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Converging Technologies for human enhancement – a new wave increasing the contingency of the *conditio humana*

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Abstract

In scientific and technical advance, Converging Technologies for Human Enhancement (CT) are at present the field meeting with the highest degree of scientific and public attention. In this contribution, I will interpret the scientific promises and the societal debate on CT against the background of the well-known ambiguities of scientific progress between emancipation and uncertainty. CT show an emancipatory aspect, in that new opportunities for action are opened to humanity – for example, the technical improvement or remodelling of the human body and mind. But with them, former certitudes are, at the same time, called into question, which disconcerts many people. This situation can be interpreted as further increase of contingency in the condition humana. It shows itself in the visionary aspects of the debates, which oscillate between expectations of salvation and catastrophism.

1 Increasing contingency through scientific progress

Scientific and technical progress leads to an increase of the options for human action, and has therefore at first sight an *emancipatory function*: an augmentation of the possibilities for acting and deciding, and a diminution of the conditions which have to be endured as unalterable takes place. Whatever had been inaccessible to human intervention, whatever had to be accepted as non-influenceable nature or as fate becomes an object of technical manipulation or shaping. This is an increase of contingency in the *conditio humana*, a broadening of the choices possible among various options.

Emancipation from nature, from the traditions of the past, and from fate shows, however, another side of the coin: uncertainty, loss of orientation, and the necessity to be able to cope with the new freedoms by responsible decisions. The opportunity of *being able* to choose from a number of options transforms itself into a compulsion to *have* to make a choice. With humanity's increasing empowerment for action, humanity's responsibility also increases: developments which go out of control are increasingly being attributed to human decisions instead of to nature or to fate; dangers become risks (cf. Beck 1986). Scientific and technical progress, by increasing the contingency of the *conditio humana*, manifests, generally speaking, a dialectical ambivalence between emancipation and uncertainty (cf. Lübbe 1997).

In scientific and technical progress, Converging Technologies (CT) are at present the field meeting with the highest degree of scientific and public attention (cf. Roco/Bainbridge 2002). In the societal discussion on this subject, it isn't solely a matter of the future of a certain line of technology, or of the consequences for society resulting from it, but also of such "broader questions" as the future of human nature, the future of the relationship between humanity and technology, or of the sustainability of humankind's civilisation.

In this contribution, I will interpret the scientific promises and the societal debate on CT against the background of the abovementioned ambiguities of scientific progress between emancipation and uncertainty. CT have an emancipatory aspect, in that new opportunities for action are opened to humanity – for example, the technical improvement or remodelling of the human body and mind. But with them, former certitudes are, at the same time, called into question, which disconcerts many people (chapter 2). The further increase of contingency in the *condition humana* shows itself in the visionary aspects of the debates, which oscillate between expectations of salvation and catastrophism (chapter 3).

Futuristic visions (cf. Grunwald 2004) and far-sighted communication of the future are not only an expression of this increase in contingency, but also an attempt to find new orientation in this situation. They are, at the same time, the expression of a diagnosis and an attempt at a therapy. At the instant when societal traditions and the orientation on the given, such as the anatomy of the natural human body, no longer suffice as orientation, orientation is sought by means of

drafts of a future and visions. The boom of visions of the future and of scientific contributions reflecting on them (cf. for example Brown et al. 2000; Grunwald 2004, 2006; Dupuy 2005; Dupuy/Grinbaum 2004; Nordmann 2003, 2005; Selin 2006, 2007) can be explained as a reaction to the potential dramatic increase in contingency of the human condition made apparent by CT.

This situation also requires new analytical and reflective means of dealing with the corresponding communications media, for instance, in order to disclose the cognitive and normative content of futuristic visions (chapter 4). Technology assessment and other, related forms of reflection on scientific and technical innovations are acquiring new assignments in view of a human condition altered by CT.

2 Human enhancement in the dialectics of emancipation and loss of orientation

Human enhancement is a very old theme. Mankind's dissatisfaction with itself is known from ancient times – discontent with mankind's physical endowments, its physical and intellectual capabilities, with its vulnerability to exogenic eventualities such as disease, with the inevitability of aging and, finally, of death, dissatisfaction with its moral capacities, or – and this will probably be particularly frequent – with one's physical appearance.

