WHY TECHNOLOGY LENDS ITSELF TO CRITICISM

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This first contribution does not yet present a critique of technology; I want only to demonstrate that technology is by its nature amenable to criticism and differs therefore in this respect from, say, the weather or gravitation.

First I will provide precise definitions of the concepts "technics" and "technology", hoping that other participants in the debate can get along with them; next I will discuss five views which in respective order allow more and more room for social influences on technological development and thus for criticism. Finally, I will link up social criticism and the criticism of technology by presenting the thesis that the technologist is an agent of social change in spite of himself.

I. "Technics" and "technology"

I.1. *Terminology*

What should we understand by "technics" and "technology" [1]? This is my proposal: "technics" is the generic, a-historical category, which is therefore not amenable to criticism, and "technology" is the specific form technical activity has assumed in modern societies and which can therefore be criticized.

"Technics" is something universal, something which to all people, all societies and all cultures has always been available and will (necessarily) be so in the future, namely: "procedures - with or without the use of instruments - for transforming external nature to satisfy human needs". I will briefly discuss the elements of this definition.

I.1.1. *External nature*

Technics is involved in the metabolism of humans or societies with the (an)organic nature that surrounds them, which is called "external nature" to distinguish it from the "internal nature" of the human bodies. Because these bodies must be fed, protected, born and nurtured, man must, just like other biological species, enter into a metabolic relationship with the natural environment. Humans intervene in their environment by picking fruits, catching fish, building houses, tilling the soil, cultivating and breeding

plants and animals etc. The complexity of this intervention may vary: hunters and gatherers consume without qualms what nature offers them, agriculture requires a more complex series of actions and stereo-towers are highly complex combinations of a variety of carefully processed materials.
(By restricting myself to "external nature" and "metabolic processes" I do not want to imply that it would not be meaningful to speak of "social techniques" - i.e. action precepts aimed at influencing behaviour -, but only that it appears sensible to me to exclude these from the present discussion. We will see that metabolic techniques possess already many social elements!)

I.1.2. *Procedures*

First and foremost in my definition figure "*procedures*" - standardized patterns of human actions. Thus I do not draw primary attention to machines and apparatus - which usually come to mind directly - but to the routinized human actions in handling them. First of all this has an historical reason. The techniques used by primitive people to catch animals and fish did not involve the use of instruments *at all*. From a historical point of view human skill and social organization precede the use of tools. This argument also has systematic relevance: action routines without tools are thinkable, but not the reverse. Technics is therefore, first of all, "what you have to do in order to ...", sow, clean your teeth, or play the piano; it involves individual and/or collective skills. We always find those standardized human actions in "labour", that which people untertake, individually or (mostly) collectively, by means of division of labour, to satisfy their needs. Labour always involves technics, in the sense of "transforming external nature for the sake of need satisfaction", but of course that does not exclude that this social activity "labour" can also assume the form of religious rituals, power relationships, repression or aesthetic enjoyment. In the notion of "technics" we limit ourselves to one aspect only, i.e. the instrumental ("zweckrationelle") aspect, of those conceivably much more rich and meaningful human activities; it is not meant thereby that labour is *nothing but* a skillful handling of tools and procedures.

I.1.3. *Instruments*

The definition refers to *instruments*, but considers them secondary and optional. Instruments are man-made, material objects for the purpose of lightening labour operations. We may think of tools (hoe, hammer, typewriter)

that strengthen bodily functions, machines that substitute for human energy and only require overseeing, and finally automatons that independently execute complex operations.
Our definition therefore conceives all technics as socio-technics, which is unthinkable without being embedded in human action. Instruments are objects with directions for use which discipline human action. A coherent set of instruments and actions is called a *socio-technical system.*

A system may be a directly visible part of society (a factory, a railway-network), but that is not necessary. Also in premodern societies, in which all action had a sacral or ritual character, the system *aspect* can be distinguished analytically. Whatever the pattern of culture, people are bound to exhibit a certain systematic behaviour in handling their cattle, water and crops, or else will simply die.

I.1.4. *Need satisfaction*

The transformation of external nature (matter, energy) by means of instruments and labour operations is not a purpose in itself, but functions in the service of human *need satisfaction.* It is oriented to results: products, services, facilities. Human bodies (internal nature) require for their maintenance nutrition, protection, nurturance, health, safety, transport and possibly higher, so-called cultural needs. But, of course, *all* needs are need interpretations fixed in cultural patterns, and are at the most based on a certain biological substrate.

I.1.5. *Knowledge*

Finally: all technics presupposes *knowledge* of a certain type, instrumental knowledge. That is knowledge of cause-effect relations involved in dealing with material objects, or let us say: in dealing with nature. One uses insights which predict that one particular phenomenon follows another more or less regularly.
Of course I do not mean that in primitive cultures too such knowledge had a scientific or explicit character; it does not need to be theoretical or rational knowledge, but may be derived from cumulative experience; it may change as a consequence of accidental occurrences. Knowledge about which plants are poisonous and which are edible, how to catch certain animals; how to construct a 64 megabyte memory; this is all knowledge of the same,

instrumental type.
It may be stored in handbooks, but also in ritual practices or in a sacral contemplation of nature: insight into the regularities of the interaction between man and nature is a component of *all* cultures which is indispensable for the survival of the human species.

