The Technological Change of Reality
Opportunities and Dangers*

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Abstract

This essay discusses the trade–off between the opportunities and the dangers involved in technological change mainly from the perspective of Artificial Intelligence technology. In order to lay the foundation for the discussion, the symptoms of general unease which are associated with current technological progress, the concept of reality, and the field of Artificial Intelligence are very briefly discussed. In the main body of the essay, the dangers are contrasted with the potential benefits of such high technology. Besides discussing more well–known negative and positive aspects we elaborate on the disadvantages of executive systems and the advantages of legislative systems. It is argued that only the latter might enable the re–establishment of the feedback–mechanism which proved so successful in earlier phases of evolution.

1 Introduction

The natural sciences have radically changed man's conception of the world in the course of a few centuries. They have brought forth a methodology with which it is possible for man to deliberately alter the natural course of events. This ability has, amongst other things, led to today's technology and its products.

Technological products have indeed, always and ever, evoked a conflicting response in the human being, admiration or gaping astonishment at the intellectual achievement on the one hand, critical consideration or a sneaking uneasiness of the unknown on the other. In our day, however, the extent of the changes which have been triggered by technology, has undergone an unforeseen increase — and the chorus of unease appears to be rising.

*The original German version of this essay will appear in [9]

Is it only the wealth of changes which gives us cause for concern, or has a new and alarming quality entered in? Do we require increasingly more complex technological systems in an increasingly more complex world, or are these systems just sawing at the branch of what is our basis of existence? Does technology contribute to a real improvement in the quality of human life, or has a degree of saturation been reached from which any further mechanization would most likely lead to an impoverishment in our lives?

Conclusive answers to these questions cannot be given in this essay. The theme is too extensive for anyone to be in the position to do so. On the other hand, these questions are of such outstanding importance, possibly even for the continued existence of our civilization, that each serious attempt in spite of its inaccessibility should at least be respected.

The attempt undertaken here consists of an analysis from the viewpoint of a scientist in *Intellectics*. In the author's understanding [1] this area covers both Artificial Intelligence and Cognitive Science, two new related fields which have come into being in the last few decades. After a short description of some of the symptoms (Section 2), which articulate the growing unease, I shall attempt to tackle the term "reality" (Section 3). The description of Intellectics itself must be restricted to a few descriptive paragraphs and to bibliographical references (Section 4).

The information technologies resulting from Intellectics are key technologies which have enormous future potential. For this reason, they are particularly suited in demonstrating both the dangers (Section 5) and the opportunities as well (Section 6), which are inherent in such high technology. For example, we shall discuss in detail the phenomenon of *executive sclerosis* which seems to be inherent in any (social and computer) system with a structure based on the idea of distributed and specialized task execution (as in administration). In comparison with these, *legislative* systems offer a considerably higher flexibility, which could achieve greater perfection through information technology. Over and above such explanations, we shall venture some answers to the above questions.

2 The Symptoms

In the Introduction we spoke of the uneasiness that is brought about in connection with technology. This section attempts to describe this uneasiness a little more precisely. It expresses itself in a series of symptoms which, in order to understand them all, it suffices to mention just a few.

A growing environmental awareness can be ascertained everywhere. The

change in the natural course of events, which was spoken about at the onset, has accumulated to such an extent, that global changes are, as a result, clearly detectable today. No one knows for sure if the results of these changes will pose a threat to our existence. We only know that fears of such a threat can no longer be denied.

The "ozone hole" over the Arctic will do as an example. We know,

- that the widespread use of certain technologically produced chemicals leads to their accumulation in the atmosphere,
- that these chemicals destroy ozone,
- that an ozone layer in the atmosphere surrounds the earth,
- that this layer absorbs rays, and finally,
- that these rays are damaging to health.