This dissatisfaction expresses itself on the one hand in fairy tales and legends, like, for example, the story of the Fountain of Youth, reports of miraculous betterments, resp., trying to bring them about, or of phantasies of omnipotence. On the other hand, various methods have been developed and established in order to give certain wishes for improvement a helping hand. Today's aesthetic surgery, as a branch of the economy with considerable and further growing returns, is the at present probably most widespread method of human enhancement. But extending the physical limits of human capabilities through intensive training in competitive sport can also be understood to be enhancement. Making use of *technical means* for improving performance in sport (doping), on the other hand, is still held to be unsportsmanlike.

If the types of enhancement just listed apply to individuals (high athletic performance, individual beauty), *collective* human enhancement is, in its turn, also no new topic. Mankind's often deplored defects in terms of morals or civilization led, e. g., in the – with regard to morality as well – progress-optimistic European Enlightenment to approaches towards trying to improve man *as a whole* through purposeful education – i. e., in the final analysis, to improve the human and societal condition. Beginning with the individual, above all, in school education, far-reaching processes towards the advancement of human civilization were to be stimulated and supported.

2.1 Converging Technologies for improving human performance

In the current discussion of human enhancement, it is not a question of an improvement through education and culture, but of *technical* improvement. Initiated by new scientific visions and utopias which are under discussion, completely new possibilities of human development have been proposed (cf. Roco/Bainbridge 2002). Among these are the

- *extension of human sensory faculties*: the capabilities of the human eye can be augmented, for example, with respect to visual acuity ("Eagle Eye"), or with regard to a night vision capability by broadening the electromagnetic spectrum visible in the direction of infrared; other sensory organs, such as the ear, could likewise be improved, or completely new sensory capabilities, such as, for instance, the radar sense of bats, could be made accessible to human beings.
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- *expanding memory through technical aids*: it would be conceivable, by means of a chip which could be directly connected to the optic nerve, to record all of the visual impressions perceived in real time and to store them externally. In this manner, all of the visual impressions which accumulate in the course of a lifetime could be recalled at any time. In view of our forgetfulness, this could be an attractive idea for many people.
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- *retardation of aging*: according to our present knowledge, aging can, roughly speaking, be interpreted as a form of degradation on the cellular level. If it could succeed to discover and to repair immediately all forms of such degradation, aging could be greatly delayed or even abolished.

These examples indicate the direction of the New Thinking: it is a matter of broadening human capabilities in comparison with those we traditionally ascribe to a healthy human being. It is obvious that an entire series of ethical or anthropological questions are associated with these visionary expectations (or even just possibilities), which increase the contingency of the *conditio humana*. These questions pertain to the moral *permissibility* or *forbiddenness* of enhancement, to a possible *duty* to enhancement (if such a duty were possible), to the consequences of enhancement with regard to distributive justice – who can afford to have himself enhanced? –, to the *consequences* for our *concept of mankind* and for the *society of the future*, to the question of the possible limits of technical enhancement, and of the criteria for drawing such a boundary line.

The recent discussion of human enhancement was initiated by the report of an American research group to the National Science Foundation (NSF), which has considerable influence on the agenda for the sciences (cf. Roco/Bainbridge 2002). The title of this report conveys its program: "Converging Technologies for Improving Human Performance". Nanotechnology and the Converging Technologies offer, according to this report, far-reaching perspectives for perceiving even the human body and mind as formable, to improve them through precisely targeted technical measures, and, in this manner, also to increase their societal performance. A special, practically as well as ethically particularly interesting sub-area, is bridging the gap between technology and the human nervous system. An interesting field of development are nanoelectronic neuroimplants (neurobionics), which compensate damage to sensory organs or to the nervous system, resp., improve the capabilities of these organs, and broaden the spectrum of human perception. If these lines of development are extrapolated into the realm of speculation, the increasing technicization of human beings, the convergence of human beings and technology, the conceivability (in the sense of a pure thought possibility) of "cyborgs" as technically enhanced humans or as humanly enhanced technology could be problematized (according to Paschen 2004). Visions of this sort pose the question, to which extent technically, resp., partly technically, partly biologically constructed man-machine hybrids could also lay claim to the status of a person.

Even crossing the borderline between technology and living systems, as nanobiotechnology does (cf. VDI 2002) is already an increase of contingency, because, in the cases in which this border-crossing succeeds, the border no longer has to be accepted as naturally given. In the consequence of our emancipation from previously impassable limits, the questions also pose themselves: what do we want to do with the new options, and where do we set limits?

