PERIODICA POLYTECHNICA SER. SOC. AND MANAG. SCI. VOL. 4, NO. 2, PP. 125–148 (1996)

NEW TECHNOLOGIES AS SOCIAL PROBLEM (A Reflection on the History of the Social Role of Technology)[1]

Imre HRONSZKY

Institute of Social Sciences and Economics
Department of Theory of Science and History of Engineering
Technical University of Budapest
H–1521 Budapest, Hungary
Fax: + 36 1 463-3473

Received: Sept. 1, 1995
Revised: Oct. 10, 1996

Abstract

The recent technological revolution raises concerns, too. Looking for the roots of technological progress the article gives an overview of the ideas on the social role of technology in history. The article ends with the criticism of instrumentalistic approaches to technological growth.

Keywords: technological revolution, social role of technology, technological progress.

1. Introduction

There is a technological revolution recently, the omnipresence of which is already experienced both in production and everyday life. This revolution realises or promises a lot for mainkind by contributing to the solution of basic social problems through producing goods, improving health. Mankind has never witnessed a technological breakthrough of this measure. But there is a growing awareness of very deep problems arising from this technological growth. Following a long historical period of trust in and enthusiasm for technological growth, now there is much more concern, there is a bivalent approach in evaluating the recent events and the future possibilities. Moreover, huge masses begin to identify the danger

[1]This paper is a part of a lecture given at the summer course in San Sebastian, 1994 directed by N. Ursua and I. Hronszky, on: New Technologies, are they tools of solving social problems or of enhancing risks? The support given by OTKA helped to realise the research.

of developing hazardous technologies and lack of their security (or at least its feeling), the growing scepticism regarding industrial growth continued, a critical attitude toward the social meaning of technological growth as a whole, leading to the call for a 'sustainable development', are elements of an overall criticism.

Empirical sociology shows that issues of technology became one of the major events people are concerned about in leading industrial countries. Technological growth, or at least its understanding, currently seems to be deeply schizophrenic. This deep divide in the interpretation of technology can often be found even in the fluctuation of one person's opinion from one to the other extreme.

These extremes in everyday evaluation of technology are reflected in scientific investigation to the problems of technology in society. This investigation has been moving into two basic directions, with a weak bridge between them. One type of researches only focuses on nothing but the acceleration and effectivity of technological growth, like most innovation studies, the other type tries to concentrate on the well experienced and the possible harmful effects in highly critical manner. Both recent revolutionary growth in technological capacities promising new social possibilities as well as the unsolved problems of threatening harmful effects, and especially the tension between these two, make technology a candidate for an important and enduring political debate.

There is pressure for the analysis and evaluation of the social meaning of technological growth we have been facing in modern history, and to explore in the direction of technological development in the future. The magnitude and complexity of this analysis require a comprehensive investigation, which would include the cooperation of much specialized expertise, from different natural and social sciences to different sorts of humanities. This need of new types of analysis stimulates the emergence of new sciences such as environmental economics and management. But, even when the solution of the new task forces it to a deep restructuring, it is also sure that the cognitive problem is by far not just an extension of economic thinking, as many claim. Arising from a prevailing overall 'instrumentalistic' approach to any social problem would be one of the possible tempting but damaging shortcuts in the investigation to reduce the approach to an extension of calculation of costs and a more effective management (including legal regulation) of technological growth.

The problems with technological growth become comprehensive now. They awake the need for criticism not only in relation to the recently quickly deepening environmental deterioration but to the social purposes of this technological growth and the changes that occur in the meanings of social relations, in the human relations to nature and in individual human behaviour, through their 'technologisation' (their technological reconstruction). Therefore, more than extended economics and management science, a comprehensive reestimation of the role of technology in society and nature is needed. The appropriate task can perhaps be an overall reorientation of all the sciences and humanities which concern with and are concerned for issues of the technology-society(nature) relationship, including disciplines on the human individual.

Both history and philosophy of technology have a task in these needed investigations. A philosophically oriented historical overview of the role of technology in society can moderately contribute to this necessary knowledge fund, too. This introductory presentation tries to supply some elements of a type of this account. The main parameters to be followed in our historical overview are: the changing type and direction of knowledge in technology, the expectations toward technology concerning its social role and the changing role technology has in society.

2. Remarks on the Periods of Antiquity and Modern Times

An overall historical look at the role of technology in society can be given through a triadic classification. Accordingly, there was a special type of technology and its role in society in antiquity, best expressed by the Greek term 'techne'. Beginning from the late medieval times, actually in modern time, a new type of technology was gradually emerging. It is difficult to give it an appropriate English name. In German there is the term 'Technik' and I shall use 'empirical technology' in this presentation to identify this special sort of technology in history. With this one can contrast a third historical type by introducing the term 'science based technology' or 'technoscience' for our time, for the more or less scientifically constructed technologies.[2]

The Greeks referred to some alleged trickiness in the activity of craftsmen when they spoke about 'techne'. It was thought that the objects behaved in contradiction to the intentions of the human users, they resisted them. According to the interpretation, the artisan was a peculiar sort of human being, able to find the way to nature's objects, which were assumed to be some sort of living beings, normally following their own intentions. His power was not to force nature to obey him (this was the 'power' of the magician) but to 'trick it out'. Technological reconstruction of objects of nature was believed some sort of constraint. Natural objects have their way normally but some people can have an impact on them and change their

[2] Classifications and terms are not innocent, of course. They always turn the attention to some feature(s) and distract the attention from some other features of the issue under scrutiny.

normal behaviour. Technology in the form of 'techne' was identified as some sort of subjective capacity closely bound to the artisan. Rules could help on a moderate way only, for the objects behaved rather individually (compared to the standardized objects of technoscience!), and beyond the rules the individual skill of the master was always very important.

Oriented toward preservation of the achievements acquired by a quasi-Darwinistic, spontaneous evolution of technology, the main spirit of craftsmanship was not inventory, it was conservative. There was no organized social type of action like experimentation to regularly provide new knowledge and its condensation into rules. Rules emerged from a long spontaneous practice. When rules were found they were preserved and the need for preservation hindered any systematical search for new situations and new rules to generalise knowledge from individual situations. Technology developed very slowly, through constraints from the outside, which forced the masters to accommodate to new situations.