From these simplified facts, which have been known for years, it follows that the use of these chemicals is damaging to health, because through the elimination of the ozone layer, the filter which blocks these rays is also destroyed. The only uncertainty really is how large the extent of the brewing development will be. This remnant of uncertainty is enough, it seems, to cause many governments to justify the further use of such chemicals. That is the reason why even the knowledge of an actual ozone hole arising has at this point led only to inadequate actions.

It is a mistake to lay the blame for such developments on individual people, or on professional groups, by which I certainly do not mean to acquit anyone from the responsibility. The inability to act in a more adequate way lies rather in the nature of man, in combination with the mechanisms of the established social systems. These systems are complex and rigid at the same time, so that any non–trivial local change proves itself to be extraordinarily difficult.

The problem described here is only one of a whole range of environmental and other problems, which have been produced by technological changes. The keywords forest destruction, Chernobyl, contamination of rivers, ocean pollution, destruction of the primeval forest, genetic engineering, antibiotics in animal food may be seen as representative for all further problems. No wonder that man is simply getting afraid of the results of a technology he is unable to take responsibility for, and a technology which is obviously no longer fully controlled by him.

Indeed the anonymous nature of this responsibility plays quite a crucial role in this sort of problem. Should the responsible person be identified, remedial

action could easily be taken. Since identification is not possible, in the case of extreme fear, the only way out might even be in a senseless terrorist act.

The suspicion is growing more and more, that the problem might have its cause in a fundamental mistake inherent in the systems involved. Auschwitz comes to mind, in this context, as an extreme example. In some countries, Germany among them, concepts such as national census, identity cards which are computerized, and the reaction of people to these, are here representative of the many manifestations of the unease connected with the mistrust in regard to the systems. Of course, the mutual threat among the systems themselves, with the latent danger of worldwide destruction, in view of the gigantic arms potential, may not remain unmentioned in this connection.

On a small scale also, the symptoms are easily recognisable. Statistics and public opinion polls indicate, that people in the industrial nations pay a high, if difficult to assess, price for their prosperity: loneliness is the predominant characteristic of modern man. The inability for spontaneous and intensive human encounter, which no longer takes place in the family or in professional roles, as well as the art of conversation, whereby people can truly express their inner problems, are lacking, and despite alleged sexual liberation, the ability of intensive, erotic play is also absent. All of this appears in no way to be founded in man's being; it is rather a result of an obligation to conform to the system. The only way out often remains in drugs, which provide an escape into another reality.

This short list of the symptoms of unease reveals at the same time a change, namely a loss of reality. On the other hand, new realities are created technologically. Which of these realities are suitable for man and nature?

3 The Concept of Reality

Reality has no uniform and clear–cut meaning. Because of this, it will be helpful to describe in brief the author's understanding of this concept. Any such interpretation is based on the individual's general conception of the world. Therefore, my own conception will be described briefly in the following, serving as a type of working hypothesis. In the necessarily abbreviated form this conception will get a stronger mechanistic touch which is not quite to my liking.

Man can be explained, in a first approximation, as a closed whole which reacts to external influences. These influences consist of diverse physical phenomenon (light, sound, temperature, and so forth). These are processed as information, and from one case to the next have various human activities as a result. Examples of such functional dependencies are familiar to all of us.

One only has to think of such simple things as the ringing of the telephone in one's home, or the reactions to hunger signals. In the individual case, however, we know very little about any details of these inter–relations. Let us assume, that in spite of our ignorance of the details, the functional inter–relation is determined by the information being put in on the one hand, and by our own information–processing mechanism on the other.

The processing mechanism has developed in its ground structure through evolution. As a "biological determinant" it is in existence at birth (a priori). It contains in itself, however, the ability for modification (a posteriori) depending on the information being processed, particularly in the first years of life. A part of the modification refers to the further construction of the individual's model of the world (in the terminology of Artificial Intelligence one would speak of the *knowledge–base*) which again considerably influences the processing mechanism itself.