2.2 Emancipation from nature and loss of orientation

Legitimate interventions into the human body and mind are at present carried out with the aims of healing or preventing disease or deficiencies. *Improving* human beings has, as yet, not been the primary aim of medicine. On the other hand, the borderline between healing and enhancing interventions can hardly be drawn unambiguously (cf. Habermas 2001). In particular, the terms "health" and "illness" are not clarified (cf. Gethmann 2004). Conceptually, and according to its common understanding, the enhancement of human beings is not the same as healing disorders. Healing orients itself of necessity conceptually on a condition of health held to be ideal. This can either be explicitly defined or merely implicitly understood – in both cases, healing means closing the gap between the actual condition and the assumed ideal condition.

What is to be understood under the ideal condition has certainly been defined culturally in different manners in the course of history. In each individual case, however, this is, at least in context, obvious enough. The ophthalmologist who subjects his patient to an eye-test has a conception of what the human eye should be able to do. He will propose technical improvements of the current state (e. g., a pair of glasses) only for deviations from this conception, and only from a certain degree of deviation on. The purpose of such measures is restoring the normal state, which may more or less well succeed. Traditional medical practice is

probably unimaginable without the manner of thinking that a normal or ideal state serves in the background as a normative criterion for defining deviation. Medical treatment doesn't extend beyond this normal or ideal state. Just this – for medical practice, essential – way of thinking would, in view of the possible technical improvement of human beings, probably become meaningless. This poses the question, how far humans *may, should, want* to go in the (re-)construction of the human body with the aim of improving it. And precisely at this point, it turns out that increasing mankind's possibilities for action and its emancipation from the given-ness of its physical and intellectual constitution also bring about uncertainty and a loss of orientation.

In the approach to the actual ethical debates on what is permitted, we first have to draw our attention to the fact that the spontaneous rejection with which the concept of the technical improvement of mankind is often confronted is, in itself, no ethical argument. The fact that we aren't accustomed to considering improvement, and the "alien-ness" of the idea of technically enhanced human beings are cultural facts, and are quite understandable – but they have only limited argumentative force.

The assertion that a human being's "naturalness" would be endangered or even be eliminated by technical improvement is also no strong argument. Mankind's naturalness or culturality are competing and partially linked patterns of interpretation of the human condition. Using mankind's naturalness as an argument in the sense that we shouldn't technically improve the evolutionarily acquired faculties of sight, hearing, thinking, etc., just because they are naturally developed and evolutionarily adapted, would be a naive naturalistic fallacy: out of the fact that we find ourselves to be human beings, for instance, with eyes which function only within a certain segment of the electromagnetic spectrum, follows – normatively – nothing at all. Limiting human capabilities to the naturally given properties would reduce humanity to a museum piece, and would blind out the cultural aspects of being human, to which also belongs transcending oneself, i. e., thinking beyond what is given.

From these considerations, on the other hand, it doesn't follow that technical improvement is permitted or even imperative. It merely follows that one shouldn't make it too easy on oneself with an ethical repudiation. Strong imperative arguments are, in fact, not in sight (cf. Siep 2005). But, argumentatively, the repudiation front also isn't very strong. It points to a great extent to the *consequences* of improvement – consequences which, like the fears of an increasing division of society (cf. Siep 2005), are, to a great extent, hypothetical, and which can therefore provide only very general and provisional orientation. In the final analysis, the ethical debate seems to narrow itself down to single-case argumentation: which concrete improvement is meant, which goals and purposes are connected with it, which side effects and risks are to be apprehended, and the question of weighing up these aspects against the background of ethical theories, such as Kantianism or utilitarianism. *Universally* applicable verdicts – a strong imperative duty or a clear rejection of any improvement whatsoever – seem at present to be scarcely justifiable. What follows out of this situation for the future is the responsibility to reflect on the criteria for the desirability or acceptability of concrete possibilities for enhancement.

Influencing the faculties of the "healthy" human body in the form of an improvement doesn't present itself against this background as foreign to scientific and technical progress, but as its *logically consistent continuation*. Fully in the tradition of technical progress, which at all times has transformed conditions and eventualities which, until then, had been held to be given, as immutable fate, into influenceable, manipulatable, and formable conditions and circumstances, the human body and its psyche are increasingly being drawn into the dimension of the Designable. With this trend, a further increase of contingency in the *conditio humana* takes place: an increase of what is determinable and a reduction of that which, out of tradition or due to nature, had to be accepted without question. This increase in contingency is, on the one hand, emancipatory, liberation from constraints, as the European Enlightenment has emphatically demanded it. On the other hand, it questions traditional certitudes. With regard to human enhancement, new choices exist, about which "society" not only *may*, but *has to* form an opinion. To this end, society, in the new human condition with further increased contingency, needs further elaborated methods of dealing with this contingency constructively.