Technics has thus been defined as a universal category, inextricably linked with the human condition. Technics is necessary - because although the sun rises automatically, humans can maintain themselves only through coordinated efforts.
A consequence of this abstract definition is that we meet in reality a whole array of different technics provided with all kinds of epithets. One may speak of technics on various levels: the technics of the sower, of arable farming, of agriculture as a whole or even the technics of a given culture. Technics is also differentiated according to production sectors; the technics of arable farming, animal husbandry, the building trade, manufacturing industry etc. It is even differentiated according to entire cultural periods: paleo-technics, the technics of Antiquity, artisanal technics and modern technics.
For technics in the latter sense we will use today the term "*technology*"; as a particular, concrete historical form which technics has assumed in modern societies. We do not therefore consider technology as the very form of technics, or as the highest form, but only as provisionally the latest form of technics in *our* society, while realizing that, partly through our own agency, a new form of technics may eventually arrive in history. At issue in the debate is therefore how our technology can be distinguished in a meaningful way from the technics of other societies and what the characteristics should be of the technics of a future just and free society, anticipated by philosophy and critical theory. Should our technology be characterized as capitalistic, centralistic, large-scale, science-based, alienating? Is a liberating, appropriate, humane and environmentally friendly technics thinkable? I won't start the debate, that is the task of technology criticism proper.

First I want to show briefly how fruitful (and non-arbitrary) the conceptual definitions that I introduced may be. For definitions cannot be said to be true or not true, but only useful or not useful for certain debates.

I.2. Historical controversy

With the definition given above it turns out that we can largely resolve the historical controversy between the critical theorists Habermas and Marcuse on technics and the criticism of technology. In his *One-dimensional Man* (1964), the book that was such a great stimulus to the student movement, Marcuse stipulated that the traditional conception of the neutrality of technology could no longer be maintained. Technology cannot be considered apart from its use.

> "Technology in itself, not just in its use, is control (of nature and of man)" [2].

The instruments for controlling nature are, according to Marcuse, simultaneously means for exercising power over people.

> "Today, domination perpetuates and extends itself not only through technology but *as* technology ..." [3].

Underlying technical instruments and scientific concepts there is a certain "project" [4] of a society in which the individual can live only in unfreedom and subordination. A free society requires therefore the severance of this fusion between technology, knowledge and power, and the development of new, non-dominating science and technics, based on a different concept of nature, by which different laws and facts may be uncovered. According to Marcuse, science and technics have assimilated a historical, transitory, repressive a priori.

It is to this views that Habermas objects in his famous essay in which he develops his technocracy thesis, "*Science and Technology as 'Ideology'*", written on the occasion of Marcuse's 70th birthday.

Habermas expostulates to Marcuse that his alternative technics is inconceivable, as the characteristic of the "domination of nature" is inextricably linked with labour, by means of which humans have to maintain themselves against external nature in whatever historical period.

Of course, an alternative way of dealing with nature, e.g. aesthetic or communicative, is not inconceivable on principle, but no form of technics can be based on such a relationship, Habermas asserts [5].

I think that in this controversy both partners are right to a certain extent. The precise extent can be clearly formulated with the help of the notions

"technics" and "technology" introduced above.

On the one hand, Habermas points out to Marcuse - rightly so, I think - that alternative technics will remain technics and therefore imply control of nature through disciplined action. On the other hand Marcuse points out to Habermas - again rightly so, I think - that his universal category "technics" need not preclude that it may assume a particular concrete form ("technology") in a particular society like ours, such that it may help to perpetuate inequality and power relations. A different society will therefore require different technics, liberating technics that will put an end to the repression of man by man. In my opinion Marcuse has to concede that the control of nature is not intrinsically connected with the domination of humans, but only temporarily and locally in our type of society.

Paraphrasing Habermas, we can summarize the entire debate in one sentence: for technics there is no more humane alternative, for technology there is.

II. Views on technological development

Next I will discuss five views on technological development, to see how power relations (standing for all the things that can be criticized) may enter the design of technologies. Of the order in which I will present these views, it can be roughly said:

a) that they have been developed in this order in socio-philosophical and historical thinking about technology
b) that they also become more and more adequate and less one-sided
c) that they allow more and more room for non-technical factors.

II.1. *Technological determinism*

The view of technological determinism can be characterized thus:

Technology develops autonomously, according to its own immanent logic; it determines its own dynamics. There is only *one best way* for solving humanity's problems, i.e. the solution of maximum efficiency. Technological development follows a fixed, one-dimensional course, a straight line along which only stagnation and progress are possible. In the process of social development technology is therefore the independent factor, corresponding to its role as "exogenous factor" in traditional economic theory. Society has only to adapt itself structurally to the *Sachzwang* [6]) of technology. There is a systematic *cultural lag* [7]); culture always lags behind the progress of technology.