Reality is a concept with two different aspects, an individual idea and an objective idea. For the individual, reality is virtually the sum of the modifications experienced in the original existing mechanism. Then reality for us is what our brain makes of outside influences or rather what it has made of them up till now. Reality consists in this sense, however, not in these influences themselves, or in something outside of the individual consciousness. In spite of this *individual* nature of reality we allow ourselves (with success) to be led by the idea of an *objective* reality, which exists independently of our individual world experiences (these, however, being incorporated as a part of this objective reality). In passing, let it be remarked that the body of the person in this idea of reality in part plays an inner and outer role at the same time.

Let us see what the technological changes of reality, under such an interpretation of the term, mean to us. Among the more obvious consequences are the difficulties experienced by elderly people in getting along with a rapidly changing world as their adapted model of the world fails to match the current status of reality. A more fundamental problem may be caused by a change in reality in the following way.

To do the processing, every mechanism is suited to quite a specific type of input. Thus the addition of water to the fuel of a car will quickly lead to the engine being ruined. With all its ability for change, the human mechanism is subject to the limits which adaptation sets. If one were to bring up a child in a silent space for example, considerable behavioural disturbances would certainly be the result. In millions of years the human mechanism has adapted itself to receive a range of information — in this example sounds. They belong to our *own* objective reality. Their absence has the result that a corresponding moulding of our mechanism simply does not take place. With this, individual

reality which was hitherto our own becomes stunted. Such a loss seems to go along with disturbances in human behaviour. As in complex, subtly balanced structures of the eco–systems, such disturbances seem to cause chain reactions of further disturbances.

Examples of this from the physical sector are in abundance and well–known in medicine and may appear in the field of collective experience in the same way, even if they are not readily accessible to scientific analysis. Thus for example a direct experience from nature could be quite a deciding factor, which the mechanism inherent in us "expects" in order to unfold in a healthy way in childhood. Perhaps a series of human behavioural disturbances (with individual or global effects) can be explained, at least in part, by the fact that many people no longer hardly experience nature in the raw, or in other words that we have distanced ourselves from the nature from which and in which we live. In this context we think of the substitute experience of children before the television, the physical experience lacking in a climatized man–made world, particularly in the big city, but also of the already mentioned worldwide environmental changes as obvious examples.

Less conspicuous are the encompassing changes which are produced through the determining influence of today's Information Technology. Nobody can foresee at present what effect these changes could have for people. Before we discuss such possible effects, we want to briefly consider a subfield of this whole area, namely Artificial Intelligence, in order to give an idea at least of what is being spoken about here.

4 The Technology of Artificial Intelligence

Intellectics concerns itself with one of the fundamental questions of mankind, which can be rendered in short with "What is the intellect?" This question can be investigated from a more humanities oriented perspective, as occurs in Cognitive Science [7]. Since computers have existed, it is, however, also possible to gain knowledge about the intellect through experiments with these "thinking machines". The latter characterizes the path which has been followed in the area of Artificial Intelligence. Both of these directions complement each other in a symbiotic way from which the justification for the recently invented [1] term Intellectics for the whole area is derived.

A part of the intellect's faculty is, for example, human vision. How do we see? If we were to succeed in building robots, animated by images (received over television cameras), which would react to these in the same way as people would, it could then be said, in the first approximation, that these robots make

a mechanical form of seeing, a reality. The thesis could be further proposed, that the "seeing technology" used in these machines simulates human seeing technology up to a certain point. With the construction of such robots we would, therefore, also succeed at the same time in gaining an understanding into human sight in the aforementioned sense.

Precisely this methodology for gaining knowledge is utilized in Artificial Intelligence. Thereby, not only knowledge, but also new technological products result:

- Robots which "see" certain areas of the environment (for instance the area of an assembly line), correctly interpret these, and carry out corresponding manipulations, for example, with grippers.

- Systems which understand the continuously spoken natural language (up to now only with many limitations) and give synthetically produced answers, like those also expected from humans.