To sum up, one can say that, according to the ancient type of interpretation, something living and subjective met something of the same nature in a technological activity. Technology as techne was not seen as an activity reconstructing basic natural conditions of human activity but as a human capacity for realising human purposes by living with and accommodating to nature. Technology was strongly conservative, oriented toward preservation of the 'tricks' and rules found by chance.

First the 14th century gave birth to an idea for technological growth as a conscious need and subject of pride in reflections on mining. This idea of technological growth was associated to the idea of social progress. It can be seen as a secularisation of the Christian idea of moving toward God's imperium in history. People began to put their trust in technology for redemption from poverty or to get rich. In modern times the idea of technological growth as steady basis to social progress became gradually one of its characteristic ideological self-reflections. It began in the early 17th century and was fully developed by the second half of the 19th century when the industrialisation ideologies assigned a central position to technological growth. Technological growth was transformed as industrialisation ideology by the self-reflection to an exogenous variable, an outer necessary condition of social progress.

The persuasion that slowly begun to grow from the 14th century, that mankind can continuously and endlessly widen its technological power over nature, was based on successfully progressing work of artisans, of course. Like techne in the antiquity, this technology was based on empirical knowledge, it is true, but gradually on an empirical knowledge that was partly gathered in new ways. The 16th century gave proof to a triumphal process of widespread and continuous inventive activity and the cumulation of technical inventions. One of the most important factors was the inclusion of systematic experimentation. (Let us refer to the metallurgists or the medical doctors, who looked for new medicines, for many of different artisanships.) A principal resource of wealth began to be seen transforming natural things through the artisans' work. Generalised to an ideology of the work of artisans, in protestant interpretations all was supported by the idea that human beings have a task from God to finish his work.

An upgraded acknowledgment of alchemy and the importance attributed to it in the renaissance was exaggerated expression of the new consciousness. The alchemist magician became one of the key figures in the self-image of this epoch. Being able to experimentally explore the secrets of nature, as it was supposed, the alchemist symbolised the self-trust in the new nature-transforming capacity of mankind.

For many reasons, among which the rapid development of the arts was only one, the empirical knowledge of nature in a suddenly and unexpectedly widening world (think only of the geographical discoveries) began to rapidly attain higher cognitive status, together with a growing tension. The new empirical knowledge was found in strong contrast to left knowledge and their acquirement methods. The ability to know things began to get a profound reconsideration by the end of the 16th century, and the (non-educated) artisan, referring to his successful material practice, began to challenge the university scientists in issues of knowledge of natural processes.[3] In contrast to the old type in antiquity, the techne, in this new historical period regular efforts were already made in different types of arts to widen this empirical, rule-based-knowledge. The idea of cognition by transforming things, too, and not only an 'empirical turn' began. Technology, however, was mostly based on trial and error type experimentation. Except for mechanics in construction of scientific tools, 'theories' very seldom gave more than a very vague orientation until the end of the 18th century, even much later.

There is an important development in the ideologies of technological power from the early 17th century with Fr. Bacon. In an effort to overcome the inherited opposition of crafts, based on purely empirical knowledge, and the scholastic sciences, Bacon prophesized human progress based on a new type of natural science and of technological inventions, themselves the results of the application of the (new) science. These inventions would make nature's powers regularly utilisable for human purposes, gradually

[3]Perhaps the most famous of these was when Bernardo Palissy, the potter, who challenged the scholars of Sorbonne in the second half of the 16th century to compare their knowledge. He claimed that, notwithstanding that he was untaught, he new more and more valuable than the scholars in empirical issues of the real world. More than he insisted on having a more valuable knowledge.

approaching the complete mastery of nature. He predicted a new age in history in which natural science would take the lead, to initiate developing technology. He formulated with this the very idea of a scientific technology, that still is only under partial realisation. He was persuaded that science consists of, first of all, the well established methods of research, of discovery. Against the widespread belief in the secret 'inventive activity' of the alchemists, Bacon argued for a methodical empirical research leading to laws of nature as the basis of advancing the utilisation of nature. With modern times nature became object of utilisation and scientific technology the appropriate tool for this.

Bacon, attempting to give guide how to conquer nature, was exaggerated by his ideas of methodical research. Orienting his methodologism as knowledge of verbally communicable rules against any 'secret' activity, like alchemy, he thought that the true methodology can easily, quasi-mechanically lead to new inventions. Expressing a new consciousness, of which Bacon represented, the late 17th century was full of promises, how, through methodical research, easy inventions will be realised and make the people wealthy.[4] The Baconian vision was a new type of science based technology, too, having important social role, not only a 'new science'.

Ridiculing the magicians and alchemists, Bacon fought for acceptance of his principle: 'natura parendo vincitur', that nature can only be 'conquered' by obeying its laws. Remember the subjective capacity to make tricks against nature's objects, understood as active subjects themselves, was the frame of referring technology in its techne period, where constraint always meant some strong limit to technological capacity, human activity was conceptualised as accommodation to nature. The exaggerated picture of magicians having the key to the secrets of the objects completed this reflection on the work of artisans, interpreting craftsmanship in terms of subjective ability (and at least partial secrecy), including the possibility of commanding to nature without any limit, in principle. The need for the exploration of the necessities and the recognition of the real, not only imagined, freedom of manipulation by obeying nature became the ontological and epistemological basis to the success story of progressive 'conquering' of nature through technological development from the 17th century. As it became commonplace, knowledge of nature and the growing exactness of natural science opened a limitless perfection of technology transforming nature into a servant of mankind. And nature itself seemed an endless

[4] 17th century was already a feverish trial to make a fortune, just as improve upon the human conditions by technical inventions. It is much less important here that all this was much more an ideology of inventive activity than a real success. The disappointment with this inventor ideology led, early 18th century, to the sarcastic humour of the Gulliver on the Royal Society's activity.

reservoir of possible resources. It seemed to be possible to gain these resources endlessly out of nature if its laws were obeyed to. The scientific engineer became the secularized inheritor of the alchemist, in this relation. He seemed to be able to realize what was historically dreamt of, because the knowledge of laws of nature narrowing down the predictive capacity seemed to be the only limit to the transforming activity.