This determinism can be found in optimistic and pessimistic variants. Pessimists (of the Brave New World type) foresee that civilization will be overwhelmed by the technological Moloch. Optimists (like the Dutch government and its supporters, the 'Science-and-Technology' sections of the newspapers, but also certain tendencies within Marxism) greet technological progress as a pre-eminent instrument for prosperity, welfare and/or a free society. Social thought is restricted to eliminating the obstacles for technological progress and absorbing its consequences. The optimists are backed by a host of historians of technology (of a rather a-historical calibre) who explain entire cultural revolutions from technical innovations, which apparently need no further social explanation than a reference to unique inventive geniuses. Thus Lynn Whyte explained the whole of feudalism from the invention of the stirrup [8]).

In my opinion this view cannot be upheld [9]). There are two reasons:

a) efficiency is not a separate norm standing apart from other social and cultural norms; we will shortly meet some examples;
b) technical development does not follow a fixed, necessary course; repeatedly alternatives will occur which do not lend themselves to an unequivocal choice.

II.2. Technology as applied science

The thesis which equates technology to applied science has been most explicitly formulated by Bunge [10]). He considers technology as a derivative of scientific development, which is taken to be autonomous and viewed as the motor behind technological innovation. Science is seen by Bunge as oriented toward truth and toward universal regularities, technology as oriented toward practical usefulness. Technology mediates between, on the hand, objective scientific knowledge, obtained by independent research, and, on the other, the a-rational knowledge of (social, moral and legal) precepts of society and the thinkerers' rules of thumb derived from the arts and crafts. Technological progress is the consequence of the further penetration of science ("scientification") and the de-coupling of common sense which is its complement.

This scientistic view is also untenable in my opinion:

a) First, the philosophy of science of the last 70 years has considerably

detracted from the privileged epistemological status of science. Science appears bound to paradigms whose adequacy cannot be justified theoretically, but amounts to a normative question [11].

b) Through its experimental character science has become intrinsically linked to constructive success: apparatus and facilities have to be designed, often in an artful way, which bring about the conditions under which scientific hypotheses can only be tested, or, more exactly, which construct the objective reality to which theory refers [12]. Without making dirty hands in practical construction experimental science will not thrive and prosper.

c) Technological development appears not only to depend on scientific progress, but has its own dynamics and even feeds back as a determining factor on scientific development.

II.3 Externalist approaches

Fuelled by the concern about technology, in the last twenty years a lot of historical and sociological research has been undertaken to undermine technology's claim to neutrality (according to the previous views) [13]. A wealth of concrete material demonstrates that various factors beyond the scientific and technical setting have influenced the design and introduction of technologies. I call these approaches externalist.

One study showed that the New York architect Robert Moses deliberately designed the 200 underpasses in Central Park with less than 2,70 metres height, to provide access to rich whites in private cars, but not to poor people and blacks in city buses [14]. A political ideology permeates the architectural design.

Your refrigerator makes a humming sound because it is a compression apparatus provided with a electric pump and not an absorption refrigerator heated by gas (which you can sometimes meet on camp). This is not due to its technical superiority, for in this respect the absorption refrigerator of 1925 scored much better. But its producer did not command the amount of capital needed by General Electric to finance the development and marketing of refrigerators for use in personal households. Here we haven before us a case in which the nature and form of the technology have been directed by economic considerations [15].

A separate and extensive research tradition [16]) around the theme "technology and labour" has by now produced numerous instances of production techniques that were installed by capitalist entrepreneurs to discipline or "rationalize away" refractory (or well-organized, or strike-prone) employees. The nicest example in my opinion is Arkwright's spinning machine [17]), the symbol of the Industrial Revolution in 18th century England. From a technical point of view it was nothing new. It had been developed already 50 years before, but at that time it had been rejected by the independently working cotton spinners because it would be driven by steam- or water-power and therefore turn them to slaves of the machine. For the very same reason that the artisans rejected the spinning machine, it was very suitable for the cotton-spinning industry on a capitalist basis that emerged 50 years later, a welcome instrument in the hands of entrepreneurs struggling with soldiering personnel. The notion of efficiency had assumed a new meaning. This was clearly seen, at least, by the Luddites and machine breakers.
But also in the 20th century many instances are recorded of production technologies that were installed by entrepreneurs to get rid of categories of skilled labourers who derived power from their indispensability: numerical control of lathes against highly skilled machinists (Noble [18]), a new generation of computers against the programmers [19]), etc.

The externalist approach is however insufficient; it does not point the way to an alternative philosophy of technology, but demolishes only the received view of autonomy by patient historical research, without offering anything in its place. Moreover, it usually restricts itself to designating one non-technical factor.