- Knowledge–based computer systems in which the specialized knowledge of a certain area of knowledge is stored in such a way, that not only the knowledge is readily retrievable, but logical conclusions can be drawn from it also. In cooperation with problem–solving mechanisms, such "expert" systems are being put into operation, for example in medical diagnosis and therapeutics. They are also being used in the configuration of complex computer systems, as mathematical "slaves" in scientific research, in the classroom as active support in the conveying of information and in the near future in almost every conceivable area of knowledge in the most diverse ways.

It would lead us too far away from the actual theme were we to attempt to give even a fleeting survey of what in the meantime has become an extremely extensive area. We will restrict ourselves, therefore, to this short description and we shall come to speak of further important aspects in the two following sections. At this point nothing but the following bibliographical references are given.

Numerous articles on Artificial Intelligence have appeared in the media, at least one in virtually every newspaper and magazine. The more professional ones can be found in the *AI magazine*. There are any number of textbooks on Artificial Intelligence, ranging from less formal ones, such as [2], to the more formal ones, such as [3,6]. A book with a particular emphasis on social issues of the field is [8]. In all of these texts comprehensive bibliographies are found, so that with these few references no limits need be set to those hungry for knowledge.

5 Dangers of Information Technology

The technologies of information processing and communication have brought a completely new dimension of reality (from now on exclusively in the objective sense) for us humans. In this respect our reality has expanded. To resume the question raised at the end of Section 3 — what effects might these changes have? Doesn't, on the other hand, a loss of reality in other areas go along with this expansion, as indicated in Section 2, and if yes, how does the overall balance look with regard to the person's quality of life? In this section we want to concern ourselves first of all with the potential loss of reality.

In the *Economist* dated July 2, 1987, the then departing editor pointed out that the world of the 80's finds itself in a type of state–of–war, which consists in a technological race. This development was triggered off in 1981 by the Japanese with their Fifth Generation Computer Systems Program. This and other billion–dollar programs such as SDI, ESPRIT, EUREKA, Alvey, and many others have, if one looks closely, the goal of attaining supremacy over others in technological ways, or rather in preventing the others from gaining this. What such a technological supremacy could result in would require a more precise analysis than is appropriate for this essay.

Many of these programs such as SDI, for example, are not only in this indirect sense but also in quite a direct manner of a military nature. J. Weizenbaum stated in *Computer Magazin 1/2, 1987*: "More than half of all the natural scientists and engineers in the world work more or less directly for military institutions or for institutions which are supported by the military". At the same time, it must be made clear that the boundaries are very fluid, military research can also be of use in civilian application and vice–versa.

Now I consider institutions which serve to safeguard our common good not inappropriate, given the current state of affairs, and I class the military as belonging precisely to such institutions. The insanity in the present development lies rather, in my opinion, in the predominance on the one hand, that is attributed to the need for security above a whole range of other threatening world problems (environmental problems for example), and on the other hand in the mindless escalation of the destruction potential. Both aspects are not being changed in principle through work in the field of Information Technology. Rather it is the quality of the military systems which can possibly be elevated to a new level by Information Technology, and that in an ambiguous way.

Thus an alarming aspect is the increasing degree of automatic decision making with a world–wide danger potential. The exchange of nuclear blows as a result of an error in the software or hardware is an increasingly serious threat. Reliance on such automatic decision making that inevitably contains this pos-

sibility is not compatible with my ethical views. This type of thing should be entirely ruled out; even the slightest remnant of risk is not justifiable. This objective is, however, not attainable through an centralized research control, or through technological development, but only on a world political level, even though individual actions could set important precedents.

There are also positive aspects, however, of the impact Information Technology has on military systems. If only the Hitlerbunker had been wiped out much sooner in World War II with weapons of such precision (made possible through Information Technology). One should perhaps not entirely ignore this particular aspect of SDI (as high–precision anti–missile defence protection) even if there is room for considerable doubt about its feasibility and the intentions of its designers.