This second part of the history of technological development and its ideologies became the triumph of the 'homo faber' idea: of mankind, able to 'domesticate' nature without limits, by exploring natural laws and obeying them, conceptualising nature itself as being just a passive subject of its technological reconstruction. The real meaning of any enduring resistance of natural objects to their technological reconstruction, experienced so far, was identified as nothing but a misguided action, based on a naive technical activity when trying to act against natural laws. Nature seemed to have submitted itself to its fate of getting transformed to taste if its laws were followed.

The trust in this 'domestication' of natural forces based on the progress of science predicted a calculable and planned future. This interpretative framework, that mankind is ceaselessly moving forward, through technological progress, from its nature-given state to a world of self-consciously constructed conditions of human life, emerged in the 17th century. But it became the ruling one only in the 19th and the first half of the 20th century. This (non-critical) idea of progress had its root beside science, and later in economy, first of all, in technology.

It is important that the only real limit to human technological activity was identified in nature itself, in its natural laws. There was no thought to the possible limits of technological activity to be set by the acting human beings themselves, e.g. to the meaningfulness, of the presumed endlessly progressing technological reconstruction of nature in the long run. Romanticism, emerging mostly from the end of the 18th century, and forceful only for a short time, who offered conservative criticism on industrialisation, was quickly ignored as non-important comment on the triumph of the progressive reconstruction of the natural world into an artificial one. These reflections could easily be dismissed in the countries where the industrial revolution began to run. There was no chance to look backward in a historical period when those strata which formed the type of society by an overweight, were committed to technological growth, no chance to argue for the preservation of earlier values and modes of life. They could successfully be pushed back to the private sphere, as subjective, e.g. artistic reflections on technological growth without a real critical account to the 'real', economic and political world of this growth.[5]

The idea of gradually completing mastery of the natural environment through advancement of the new science was developed as early as the beginning of the 17th century. The industrialisation ideology from the mid-19th century added something important to this belief. This is that continuous technological growth is some sort of necessity. One sort of technological determinism appeared in the reflections on society. There is no place here even to enumerate the variety of 'technology deterministic' ideas in different social theories. Nevertheless, it is worthwhile to point out that it ranged from a naturalisation of human history (based on the idea of the reificating conception of a somehow natural-law-like growth of technology as the fate to mankind, somehow from outside) to ideas in which technological determinism meant something different. According to these, solving social problems preconditions technological growth. In the ideological reflexes to changing social (and natural) world through industrialisation technology became the moving force of social progress, either as a fatelike outer factor or a precondition, on which the social forces should be concentrated first, if social progress has been be realised.

One of the later elements of the technology deterministic industrialisation ideology is an interpretation of invention with the so-called 'technological imperative', an idea, perhaps typical around the mid-20th century. This 'technological imperative' can be formulated in descriptive and normative ways. According to the descriptive version technological inventions necessarily go through. According to the normative formulation, no control should be practiced over the inventing activity from 'outside'. Mankind has fully to explore (and utilise?) the technological potential available. (The

[5]Looking forward in history as the progressing self-realisation of mankind, the young Marx (in Economical-Philosophical Manuscripts of 1844) claimed to identify technological action toward nature as a main emancipatorical force for mankind. According to his understanding, history of technology is the appropriation of nature by mankind in a double process of mutual mediation of objectification of the capacities acquired through the appropriation of nature and appropriation itself. It leads, he hoped, to the perfect 'naturalisation' of the human being on the one to the ever progressing 'societalisation' of nature on the other end of the interaction of the human being with nature. The history of industrialisation and the recent development of technology (including the application of high-tech to social relations and individual psyche) surely requires another approach, too. According to this, technoscience is only a successful development of instrumental control capacities, a revolutionary step in its instrumental efficacy. The philosophical-antropological idea of emancipatory power of technology does not exclude at all the neutral or critical historical sociological views on technology as a control tool having a strong transforming, an instrumentalising effect on the social relations and individual behaviour, and vice versa, of course. The recent technological revolution is probably a mixture of both tendencies, running in both directions.

technological imperative has a less philosophical but more empirical, social science justification as well, when it is argued that economic growth is based on technology and cannot or should not be stopped.) The idea of 'technological imperative' fits into a special type of thinking about partial issues in society: according to this it is rational when any segment of society regulates itself to maximise its own purpose. The inclusion of its products into the social whole will be considered and regulated at the outcomes, in the so called 'application context' as an end-of-the-pipeline regulation in a selection and rectification process.

Understanding of any social activity in means-ends terms slowly became prevailed through the social transformation of feudalism to capitalist society. It liberated the end-setting activity of society, (in principle) from any social structural and ideological hindrances. Commercial activity and technology were good basis and empirical models to this interpretation. In some ideologies by the end of the 18th century calculation became synonym to the rationality. (The prepositivistic ideology, that became the basic framework to establish the new Ecole Politechnique in Paris during the French revolution by 1994, made this identification first for higher education. The practical consequence was an introduction of a very strong mathematical education to make calculations by solving equations, where it was already possible (the smaller part of engineering activity to this time) and moreover (!), to educate the students to be calculating human beings, giving them this type of culture for their life, so that they became accustomed to consider everything by looking for and taking into account any possible quantitative information.)

From the mid-19th century the industrialisation spread from the craft to other fields of work. One example from the second half of the 19th century is the rapid and widespread dissemination of artificial fertilisation, itself the first element and symbol of the beginning industrial reconstruction of agricultural activity. With chemistry as a basis, artificial fertilisation was the first science based technological activity in agriculture.

For a meaningful philosophical and historical-sociological analysis of technology, one can find an interesting grasp when comparing the role artificial fertilisation had for about one hundred years long and our well based fear after this 'success'. This type of analysis begins by stating the necessarily ambivalent nature of any technology, or to put it differently: any technology shows earlier or later its negative effects, too, and there is a chance that these become the prevailing ones on the long run.

One can illustrate a rather strong variant of the thesis on the ambivalent nature of any human intervention into natural relations by referring to agriculture, as a case. The first agricultural activities, needed on the long run correcting technologies. In the long series of these correcting actions artificial fertilisation was included by the mid-19th century. Technologies were to be changed in history because it threatened that the 'side-effects', necessarily belonging to any technological innovation, in agricultural activity, on the long run, began to turn down the main ones. Agriculture shows a continuous story of correcting activities toward any historical type of it, if this run already for a while. 19th century agriculture, after shorter run successes in intensification of the utilisation of the fields, begun to turn over to showing failures, exhaustion of the soil, moving toward an overall crisis. An additional activity, artificial fertilisation cured the problem for a while. But on the long run just this activity became the main source of problems. Looking at the causes of this turn-over one can find a necessary lack of human knowledge. Any activity can only be based on a finite model of the natural issues to be reconstructed. This finiteness of knowledge and ontological reasons, too, should be taken into account when explaining the ambivalence of technologies to human purposes.