3 Increase of contingency and communication of the future

3.1 Functions of communication of the future

It is a characteristic trait of modern societies that they draw the orientation needed for opinion formation and decision-making increasingly from debates about future developments, and less and less from existing traditions and values (cf. Luhmann 1984). Modern secular and scienticized society orients itself, instead of on the past, more on wishes and hopes, but also on fears with regard to the future. The frequent discourse on sustainable development (cf. Grunwald/Kopfmüller 2006), on the Risk Society (cf. Beck 1992/1986), and on the constitutive role of innovations in the modern self-understanding give evidence of this fact.

In this chapter, I am going to interpret the marked increase of futuristic and far-sighted communication of the future observed in connection with nanotechnology and the Converging Technologies against this background. Here – as an anticipated hypothesis –, there are, as more concrete aspects of the general orientational function mentioned, the following functions of communication of the future, and they are often so strongly intermingled that differentiation threatens to become difficult: communication on the future of the type of "human enhancement" contributes to increasing contingency (catalyst function), points up increasing contingency (indicator function), and is supposed to contribute to coping with its consequences (orientational function):

(1) *Catalyst Function:* First of all, communication of the future (it is immaterial, whether it is a matter of visionary expectations such as slowing down or abolishing aging, or of fears of catastrophes, cf. chapter 3.2) is in itself a catalyst and a pacemaker for increasing contingency. Previously unquestioned certitudes (for example, the abilities or capabilities of a healthy human eye and its limits) are already dissipated by the fact that future technical possibilities for improvement are discussed throughout society. Independent of the question, whether and when these possibilities could be realized, the possible alternatives and, with them, the options come into view through the visionary communication on the future *itself*. Traditional certitudes are eliminated, and new contingencies are created without their technical preconditions having been established – on the whole, the consequence of chapter 2 on the example of the debate on "human enhancement".

(1) *Indicator Function*: The augmentation of communication of the future with visions such as the molecular assembler (cf. Drexler 1986) or human enhancement (cf. Roco/Bainbridge 2002) points out the current erosion of traditional certitudes. In such communication, the disintegration of these certitudes and the appearance of new questions, as, for instance, of the naturalness or designability of the human body and mind, show themselves clearly. Communication of the future – precisely when, as is shown in chapter 3.2, it oscillates in an extreme fashion between positive and negative expectations – is an indicator of increasing contingency.

(3) *Orientational Function*: In the sense of the hypotheses concerning the increasing orientation on the future in modern societies postulated at the outset, communication on the future is, however, always also an attempt to regain orientation in the situation of increased contingency, increased power for deciding, and uncertainty, and, in this manner, to reduce again the contingency it itself just increased. If it would succeed, by means of a societal agreement on futures planned, desirable, or those to be prevented, to bring about orientation in decisions on the agenda, then the situation of increased contingency would be mastered constructively. This, however, succeeds, as a rule, seldom without problems (if one considers, for example, the conflicts over the future of the energy supply), and in the case of CT, it hasn't succeeded to date at all (chapter 3.3).

In the following, the controversy over utopian or dystopian potentials of CT will first be discussed, in order to provide further explication of, and give the reasons for those functional attributions. Against this background, my deliberations at the outset will be interpreted (chapter 3.2); then, general aspects of the ambivalence of the futuristic visions will be addressed

(chapter 3.3), which, for their analysis, indicate a clear need for further development of method (on this point, see chapter 4).

3.2 Expectations of salvation or fear of catastrophes?

Some CT-proposals in the context of "human enhancement" are propagated in such a manner that one can classify them as expectations of salvation and anticipations of paradise: "Rapid advances in convergent technologies have the potential to enhance both human performance and the nation's productivity. Examples of payoff will include improving work efficiency and learning, enhancing individual sensory and cognitive capacities, revolutionary changes in healthcare, improving both, individual and group efficiency, highly effective communication techniques including brain to brain interaction, perfecting human-machine interfaces including neuromorphic engineering for industrial and personal use, enhancing human capabilities for defence purposes, reaching sustainable development using NBIC tools, and ameliorating the physical and cognitive decline that is common to the aging mind" (cf. Roco/Bainbridge 2002, p. 1).