The second big block in the negative part of the balance of Information Technology consists in the immense upheavals in the current use of the human workforce, and by and large of a substantial decrease in existing work deemed necessary by society. In contrast to the first industrial revolution, it is now also a matter in the *second* industrial revolution (as one often describes the current changes) of the loss of that work, which appears to be thoroughly enjoyed by the people and which in no way impairs them healthwise.

First of all, it must be established as an inarguable fact, that information technology through accelerated automatization will possibly make a massive amount of previous work unnecessary. Two and a half million unemployed in a prosperous country such as Germany with a work week of less than forty working hours, numerous holidays, and a thriving economy should make this clear to the most unreasonable. Moreover, technological development forces those employed to constantly adapt themselves to new conditions. Due to the enormous speed of these changes, which people are simply not up to, the understandable opposition of those on the receiving end could not fail to materialize.

Without wishing to gloss over this problem in any way, I still see positive aspects, worthy of consideration, which possibly have concealed in them the seed to an acceptable solution. So, in the industrial nations there are first of all two moderating developments, namely population demographics, i.e. the increase in the percentage of old people, and the growing demands on quality. Over and above that, the question may by all means be asked whether with fairly allocated, but markedly less work we couldn't all be just as happy if not even happier. M. Boden likes to speak in this context about the vision of a "Tahiti–society" in which human deficiencies, referred to in Section 2 would be noticeably diminished. Finally, we could simply liberate ourselves so far from the force of the machines, that we would perform a lot on our own, although the machines could carry out the same work cheaper (in the debatable terms

of current accounting) and better. Knitting is a good and widely practised example of this today. The reader may like to pick out similar examples for himself for his own life (and the community should reward such behaviour).

A dangerous, and in contrast to both the aforementioned, little noted problem is that with each software and hardware development, specified knowledge will be preserved in a fixed way. So the systems criticized already in Section 2 because of their rigidity become still more rigid. An increase of the unease would be the inevitable outcome.

Let us think of spelling in order to give a comprehensible example. Up to now this was always fluid, even though increasingly less since the technique of printing was invented. Now more and more text processing systems are used which are in the position to check the spelling in each text and if need be to correct it. It is obvious that with the further spread of such a system any further organic development of spelling must be brought to a standstill, for also in the intellectual field, mutations emerge and take over when they are met with approval. Accidental changes of this type are, however, incompatible with the conception of such systems.

The effect is still more distinctive with systems which are essentially more complex than text–processing systems. One can imagine such a system as a far–reaching network whose nodes perform certain basic operations. Whenever a dossier, that is a package of information, enters into the node the prescribed basic operations are carried out there, and the resulting information package is forwarded to the relevant node. One can by all means imagine as a node, a government official who is responsible for a certain specialist area. In computer systems such a network can definitely show thousands upon thousands of such nodes.

To change such a system is extraordinarily complicated, since it touches possibly upon many thousands of nodes, all of which, as a result, must receive new instructions. If only because of this, the inclination to change such systems is small. If one dares to, nevertheless, it would result in mistakes not only in the conception of such changes, but also in their performance. As a result the systems work inadequately for a while until the mistakes are discovered with time and the old stable condition is adapted to again.

Everything that is said here applies for computer systems, for administrative systems, yes, in the same way for the social system as a whole. The poor flexibility of such systems, established in Section 2, is due to this functionally complex interconnection of the nodes. This makes every change much more difficult, in particular because as a rule it results in an undesirable, often even a dangerously unstable phase which one attempts to avoid wherever possible. This defect appears to be inherent in systems that implement conditioned sequences

of instructions and in this sense they possess an *executive* (or functional) structure. It is therefore worthwhile for this deficiency, to introduce a term which I want to denote with *executive sclerosis*.

In the combination of administrative systems with computer systems the effect, which this executive sclerosis has, is even more drastic. Even in the simpliest case, new instructions must not only be given to the specialist, but also the computer system operated by him must be reprogrammed. Whoever has some experience with conventional software systems knows that such a reprogramming adjustment as a rule almost costs the earth. On top of that there is the retraining of the specialist. To sum up, practically insurmountable problems ensue. A complex interconnected system with conventional software will, therefore, forfeit the last trace of flexibility. And yet again, there is also a glimmer of hope which we will take up again more closely in the next section.