We now face a recent turn to biologisation. A type of 'accompanying research', set from the beginning of the new orientation, could perhaps help to recognise some sort of inflexion point earlier than the accumulation of negative effects begins to force us to this recognition. Instead, at the moment, one can face a repeated, one sided orientation toward the new as if it were the long expected panacea. The frame of the comparison, the critical rhetoric is nearly exclusively set toward the old method, the artificial fertilisation. For ideological reasons a one sided interpretation is given to a new, but somehow once again one-sided technology, instead of developing an accompanying continuous critical consciousness.

Despite the negligence of the harmful side of technological growth in the ideological reflections on it, during the early industrialisation period, it actually caused a lot of harmful effects, e.g. on human health, on the environment, etc. of course. In the 19th century, being yet an especially rude phase of introducing new technologies into social practice, the harmful effects were much more immediate and were more carelessly dealt with than they can be today, at least mostly in the industrially leading countries.[6] The typical identification of all this was that these are (perhaps necessary) 'side-effects' of the technological progress. The naming of the issue with the term 'side-effect' already worked as rhetoric, suggesting both the necessity of the named both that it could be only the transitional price for

[6] To refer one case, the utilisation of common salt for producing natrium for soap production, a very important achievement for society had the consequence that, after its first industrial realisation, hydrocloroc acid was simply released into the air for about fifty years. It had devastating effect on the agricultural surrounding. The 'alcali-bill limiting this in the early 1840s can be seen as thee firts state regulation activity for environmental protection.

progress, to be put an end to it by extending the rationality of technological invention.

To summarize some features that ruled the ideologies over technological activity in the 19th century, one was a belief in endlessly progressing technological reproduction of any natural relation as a rational activity (both in the meaning of calculability and of human meaningfulness). Another one was that technological growth was identified with social progress.[7] Typical technologies of the 19th century, at least in its first part, were still based on methodical-experimental empirical research, on a lower level of engineering and not on scientific research. Therefore, most of the credit, given to the endlessly progressing technicalisation of natural relations as social progress, was given for future scientific technology. This is the third characteristic feature.[8] Technological growth in the industrialisation period focused very narrowly on industrial goals and the harmful effects caused by industrialisation were not dealt with or their regulation began to limp very slowly after the introduction of technologies.

As an expression of the belief in technology as basis of social progress in the early 20th century the engineer became a cultural symbol in the developed industrial countries, especially in America. Many silent films took the engineer as their hero. Some general intention of society to change the nature-given relations by the work of engineers was expressed in them. New dams, crossing valleys, built up in the first third of the 20th century in Colorado, illustrated how mighty mankind became in reconstructing nature, just as skyscrapers did. The task of realising of engineering phantasy gave a new definition to technological progress. Some social scientists went further. They began to identify the main problems in conduct of society as a lack of 'engineering of society' already around the turn of the century. Th. Veblen, then Dewey conceptualised the idea of 'social engineering', the technocratic movement in the 30s tried to gain social support to this idea, to realise, they claimed, a step needed already long again social progress.

So, technocracy claimed two closely related theses. According to one, technology meant regulation and the experienced lack of regulation of social relations meant social technology was missing, the capacity of forming and organizing social issues in analogy to issues in nature, the original place of technology. According to the other, engineers should take the leading

[7]A comparative look at the successive world exhibitions in the 19th century can show how later the competition among the nations and progress of mankind became expressed in technological terms and in terms of growth, in capacities to do something quicker, bigger, etc. World exhibitions until recently continued to reflect on and prolong the feeling that social progress is to be measured by technological growth.

[8]Actually the chemistry of artificial fertilisers and the organic dying industry plus the electric industry originated in previous scientific research in the 19th century.

role in political bureaucracy, partly because technology became the main factor in social change and partly because social issues should be handled as objects of (regulatory) technology, to make them effective. Engineers were to be seen, par excellence, the appropriate people to realise these tasks – according to the technocratic ideology.[9]

It is meaningful to touch upon the socialist interpretations of technology as a tool of solving social problems. All these interpretations, notwithstanding whatever political specificity they were, agreed on the basic importance of accelerating technological growth as means of social progress. One of which the effect on the social practice of the later socialist states was not important but it is theoretically interesting, nevertheless, was a leftish 'messianistic dogmatism', to lend the term of Gy. Lukács for this issue. This dreamed, among others, of a specifically socialist type of technology, which should have realised an opposite type of unification of the worker and the object of labour in the process of labour than the, at the beginning of the 20th century just emerging Taylorism did, which reduced the need for the skills of the labourer to the extreme. Led by the request of an 'emancipatory' relation of the worker to its labour through a new type of organisation of the labour process, its most famous representative, Bogdanow developed some quite modern thoughts on the effective utilisation of the workers knowledge for improving the labour process.

The ideology of technology which became realised in practice of the socialist states, by the 'buroeaucratic dogmatism', to lend the other term of Lukács, utilised by him to name the opposite ideological and political approaches in socialist movement, was deeply modernist, that means a sort of short-sighted industrialism as a legacy of the 19th century. By 'bureaucratic dogmatism' industrialisation was seen as the sufficient basis for solving social problems under the control of the state. Growth of technology meant the growing amount of goods and symbolised calculative planning activity. It was hoped to make the new social system more effective than the market system, reconstructing the whole society into a production and consumption system regulated by overall planning activity and control of the state. Concerning the problem of technological growth, as in any other relation, the socialist system extinguished the counterbalancing power of, at least some sort of, democracy to the modernist project and its narrow minded growth orientation. All this led to a type of technological, industrial culture, in which environmental pollution, extinction of resources and

[9] Only one US president has been with engineering career so far. Taken into account the nuclear engineering studies of J. Carter this number grew to one a half. One can wonder about the lack of social persuasive power of technocratic movement in taking account this fact, too.

enslaving the worker into deskilled work to the extreme, far overcame its capitalistic origin.[10]

A look back in history on the legitimation speeches of technological growth in the modernisation period was made. The basis for comparison of the effects of technological action was the past: either bringing natural forces under social control was contrasted to natural forces, having earlier an uncontrolled effect on society or the individual human being, or the meaningfulness of all this was denied in the name of preserving an earlier way of life. For most people the future of technology seemed to be the enduring progress of reconstructing and controlling nature in interest of mankind. Nature was not problematized as an object of human activity when reproduced by and into technologies, nor the question, if meaningfulness of technologisation of future society, both of the social relations and the individuum, is limitless, was asked.[11] Technology was seen as a social tool and the assumed limitless calculability, predictability of technological action gave meaning and security for mankind and gave the belief of the realisability of any technological action toward nature.