In part, these expectations extend far beyond the anticipated solution of humanity's problems and merge into transhumanistic lines of thought, in which mankind is supposed to improve itself into a technical civilization (cf. Coenen 2004). These prognostications, which stand in Eric Drexler's technology-optimistic tradition (cf. Drexler 1986), contrast radically with fears expressed in the technology-sceptical tradition of Bill Joy's line of argumentation (cf. Joy 2000). The uncertainty of our knowledge about CT and their consequences in connection with the immense potential for damage, of possibly catastrophic effects, are taken by Jean-Pierre Dupuy and Alex Grinbaum (cf. Dupuy 2005; Dupuy/Grinbaum 2004) as an occasion for categorizing even the precautionary principle as insufficient for handling these far-reaching future questions. Instead, Dupuy's view of society's future with CT (he emphasizes the role of nanotechnology) leaves open solely the *existential renunciation* of nanotechnology as the only solution. Just that is the purpose of the following argumentation, which makes use of strong assumptions about the future:

- Nobody can know anything about the future of nanotechnology – except that it's the utter catastrophe;
- if everyone can be convinced that nanotechnology is *the* catastrophe, there could be a general renunciation of nanotechnology, so that finally,
- the catastrophe could still be avoided.

This argumentation is paradoxical: if everyone would believe the assertion that nanotechnology is simply "the catastrophe", and then "renounce nanotechnology", then the catastrophe wouldn't happen, even if it is at present claimed to be certain that the catastrophe will happen. To put it concisely: the catastrophe won't happen because everybody's convinced that it's certain that it will happen. The assumption of the inevitability of the catastrophe has no "validity" in the sense of a discourse, but only serves didactic purposes, to motivate a "renunciation".

Dupuy's concern is a "renunciation". He goes beyond even Hans Jonas' "Heuristics of Fear" (cf. Jonas 1979), inasmuch as he formulates a "duty to expect the catastrophe" in order to prevent the catastrophe. This argumentation fails, however, as soon as one inquires about the reasons for the diagnosis of nanotechnology as "a catastrophe". Finally, the argumentative opponent also warns against catastrophes, but only in the opposite sense: "If we fail to chart the direction of change boldly, we may become the victims of unpredictable catastrophe" (Roco/Bainbridge 2002, p. 3). If, however, the ultimate catastrophe is cited in both directions as a threat, this leads to an arbitrariness of the conclusions.

On the basis of this short description of two extremes in the current state of argumentation, the following can be learned for the purpose of this contribution: first of all, the extent of the increase in contingency seems to be maximal – everything seems to be possible between paradise and catastrophe. It's obvious that this debate, on the one hand, increases contingency, and on the other, is an indicator of increasing contingency (chapter 3.1). An orientational function, in contrast (here also chapter 3.1), isn't discernible in it. On the contrary, when the

debate runs into this sort of aporia, which can only be interpreted as arbitrariness, then visionary communication of the future would seem to worsen the lack of orientation. In the following, it will be argued that this is no coincidence, but is an expression of the systematic ambivalence of communication of the future. And finally, a solution for saving the orientational function will be proposed (chapter 4).

3.3 The ambivalence of futuristic visions

In futuristic visions, as in the debate on "human enhancement", what is *completely new* is put into the foreground, because only in this manner can the functions named above be realized in public awareness. Public attention has become a scarce commodity in the media society, with the corresponding consequences for the threshold of perceptibility. This mechanism leads to an inflation of scientific promises, of announced changes of paradigms, and of the expectations of something presumably "completely new".

But what is revolutionary and "really" new is by no means only fascinating, but also arouses fears, worries, and rejection. What is new is *per definitionem* not adapted to established patterns of perception, but is at first foreign in the accustomed world. What is new evades the usual, self-evident judgement criteria, and perhaps even questions them. Revolutions give rise not only to enthusiasm, but also to anxiety. Because revolutions leave winners and losers in their wake, circumstances will change radically, values are endangered, and traditional structures will be destroyed. Using metaphors of what is radically and revolutionarily new in the form of scientific-technical visions can backfire: the attempt to fascinate and motivate people through positive utopias can lead directly to rejection and contradiction: "Tremendous transformative potential comes with tremendous anxieties" (Nordmann 2004, p. 4).