Apart from these three big blocks in the negative balance, there are still a series of further serious negative items which we can't discuss further here. They extend from immediate health considerations (radiation damage through computer monitors, damaged posture, who knows, perhaps brain damage through the introduction of optical computers soon, and so on) to the dangers of the personality being stunted through the constant contact with these machines, which indeed are still so stupid (the stereotype of the "hackers" which has however like the bookworm quite endearing characteristics also), through to the tremendous problems of the protection of the individual against infringements of his/her rights through storage of computerized data. Let us now turn to the lighter sides of technology, however.

6 Opportunities of Information Technology

Human life without technology is unimaginable. Every technology can be used both to the benefit and to the detriment of mankind and nature. Even with the most primitive technology of the unhewn stone, Cain was able to strike Abel dead. But with the same technology the ploughing of fields for instance was also made easier for the good of mankind. Technology in itself is not good or bad.

Research in as far as it creates new knowledge is also neither good nor bad. It can, mind you, become susceptible to ethical assessment, if it leads directly to threats or encumbrances (as with bacterial cultures, gene manipulation, animal experiments, major research plants, etc.) which is not discernible for research in Information Technology (but see [8]). In regard to this one has even spoken of the "greening of technology" not entirely unjustly as we will comment on in

this section.

Undisputedly, however, the *application* of knowledge and the *implementation* of the technology is subject to ethical laws. I would go still further, however, and require from a researcher or technician (yes from each employed person) an ethical objective for his actions. In this sense, we now want to ask, to what extent Information Technology in general and Artificial Intelligence in particular offer also opportunities, and how they could serve a useful purpose.

Everything indicates that man with his biological determinants, developed through evolution (the human information–processing mechanism of Section 3) is no longer equal to the global problems of our shrinking world. While these problems need solutions that take into account the complex network interrelationships in reality, man tends to simplify things in inappropriate linear cause-effect chains [4]. Further, whether we are dealing with Joe Soap or the President of the United States, when all is said and done, each person thinks about himself first, and in the second place about his next–of–kin, therefore, in an indirect way, about himself again. In other words, man acts as a locally oriented being. As long as his actions have demonstrated only local effects, his instincts have turned out to be to his advantage only. Since every misconduct more or less directly rebounds, each one would do well to behave himself as uprightly as possible.

The effects of man's activities have become increasingly global through mechanization, and an immediate feedback of the effects on those involved hardly ever takes place anymore. This provides everyone with a carte blanche to gain for himself what is considered to be locally best, even if considered on a global level it should prove to be conceivably disadvantageous. Such objective misconduct could be prevented, for one, through the elimination of the biological determinants which the biologist Hans Mohr [5] speaks of, for example. All of them? Then we would no longer be people. A part of them? Then which part and how? These are questions to which I cannot see any convincing answers.

The other possible way, which entails the establishment again of the direct feedback of the effects of such actions on those who partake, seems to be more practical. We have succeeded to a restricted extent in getting such a feedback through law and order. But it is not sufficient on a small scale anymore, because the individual can no longer cope with the abundance of regulations by which the feedback loses its effect. Here it is about dealing with a purely information–technological problem which could be attempted to be solved with technological means. The solution would entail that a system based on the existing law would draw the attention of those involved to the respective negative aspects of their actions, when required, with insistent explanations.

This alone, however, is not sufficient, since worldwide law and order does

not exist in any case. Such a previously necessary agreement on worldwide objectives which again must be based on a type of global ethics could then perhaps succeed relatively easily, if its use could be made apparent for each single individual in his own situation. The establishment of such a connection between a global law and its effect on individuals deals with a type of problem that is being investigated in a comparable form but with incomparably less complexity in Artificial Intelligence. One must, therefore, "only" transform this technology, feasible in toy worlds, to this global and real world problem, a task whose dimensions cannot be grasped at present.