3. Overcoming the Modernisation Period? The Instrumentalistic Approach to the Problems

Technology continuously realised more and more of its promises in the last centuries, bringing us to a new, rather comprehensive technological revolution, based on scientific research, in the last thirty years. Concerning this recent revolution one can enumerate biotech, informatics and computer industry, materials science, psychology or management science, medical technologies, or just space industry as a comprehensive item: one can find new technological capacities everywhere. On the one hand the earlier idea,

[10]The socialist system gave a favourable political milieu to one-sided technological projects, in which several times, alongside the usual short range technological and economic purposes, longterm, overall technological dreams were the leading ideas. One case can be especially illuminating concerning the missing counter-balances to some 'bold' ideas. The idea of reversing the course of some rivers originated in Canada, in the 40s. But it never got an appropriate support, for the obvious fear of the possible consequences. Better to say, the lack of appropriate knowledge of the consequences stopped it. But Stalin found it a task worthy of the efforts of a centralized, socialist state. The later, softer dictatorship moved much in the same way. Orienting toward narrow minded short range technological projects in general, it changed several times for one sided long term endeavours, suffocating their democratic negotiation, building this way the future social dramas into the technological systems.

[11]Some philosophers, like Heidegger disputed this and argued that inclusion of natural forces into human activity brings with itself the danger of some sort of dark, uncontrollable forces and hence an uncontrollable future.

which was partly a hope until now, became a large real potential: technologies based on new, breakthrough developments of sciences are rapidly becoming typical and the recent technological development promises a fuller realisation of important social purposes than at any time.[12] One part of the modernisation project, inclusion and development of newer natural capacities for serving the mankind seems reinforced.

But it does not need a long time either to describe how the so called 'side-effects' of industrial growth became one of the most serious social problems in our time. The very rapidly accelerating industrial growth in the last period, after the second world war, extended the 'side-effects', too, in an accelerated way and made the problems of 'side-effects' global. The accelerating tendency to rapid destruction of natural resources of civilisation, by continuing the type of industrial growth so far, made obvious the short-sightedness of the industrialisation ideology and the lack of economic and legal regulation mechanisms.

Recent technological growth shows a sort of schizophrenia and an open polarisation concerning the evaluation of its possibilities, even when one approaches the evaluation question purely instrumentally. The term 'purely instrumentally' is used to refer to an approach in which the meaning of technological growth is not questioned and therefore any criticism is oriented only toward achieving (a safe) growth, in which the problem is identified as one of methods. (With the importance of criticisms toward the human meaning of technological growth as a whole or some special technologies will be dealt later.)[13]

Four types of problems are usually mentioned as the most important ones. The first one is the rapidly extending deterioration of environment. Environmental pollution caused by non-appropriately developed technologies and the problem of hazardous waste already has a global dimension.

[12] Electronisation and molecular biology are the usual trivial references in this relation. Let us mention that a networklike progress, in which each element somehow presupposes the others, is actually going on, that not only sectors of technology will be revolutionised. The sciences in the forefront need to their purposes the evolution of others and they give an aid to the others. The case for micromechanics could be an example, for many experts evaluate that it is beginning to make a similar jump as microelectronics in the last 30 years, itself partly based on the evolution in microelectronics, among others. This jump promises very important progress in medicine, among a lot of fields of application.

[13] To give a simple case to differentiate between the two types of criticism one can call in mind the problem of 'rent-an-uterus', the problem of 'wage mother'. For some, it is nothing but a problem to solve safely, that means it is a problem of method, for others it is to be opposed on ground of basic value commitments, that means it is a problem of purpose. Problems relevant for medical ethics are trivial cases where an obvious value plurality accompanies technological development but many other fields show the same feature.

The other one is the depletion of (some types of) resources, a threatening problem already in the near future. The third problem is that mankind must understand that there are some natural limits not to overcome by technologies. The problem of global warming can be first mentioned here.[14] This later problem shows especially clearly how misleading is to tranquilise ourselves concerning the harmful effects of technologies by labelling them as 'side-effects'.[15] Some sort of natural limits are already found, in connection to human reconstructing activity. The fourth type of problems arises, paradoxically, from the growing effectivity and the deeper level of effects of technology has effects on nature nowadays. It is the problem of the possible non-linear, chaotic effects (to be) caused by new technologies on nature.[16]

One can recognize that these problems are the effects of full-fledged development of the modernisation idea as the leading spirit behind industrialisation. All the mentioned types of problems attack ideas taken as preliminary suppositions earlier. The first is about 'side-effects', always of secondary importance, the second that nature was taken as, at least practically, inexhaustible.[17] The global warming reminds us that human technological activity reaches the measure of the globe, as its limit to ex-

[14]It is about the story that mankind with its agriculture, urbanisation, etc. accommodated itself to a rather stable climatic and natural geographic situation and a change in the average temperature caused by industrial activity would cause overall climatic and geographic changes like the raise of the level of seas, the change of weather zones, etc. All this would challenge in an unbearable measure. The neglected 'side-effect', cumulation of carbondioxide in the atmosphere begins to be the main industrial effect.

[15]Small 'side-effects' can sometimes cumulate in unbelievable measure and become the 'main' ones. Any 'exact' calculation of costs of a technological investment made earlier without counting the long-run effects can mislead and simply shows how much the 'exact' economic calculations are issues of choices of what should be calculated. They actually are the results of some sort social consensus on what should be calculated. This referring to concensus nature of these 'objective' calculations does not mean, of course, that setting their limits would only be a matter of negotiation.