This ambivalence shows itself, for instance, in the vision of a "New Renaissance" on the basis of the "Converging Technologies" (cf. Roco/Bainbridge 2002). There, the dawn of a new Renaissance – as the result of dramatic scientific and technical progress – is treated as a positive utopia, in which Leonardo da Vinci is seen as the ideal of a modern human being. The new Renaissance is announced as an age in which humanity's problems will be solved and in which "The Hope Principle" (cf. Bloch 1959) is supposed to find its fulfilment. But the announcement of a new Renaissance can also be read completely differently. Because the prototype, the Renaissance of the 16th century, was *in fact also* the epoch of Leonardo – above all, however, a period of uninhibited violence (one thinks of the Sacco di Roma, which found its artistic expression in Michelangelo's awesome depictions of the Last Judgement in the Sistine Chapel), of the Peasant Wars, the religious wars, and of intolerance, of a violent redistribution of wealth, and of upheavals. Today's perception of the Renaissance as an age of light and rationality is a construct of the European Enlightenment – by far the great majority of Leonardo's contemporaries would have experienced it completely differently.

Innovations don't often come into the world greeted with frenzies of enthusiasm, but through sacrifice, societal disruptions, losses of tradition, and problems of orientation. The visionary pathos in many technical utopias is extremely vulnerable to the simple question, whether everything couldn't just be completely different – and it is as good as certain that this question will also be asked in an open society. But as soon as it's posed, the hoped effect of futuristic visions evaporates, and can even turn into its opposite.

The most recent example of this reversal of positive expectations into sinister fears is provided by the CT. Since the now-famous contribution "Why the Future Doesn't Need Us" (cf. Joy 2000), self-reproducing nanorobots are no longer simply a vision which is supposed to contribute to the solution of humanity's gravest problems (cf. Drexler 1986), but are communicated in public partially as a nightmare (independent of the fact that there are, in principle, doubts about their technical feasibility: cf. Smalley 2001). This reversal with respect to highly speculative developments then gave the occasion for a specific risk debate on nanotechnology and CT (cf. Schmid et al. 2006) – a genuinely significant impact, and evidence for the hypothesis that futuristic visions can have a great deal of influence, independent of their realizability (see chapter 4.1).

Out of this ambivalent situation with regard to far-sighted visions of the future (the more radical the innovation, the greater its potential for catastrophes), and due to the fact that, because of

their speculative character, there are hardly any arguments for deciding "rationally" for one or the other variant, a serious problem arises here for the "orientational function" of communication of the future (see chapter 3.1). The purpose of providing orientation and contingency reduction by means of communication of the future just doesn't succeed in this manner. On the contrary: if it turns out that a negative utopia stands against a positive one, even just the opposite can be the case, and the uncertainty and confusion could even be increased. But if, on the one hand, realization of the orientational function of communication of the future is indispensable for preventing blockades of societal action, fundamentalism, or destructive ideological trench warfare, and on the other hand, this orientational function as described doesn't become effective by itself, then supporting activities are needed, in order to remedy the situation. New tools for the structuring, interpretation, criticism, rationalization, and evaluation of this communication of the future are necessary (chapter 4), possibly also new forms of the institutionalization of analytical and reflective scientific support and of its societal nexus.

4 Vision Assessment for the rationalization of expectations on the future

4.1 The actual significance of futuristic visions

Frequently, the opinion is expressed, in particular, by natural scientists and technologists, that futuristic visions should be ignored because of their speculative nature. According to what has just been expounded, this would be a fallacy, because these visions develop real force in the abovementioned catalyst, indicator, and orientational functions (see chapter 3). When one postulates "[…] but scientists must also become visionaries who can imagine possibilities beyond anything currently experienced in the world. […] At times, scientists should take great intellectual risks, exploring unusual and even unreasonable ideas, because the scientific method for testing theories empirically can ultimately distinguish the good ideas from the bad ones" (Roco/Bainbridge 2002, p. 26), then scientists' responsibilities are stretched far beyond their traditional self-understanding. Visions express some scientists' motivations and their conceptions of future science and technology (and partially, of future society). In this sense, visions are often far in advance of scientific and technical research (cf. Dupuy 2005), and still have concrete consequences for society. They are supposed to draw attention to fields of research and bring about positive perception, convince politicians and research funders of the field's finance-worthiness, "accustom" society early to new and revolutionary innovations, and induce colleagues and other disciplines to cooperate, as well as motivate the new generation of scientists and technicians. On the other hand, they can effect just the opposite: give reason for anxieties, and initiate risk debates (see chapter 3.1).

