elements of systematic knowledge. This in turn is resulting in the transformation of both the form and content of *political* criticism. In view of the compulsion to provide a rational line of argument, this can also be said to be subject to scientisation. While traditional forms of protest still exist, these days they carry far less weight than so-called alternative expert opinions. It would appear that in a functionally differentiated society, criticism can exist and be effective in several places at once only when it is notoriously dialectical—a method which, though scientifically founded, is nevertheless devoid of any guarantee.

It is not just the traditional mechanisms and standards of reflection and criticism that are losing their validity, but also our conventional apprehension of who in society is responsible for the same, i. e. of who should be the engine of social progress and theoretical rumination on social progress. The proletariat as a guarantor of unity is now defunct, or so it would appear. New points of reference must be found for the bearers, standards and unity of criticism—to the extent that unity is possible at all. To be an engineer in such a situation, it is no longer enough to be *only* an engineer. This insight on the part of the Spanish philosopher, Ortega y Gasset, could be reinforced by Günther Anders' paraphrasing of Marx's Feuerbach thesis: It is not enough to transform the world. We do that anyway. We have to interpret this transformation as well—in order to transform it. In other words, an engineer today has to be a philosopher too, at least up to a point. For the postmodernist technologies have reopened that old philosophical question about the identity of man and what man really is. Except that they are asking it on a historically higher level of discourse between man and nature. The question is no longer asked in the abstract or on a purely theoretical level, but rather is worded in practical terms. To 'philosophise' as an engineer 'in the field', as it were, would then mean participating both actively and cogitatively in social decision-

making processes, would mean helping to shape the future of society by using one's professional expertise to initiate, support and follow the necessary discourse and reflection.

The Inter-University Research Centre for Technology, Work and Culture (IFZ) views itself and acts in line with this point of view. It seeks to influence the conditions under which technologies are developed and applied in the most diverse problem areas of society. It smoothes the way for some technologies and tries to slow down the diffusion of others. At the forefront of its work is not so much the constructive aspect of the individual technologies, but rather the way in which, and conditions under which, they are being disseminated and selectively adapted by those who use them. Exploiting technology's creative potential therefore means above all intervening in the networks of the actors involved in an effort to create the organisational conditions required to make use of certain technical innovations, to establish links between the organisations and people involved in the development and use of the said innovations and to organise joint learning processes. These demands are met by the countless projects currently under way as part of the various IFZ programs, as well as by the Institute for Advanced Studies on Science, Technology and Society (IAS-STS) and, thirdly, by the International Summer Academy on Technology Studies. To be able to meet these requirements, most employees of the IFZ have a dual function. Not only do they have a background in the social sciences and/or the humanities, but *they have also* trained in a scientific or technical field and can therefore be said to be living proof of Ortega y Gasset's thesis that to be an engineer these days, it is not enough to be *only* an engineer.

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