[16]The civil stratospheric flight can be seen as an appealing possibility in instrumental terms for it would reduce the flight time among the continents very much. The solution of this problem needs a concentration of the overall technological capacity and its purposeful development. One of the reasons for this technological project in Germany is this, because it can give an overall direction to technological innovation. But there is also a very well founded concern about the possible effects on the stratosphere for there scarcely is knowledge available about the behaviour of stratosphere. It shows a growing new type of awareness and its translation into research terms that the so called Sanger project, itself intending the solution of the reliable flight until 2020 includes from the very beginning a research on the possible 'side-effects'.

[17]The first recorded case when a bird disappeared from the biosphere was in the 17th century in Madagaskar. The new 'sustainability' approach intends to fight against any annihilation of resources for the future generations. It seems to be questionable if a stronger variant of this thesis can be validated, even when intended destruction can be dismissed. Industrial reconstruction of the natural conditions of human life, it seems, have

tend it in some directions and that actions always effect in a network of relations. This and the fear of possible chaotic effects reminds us of the limits of the presupposition of limitless computability of natural processes as predicted.

As mentioned, criticism of technological growth can include reflection on the meaningfulness of the purposes, too, and calling for a different type of purposes or it can be reduced to an extended modernistic approach. This latter mainly means the extension of the scientific calculatory approach to the 'side-effects', too. It thinks that the problems are only based in lack of further knowledge of methods and not, at least some times, in some basic assumptions and ontological relations.

Even the more moderate, instrumentalistic criticism can already show very deep problems. One of them is that the recent period of technological growth is mainly based on recently born new technologies which, concerning their safe control, force mankind to face problems of new sorts, because some of them can be seen as especially dangerous technologies. One of the possible dangers emerging through the new successes in a growing mastery of nature through industrialisation and developing technoscience for this purpose arises from the recent quick conquering of the sphere of biology. We are now facing, through genetic manipulation, the beginning of engineering of life itself. As any earlier step, promising to extend human control over nature, it promises liberation from constraints in many directions. And genetic engineering already is well on the way to realise some of these promises.[18] In its extrapolation, genetic engineering, applied to the biosphere, gives the possibility of putting the evolutionary fate of existing species, as well as the possibility of creating new ones at the disposal of mankind. Genetic engineering, promises the revolutionisation of curing diseases, by intervention on the genetic level. It gives the possibility of conscious transformation, potentially extended to the whole biological world. The idea of becoming a partner of evolution on a much deeper level than earlier agriculture and biotechnology could occur now.[19] But this is a point, too, where mankind stumbles into one of the basic conditions that

a consequence in reducing or even destructing some sort of resources. even then, when they won't be blindly dealt with like the mentioned bird in Madagaskar.

[18]The rapidly growing diagnostic capacity of genetically caused diseases, new bacteria, working for pharmaceutical purposes, are just but a few examples.

[19]The typical value approaches to the transformation of nature are anthropocentric ones. Most of them are purely instrumentally oriented. Their main question is if the problem at stake can be solved by some tools. There are important challenges to this approach based on some value-commitments, to set limit or to prohibit some sort of instrumental dealing with these problems. These value-commitments can be anthropo- or non-anthropocentric types. There are non-anthropocentric but biocentric approaches, too, esp. in environmental ethics.

made modern science from the early 17th century to what it is today. Let us make some remarks on this problem.

Agriculture together with industry in the late centuries reproduced a comprehensive 'second nature'. This had a strong effect on the biosphere, by forcing species to accommodate to the new conditions set by human activity, but concerning the genetic code it had a shallow effect on the environment, non-comparable with the alleged emerging possibility of genetic engineering on biological evolution.

In contrast to earlier agricultural effects it is already possible to construct 'artificial beings' by controlled genetic manipulation but there is not enough knowledge of their possible effects on the biosphere, comparable to the operational knowledge of their creation. To escape this problem of engineered life-science there is a choice in principle as follows. One possibility is to follow the technique of dealing with highly dangerous artificial products, already well known in physics and chemistry, and to develop a new type of laboratory science and technology, developing and preserving well-controlled artificial conditions for the new biological technology. But another appealing direction is to develop a genetic engineering which works in nature itself, under spontaneous conditions, like most chemical and physical technologies. This brings the problem of the so-called environmental release. Scientists are only at the very beginning of research in this direction, knowing how genetically produced beings would behave in a non-artificial environment. In some new types of experiments parts of the natural environment are modelled to reach a mediating stage.

Time and diversity were two parameters for natural evolution to accommodate to conditions, science has to find something to account for their effect in the selection process as a technological parameter to be able to include human planning activity into evolution on genetic level. There can be a well based concern, nevertheless, that complexity puts some basic constraints on the intention to release into the environment of genetically engineered beings.

There are other technologies giving a difficult task to the engineer constructors, and continuously moving the lay opinion, with the raising development of technologies of high catastrophic potential in the last 40 years. To put it ostensibly, nuclear power can be one and transport of liquified gas another case. Contrary to genetic engineering, one mostly can know rather exactly what the result of any catastrophe would be. The safe treatment of these technologies requests a solution of reliability problems of these technologies, higher by several orders of magnitude than that of the usual technologies. The very basic relationship to consider this safe treatment is that of risk, probability and damage. Experts argue that technologies with low enough probability to cause damage are safe enough for utilisation, notwithstanding their damage potential. Then the well known problem arising with these highly dangerous technologies is the answer to the question 'how safe is safe enough?' and who should decide on this. Without being able to go into any detail it is worthwhile to mention, nevertheless, that it can be misleading to say that the discussion is between neutral experts and their opponents, the lay movements (the scientific rationality and the lay irrationality) but between two committed approaches.

Official experts have been doing investigation forming a problem soluble under some special preconceptions and movements oppose these presumptions needed to the possibility of solution. It is important to understand that the basic controversy between them is not a problem of more or less exact calculation but of value commitments leading to different evaluations. There are a lot of fights between scientific rationality and massive illiteracy in technological affairs in discussions over dangereous technologies, it is true. And there is no excuse for illiteracy when somebody wants to have a say. But I want to draw the attention to something else. This is that real political content is mostly covered by this. One of the keys to identify this political content is to understand that the debate, liberated from the mentioned illiteracy in scientific knowledge layer, is between value approaches.