The real significance of far-sighted communication of the future consists, as can at present be seen on the example of nanotechnology and the CT, above all, in its considerable effect on public awareness with respect to the positive expectations on progress as well as – as the ambivalent reverse side – to the questions of risk. We have to give special consideration to the fact that far-reaching visions have influence on the sciences' *agenda*. As soon as they turn up in political and public communication, they influence – directly or indirectly – societal attitudes, and thereby, in the final analysis, also research funding. Visions and their reception in society therefore also decide on which projects and with which budgets research is done – and are therefore part of an at least implicit "Knowledge Policy" (cf. Stehr 2004): "The expectations surrounding the technology, the promises made, and the pay-offs guaranteed all contribute to the success, strength and efficacy of the resources poured into a new technology. More explicitly, it is the temporally bound claims and counterclaims that testify for the technology and serve to make it so" (Selin 2006).

The requirement for transparency with respect to the projections into the future and the arguments, premises, and imaginations standing behind them is indispensable in epistemological respect as well as according to democracy-theoretical standards. This is, however, as the exposition in chapter 3 has shown, by no means given: the indubitable actual relevance of futuristic visions stands against their methodically and epistemologically non-clarified status. The combination of factual relevance and methodically unclear status makes a transparent scientific and public discussion difficult: "The recourse to time built into an expectation can be short-term or longer-term, yet is rarely made explicit. This invisible temporal

marking is part of the reason for controversies over the future of nanotechnology" (Selin 2007). This situation requires that such visions be made the subject of analysis: "If the future depends on the way it is anticipated and this anticipation is made public, every determination of the future must take into account the causal consequences of the language that is being used to describe the future and how this language is being received by the general public, how it contributes to shaping public opinion, and how it influences the decision-makers" (Dupuy/Grinbaum 2004, p. 17).

A "Vision Assessment" (cf. Grunwald 2004) to supplement established approaches of technology assessment (cf. Decker/Ladikas 2004; Grunwald 2002), with the participation of the philosophy of technology and science studies on the one hand, and of the empirical social and communication sciences on the other, would analyze visions as a medium of communication in their cognitive and evaluative contents and consequences, in order to make a transparent and rational discussion possible. Vision Assessment would be a building-block of an open, cognitively informed, and normatively-oriented dialogue, for example, among experts and the public, or among natural sciences, research funding, and regulation, which is necessary in order to be able to exploit the innovative potentials of modern technologies without winding up in a fundamentalistically hardened discussion of risks. In this fashion, Vision Assessment would also take on the task of building bridges to the other "future debates" in society, for instance, on the sustainability of mankind's manner of pursuing economic affairs, on the demographic transition, or on the future of the developing nations.

4.2 Steps in Vision Assessment

Vision Assessment would have a number of aims, and would consist of various steps: (1) analysis, (2) evaluation, and (3) management of visions (cf. Grunwald 2004). This exposition, existing to date only as a rough sketch, would have to be concretized on the basis of case studies and be elaborated to a method.

(1) With respect to analysis *(Vision Analysis)*, it would be a question of disclosing the *cognitive* contents of the visions and of judging epistemologically the extent of their reality and practicability, self-evidently on the basis of current knowledge in the immanence of the present. This leads to the questions of validity mentioned above (see chapter 3). Then, an important aspect, the prerequisites for the visions' realizability and the time-spans involved, would have to be investigated. In both analytical steps, observing the language used on the one hand and the question of the antecedents of the predictive statements play a special role: "[…] the nanoethics researcher must be attentive to the twists and turns of language which can be symptoms bringing light to the most hidden layers of the scientific or technological imagination" (Dupuy 2005). Further, the visions' *normative* contents have to be reconstructed analytically: the visions of a future society, or of the development of human beings, as well as possible diagnoses of current problems, to the solution of which the visionary innovations are supposed to contribute. For a "rational" discussion, the transparent disclosure of the stocks of knowledge, nescience, and values is necessary, above all, with regard to the relationship of fact to fiction (cf. Schmidt 2003). The contribution of such reflective analyses could consist in this respect in the "clarification" of the pertinent communication: the partners in communication should know explicitly what they are talking about as a prerequisite for rational communication. It is a matter of society's "self-enlightenment" and of supporting the appropriate learning processes. Within the framework of analysis, it is also the task of Vision Assessment to study the communication of visions in *strategic* respect: which actors are taking part, how are interests and power distributed, how does the course of the debate let itself be reconstructed to the present, and which solutions are proposed (cf. Selin 2007).