In other words, I am here pleading for the attempt to expand the local feedback mechanism which up to now has been so successful, with the aid of Information Technology on a worldwide scale. At any rate, I am convinced that such a worldwide law and order would sooner be reached and carried out by machine than were it to lie in the hands of people alone who in turn would pursue their own interests again, and because of that it would enjoy little credibility. At the same time, I consider this in the sense of the above mentioned *direct* feedback to be a matter of legal jurisdiction which *accompanies* the decision — not one that is passed later.

As stated, this idea, given the present state of technology, is still more or less illusion. But I do not regard this objective as being so unattainable that it could not be achieved, at least to a certain useful degree in the foreseeable future. In view of the problems described in our world possibly nothing else remains, but for us to steer toward such a goal with all our might.

We talk in our field of the types of systems taken her into consideration as of *evolutionary* systems. Their characteristic feature is that they lend themselves to modification, relatively easily. This flexibility is achieved through a normative (instead of executive) oriented structure. Instead of setting the modes of behaviour in the individual nodes (recall the information processing modell from the previous section) with instructions on how to perform, the systems are fed on the one hand with norms or laws, on the other hand with the properties and the abilities of the nodes in a descriptive, quasi legislative way. A modification consists then here only of the exchange of the appropriate law or of the property description.

The functioning of such a system is carried out over an interpretation mechanism, whose method of functioning is comparable to that of a good jurist (for instance in the business management of a firm) who understands how to bring the rigid legal regulations, entrepreneurial potential and targets into accord, so that concrete actions will be derived out of this. Obviously such *legislative* systems offer an attractive alternative to the executive systems tending towards executive sclerosis which we spoke of in the last section.

A progressive Information Technology could contribute in this way in guiding the worldwide misconduct of man back into evolutionary well–ordered paths again. In addition it could make our human social systems more flexible again in spite of their increasing complexity.

Technological development itself can, with the support of Information Technology, lead to noticeably better results. Abstract technological areas are not the human's greatest strength. Already today there are (quite narrow) areas in which expert systems are superior to human experts. It is the lack in intellectual quality which brings people to protest on the streets against technology. In demand is simply more intelligent (or let's call it, to use a different familiar term, *soft*) technology which in the solving of one problem does not create a hundred new problems, but rather offers a solution which takes into consideration, to the greatest possible extent, all of the necessary requirements. On account of the complexity of this venture, only Information Technology can also help us here in making this fulfilment possible.

What we have described in more detail concerning global society and technology is valid of course in the same way for other areas, in particular for minor ones. For instance, if we could achieve some sort of a global law as described above, then certainly also a balanced system of social order in a particular nation. Also, the perspective of an improvement of technology, in general, could in particular lead us to a better energy technology, a more human medical technology, agrarian technology which would spare the environment, and so on. Of course, all of this creates new realities. None of these must necessarily, however, demonstrate the negative effects, a few of which we discussed in the last section.

In Section 4 we spoke of knowledge–based systems for practically all conceivable specialist areas. It is completely appropriate to evaluate such computer systems as a new quality of the former book form. While the book presents knowledge only in a passive way, such a system can, of course, also fulfill this function (if one for once disregards the smell and the feel of the touch) but over and above, such a system can play active roles such as:

- To allow the presentation at any time of a point–of–view or part thereof, which may be freely chosen;
- To point out possible conclusions from the knowledge presented;
- As an unendingly patient teacher to impart the knowledge, well prepared in small portions, and to check again and again the progress in how those learning absorb the knowledge.

Despite such indisputable advantages: Long live the conventional book (also).

In general, I will not speak the word here of a euphoria of progress. But apart from the simple fact that nothing would go on at all without technology, it is not to be doubted that Information Technology just shows quite positive perspectives. Responsible political engagement in the most general sense must bring us to avoid the very big dangers which could accompany such a development.

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