Discussions over these issues, both over the biotechnology and nuclear technology, show a non-appropriate type of understanding of how technology should function in society, provided the political nature of these issues in a democracy would be acknowledged. There are many calculations and scientific researches made, dealing with the safety issues, true. But most of these calculations and regulations are made without engaging into a genuinely political process. That means an enduring trial of reducing the problems of exploring and managing the effects of technologies according to reasonable models, developed without the effected people, as if this management were nothing more than a bureaucratic process only, based on scientific regulation, and not about people's fate having their say to it. (To give some evidence: one point of concerns about people's fate may be that in the existing regulations there is no full financial compensation prescribed to damages, another one is that, as damages, mainly individual and not social costs, too, are accounted for. A third problem is how to evaluate the rights of people for choosing their own living conditions, that means how to evaluate people's right to state their fear of living near technologies with catastrophic potentials. The list can be enlarged without difficulties.)

Scientific expertise may in different ways be abused for bureaucratic reasons and partial interests in risk assessments. Sometimes scientific calculation itself as it is becomes rhetoric, covering the value commitments that direct its focus, by declaring itself neutral and not taking into account all the possible alternative calculations and evaluations to be made.[20] Even there is a tendency for reducing scientific expertise to special types of sciences, not including into the arena important social sciences.[21]

All this is about expertise. But lay people, as involved ones, have a basic political right to have their opinion considered. In early trials when these types of discussions were first organized there was an expectation of making an easier consensus this way. This was the original reason to organize public discussions. This expectation partly is an extension of the instrumentalistic expectation. By now, more and more experiences show that a consensus may not be the usual outcome of the so called consensus meetings and including lay opinion may not be too effective in solving the dispute this way. The reasons can be numerous. But, none of them is enough to return to reduce the decision processes to the cooperation of state bureaucrats, industries involved and experts trusted by the state alone. Instead, these meetings should clearly show the genuine political nature of introducing hazardous technologies and should lead to genuine political means to solve the problems of these introductions.

Often there is a typical case in technological public controversies, of which both outcomes are problematic: either a decision will be made without lay participation justifying this by referring to their non-competence, a reduction of their political right in principle, or a win, over expertise, of massive lack of scientific understanding of the issues at stake. One way out of the impasse seems the inclusion of alternative expertise as a mediator. Because these issues are tense, due to a lack of trust in the state and the experts acknowledged by it, trust in the inclusion of values of the effected people into the calculations by experts may help to get to some sort of discussion arena, arguable from both sides, in which the reasons can be made clear at least. (More to this will be said at my third lecture of the summercourse.)

---

[20] At least at the third level of assessing risks, the level of evaluation, alternative values should be taken into account, just because any technological action can differently affect people and they may have different value orientations to the issue in question. But more than this, a scientist has continuously to make methodological decisions on the level of description already and these decisions can influence the understanding of the issues to advantage of some and harm of others. Just think of looking for the representative case for generalisation of issues as a very clear example.

[21] Organisational sociology was included into the evaluation of possible nuclear catastrophes first in 1979, at the investigation of the Harrisburg accident. Being obviously competent in analysis and evaluation of man – machine–system relations in complex technological systems organisational sociology had to fight out its place, nevertheless. Some hard scientists' and buroeaucrats' arrogance was to be identified in this case and was successfully overcome. The analysis of the 1979 issue initiated Ch. Perrow to his world famous book on Normal Accidents, published in 1986.

The need for regulation of technological growth through a political process including scientific expertise is today more and more accepted both by state administrations and lay people, less, of course, by industrialists. But it is worthwhile to mention some problems that may cool down any exaggerated hope in the effectivity and simple evolution of the recent or planned regulatory mechanisms even when they will be reconstructed as a genuine political process.

One problem is with the level (and time limit) of the regulatory actions. Let me refer to some facts concerning the first. The fact that the fuel for cars proved to be dangerous for health and the environment led to the reduction of damaging materials in the combustion products. It diminished the amount of dangerous materials by one car, it is true, but, because of the growing number of cars, it did not lead to the goals it expected. Another case can be the well-known story of DDT. DDT proved to be a dangerous poison to be taken out of the insecticides because of its cumulative behaviour. The legal prohibition of the utilisation of DDT led the industry, among others, to look for materials that had not been prohibited.[22] Paradoxically enough, these usually proved to be more dangerous than their predecessors. Legal regulation, based on the best wish to improve the situation, led to an undesirable result.

The problems with safety of cars led designers to enhance the safety of newer cars. As response to this development there is now a tendency to drive faster due to these achievements. All these cases suggest that the regulating mechanisms sometimes do not work on levels deep enough and on appropriate manner, leaving deeper structures of economic interests and regulating mechanisms and individual human attitudes untouched by the regulatory action. They even show something more: regulatory effects on the non-appropriate level may move society's reaction in dangerous directions, too.

The handling of the regulation of these technologies seems to be based on a consciously chosen modernist approach, further, especially in the late socialist countries, in trying to keep the distance of the expert and the rest of the population. But in contrast to this official effort, at the same time, the setting of new technologies became a deep political issue everywhere. To rely only on expert calculations would mean denying this political character in a time, let us call it post-modern, in which people begin to be more sensitive toward post-material values, like want a part in political decisions. Experts can even produce rather persuasive arguments about the very small likelihood of a catastrophic issue (this is several times not the case!) but,

[22]Another way to avoid the problems of DDT caused by the legal prohibition for utilising DDT in developed countries has been to keep their transport to third world countries.

even then they may miss something belonging to the political nature of the 'technological controversy'. This is that the solution must be trustable. It is because the whole arena misses the possibility of counter-expertise and the expression of the lay opinion. One way to seemingly avoid conflicts is to deny the political nature of the debate, as dictatorships do, which way does not seem the best one or to give full acknowledgment to the political nature of main technological debates.[23]

It is just this point, the failure to provide simple instrumental results to the problems of 'side-effects', I think, that makes a lot of recent warriors of the industrialisation project, and their careless belief in the thesis that growth means progress, rather angry. Modernism argued against romanticism by defending a purely instrumentalistic approach to technology as social tool and by a naive belief that technological growth is equal to social progress, at least as its base, requesting that any valid comparison should be made, through a possibly quantitative way, by comparing this instrumental effectivity through calculations based on expertise. By now, surrounded by a global problem of environmental deterioration, with more and more menacing time shortage for action, even earlier victorious instrumentalism proved itself self-defeating. When the dangerous effects cannot be (at least practically) dismissed anymore, as it was for a long time, when gradually any accounting for the effects of a technology must include these, opening the question 'what should be seen as the main final result, the good effects for which technology implemented or the negative effects, perhaps massively threatening already?', any simplistic reference to an extension of expert calculations necessarily raises counter opinions.