(2) Vision Assessment would, further, include evaluative elements *(Vision Evaluation)*. These are questions of how the cognitive aspects are to be categorized, how they can be judged according to the degree of realization or realizability, according to plausibility and evidence, and which status the normative aspects have, e. g., relative to established systems of values, or to ethical standards. The purpose is the transparent disclosure of the relationship between knowledge and values, between knowledge and the lack of it, and the evaluation of these relationships. To this end, one can draw upon the established evaluation methods of technology assessment, which often include a participative

component (cf. Decker/Ladikas 2004; Grunwald 2002). On the other hand, there are, in this case, in normative respect, some far-reaching questions which stand to discussion and which require philosophical reflection (cf., for instance, Habermas 2001 for the pertinent analyses and judgements of the debates on the future of nature and of mankind).

(3) Finally, it is a matter of deciding and acting (*Vision Management)*. The question is, how the public, the media, politics, and science can be advised with regard to a "rational" use of visions. First, the question of alternatives, either already existing or to be developed, to the visions already in circulation, stands here in the centre of interest, in accordance with the basic position of technology assessment, of always thinking in terms of alternatives and options. In this manner, visions based on technology can be compared with one another or with non-technological visions. Finally, it is a question of strengthening reflexiveness. Communication on the cognitive and normative backgrounds of visions is also part of "responsible" communication making use of visions, in order to make a transparent discussion possible.

In particular, it would be the assignment of Vision Assessment to confront the various and, in part, completely divergent visions of the future directly with one another in all of these phases (see chapter 3.1). This can, on the one hand, be done by analysis; on the other, however, the representatives of the various positions should discuss their differing estimations in workshops directly with and against one another, in order to lay open their respective premises and assumptions. To this end, a participation of philosophy in the form of ethics and of science studies is highly necessary, in order to be able to judge questions of the validity of knowledge of possible futures and of the justifiability, resp., of the normative basis of certain evaluative contents.

5 Resume: The new *conditio humana*

The drastic increase in contingency in the *conditio humana*, as it becomes apparent, above all, in the dissolution of traditional certitudes as a result of the discussion on the technical improvement of human beings (see chapter 2), is a characteristic of CT. Central concepts, such as nanotechnology, CT, or human enhancement, act as a "Cipher of the Future" (cf. Grunwald 2006), on the basis of which the increase of contingency takes place, in which it becomes manifest, and through the societal discussion of which new orientation in the disjointed world is to be brought about (see chapter 3). The new human condition is a world in which there is no longer any ideal state of the physical or intellectual constitution of a healthy human being, but rather in which even the currently ideal state seems optimizable.

The increase of contingency is a constant, concomitant motif in scientific and technical progress. The transformation of something which has to be accepted as given into something manipulatable is the hallmark of technical progress. To the extent to which the human power of disposition is increased, new room for visions and manipulation open up, but at the same time, so to speak as a side effect, the challenges to compensate for the loss of traditions with new means of orientation increase. Orientation on the future serves in a modern society as an important new form of society's negotiation with itself (cf. Luhmann 1984). In this orientation, it can only be a question of comprehending the debates on the future – about opportunities as well as about risks – as catalysts, with the help of which this type of internal negotiation is carried out. In comparison with the claims of cognitive and normative rationality, just as according to the democracy-theoretical standards of a deliberative public debate on the self-concept and the future of society, the need for an epistemological and ethical analysis of the grounds for the validity of the predictions of the future is evident. Nanotechnology and the Converging Technologies are *the* fields in which it at present becomes clearly apparent, which temporally and thematically broad dimensions these prognostications about the future can assume, and how extremely they can oscillate between expectations of salvation and of catastrophes (see chapter 3.1).

Regaining orientation in this new human condition, as hoped for from the debates on the future, doesn't by any means take place automatically. Ambivalence can bring about the exact opposite (see chapter 3.2). In order to make constructive use of the orientational potential in communication on the future, new instruments for the rational pervasion of such projections into the future are needed (see chapter 4). In view of the visionary nature of the prospects for a

technical enhancement of human beings, and of long and longer spans of time within which the realization of certain milestones can be expected, there is, in all probability, enough time to analyze the questions posed. In general, it applies in this case that this reflective discussion should take place already in the early phases of development, because then the greatest possibilities for influencing the process of scientific development are given. The chances are good that, in the case of human enhancement, ethical reflection and the societal discussion don't come too late, but can accompany scientific-technical progress critically.

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