Clearly, no argumentation strategy is anymore justified by arguing the same way for any technology as it seemed during the industrialisation, the modernisation period.[24] One could object to this statement that technologies should not be seen as political questions. But they are actually for people think they are, and, as experience shows, efforts to persuade them about the truth of the opposite only raised the political content of controversies.

---

[23]Especially poor countries may provide for a third possibility like a Hungarian village where the burgomaster explained their willingness to accept a waste disposal for they urgently needed the compensation money. Notice that the issue was changing the safety issue to buying willingness for money, a well-known issue in the practical regulation in hazardous work as compensated wage. By the way, it may have been the case that the disposal should have been accepted as safe enough but the decision was made on a different ground.

[24]All this means that no practice seems to be justified anymore when it is only based on economic and technological effectivity comparisons, taken economy as evaluation of investment costs versus benefits coming from the utilisation of the technological object, notwithstanding the inclusion of the 'side-effects'.

Comparing knowledge, available to develop technology in its different historical periods, one can see how much the knowledge base changed from empirical knowledge, acquired by chance, to a science based, computer aided, modern knowledge base. We are witnessing that this enormous potential begins to be used not only to explore the means leading to the realisation of the technological purpose but also to the simultaneous exploration of possible 'side-effects'.[25] One can further see, that a wider knowledge base allows us to guess begins to show some sort of natural limits to meaningful technological action, too, and does not provide for possibility of on, in every direction progressing technological action.

It seems that all this said can be comprised into the in two, opposing, overall approaches toward the meaning of technological development in society. The two conceptualisations, to be compared systematically, are a so-called modern age type approach and, let's say, if we do not have a, with highly questionable commitments less burdened terminology, a post-modern age type, respectively.

Modernism, as I understand it, operates with an overall instrumentalistic frame, with an overall means and ends rationality (including everything in nature and society), taking everything into account as issue of utility, with the claim of continuous extensive growth of consumption, and the idea of a universalistic and total change of the nature-given preconditions of human life. The overall tendency of realizing a society, led by means and ends rationality, makes effectiveness an overall tendency and the supreme value.

This overall tendency to effectivity moves toward realizing a special type of hierarchical structure, based on elites of economy, politics, the buroeaucracy, science and technology, the specialists, and is highly demarcationistic toward the lay masses. Together with this, modernism is based on a progressing division of labour, the acknowledgement of eminence inside the demarcation (to be expert for something and being superior in this meaning in comparison to other people). Society works, according to the

[25] Technology assessment, a bureaucratically institutionalised exploration of 'side-effects' and its development from science and technology policy advisorship toward a social conflict solving activity relying on expertise will be handled with in my next presentation in detailed It is worthwhile to mention here already that some overall technological projects are planned to realise their goal in 20 up to 40 years. A needed research on possible 'side-effects' emerges, planned already to continuously accompany these types of researches. Technology assessment as early warning gets new importance and must be made continuous. Comparing engineering with pharmaceutics where a sort of 'technology assessment' was prescribed already some hundred years ago, one can wonder why this exploration of 'side-effects' could not effect on engineering thinking, until the last some ten years. An explanation may lay in the different social entrenchment of engineering in comparison to pharmaceutics.

modernist project, through the continuous exchange of expert knowledges, worked out for formalised action, above the wide lay mass. Unified with a tendency from the political power, in centralised bureaucracies this project is moving toward the realisation of a universalistic plan, a special sort of rationality and appeal to 'rational' action. One of the important features of the modernist project is the insistence on understanding technology as a universalistic, hierarchical power, conceptualising it only as nothing but tool for rational social action.

It seems that the still widely accepted modernisation thesis on the creation of conditions of production, the progressing universalisation progress of technicalisation of natural issues makes not only the presupposition that the conditions of production, in this meaning technology, can be taken under control without any principial limit. Further the thesis is also held that these conditions are reproducible or producible by human action on them without limit. These presuppositions clearly need a reestimation of their content, think of all the objections concerning nature's behaviour as an organic whole, as setting limits to human action, that mankind needs accommodation time to some basic natural parameters, that some natural conditions should be seen as unchangeable if human assets should be preserved, etc. The point is important for it attacks a thesis which would base conditions of the freedom of mankind in the capacity of mankind to control or more, to reproduce and produce natural conditions of human life in an unceasingly advancing historical process. All this criticism is valid even when it would be meaningful to control and reproduce old and produce new conditions in nature for the mankind without any limit.

A post-modern perspective for human life makes an emphasis on quality of life and post-material values, like preserving nature, instead of economic and technological growth. It tries to give to consumption a different meaning from modernisation ideologies. Individual creativity is emphasized against standardisation of consumption. It does not accept a hierarchical structure for social life, based on the eminence of some, but requires democracy and participation. Instead of accepting a strong order as a necessary consequence to utilising the main tools of modernism (like market economy, technological growth and science, among other elements), it tries to emphasise a much more 'playful' life as meaningful, exemplified in political decentering and in an everyday life, resisting the disciplining force of steady growth of effectivity.

In my opinion the post-modernist perspective is a direct refusal of the modernist value system. In this quality of direct denial its cognitive technique is just reversing any sign in the opposed system. This can be helpful for concentrating on the needed changes as a mainly artistic visualisation, through contrasting old and new value systems but it is not immediately translatable into a new rationality of action. The reason for this is that any continuity is missing from it, by the definition of its purpose and cognitive technique. By that I mean that there is no coherent leading idea at present, upon which a new understanding of life, including a philosophy of technology can be based.

The perspective of technological development which is currently gaining ground is an eclectic mixture of modernism and post-modernism, including some elements of post-modern requirements, taking into account of some post-material values. This perspective may be the consequence of 'negotiation', primarily realised on the market in form of changing consumption habits, but it seems that it continuously needs a political power to make new requirements obvious and forceful.