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Science and Ethics

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Introduction

We have set aside twenty-five minutes of our time together to consider science and ethics — across disciplines, across cultures, across conflicting views and interests. We meet here in a unique historical situation with marvellous opportunities and terrible dangers. It is my task now to set up a platform for facilitating ethical discourse amongst us — here and to be continued later — with a view to grounding our work in science in values that we can share. This task is clearly unfulfillable in terms of a proper academic lecture[1]. I shall rather use very simple words in an attempt to reach you as human beings, and to explore with you how we can take three steps together, each in our own way: Learning to Speak, Enhancing our Vision, Daring to Act.

Allow me first to join the organizers in welcoming you all at this congress. We should not forget to celebrate the very possibility of our meeting here in Berlin in a mixed gathering of scientists and engineers from East and West. Of course, this is due to the recent opening of Eastern Europe — an entirely unexpected gift which provides us Europeans with the opportunity and the responsibility for overcoming fragmentation and becoming whole. Yet we know that this new beginning is a very difficult process involving mutual mistrust, lack of understanding and the danger of renewed conflict. In this troubled time, the present congress gives us a chance for exchanging our views on issues of vital importance for the future of our continent.

But these issues take us well beyond the borders of Europe. Science and technology are pursued internationally under the leadership of the industrialized countries and have global effects. The network of links between scientific institutions is so tight, the technological and economic conditions associated with it are so similar that — in spite of national and cultural differences — science and technology are perceived as *one programme*, formulated and implemented by the North and implanted into, or rather imposed upon, the South. At this congress we attempt to discuss our common responsibility for the future of humanity with representatives from both industrialized and developing countries.

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1 In the scope available, I cannot even hope to properly introduce my basic terms or begin to deal with the enormous wealth of literature.

I take the title “Science and Ethics” for my talk to imply that we should focus here on the reality of research, and of the development and use of technology that we all share. Each of us brings in a distinct individual and cultural perspective when we look together for ways to let our work unfold in keeping with the needs of the human community. As scientists we have overwhelming reasons for great concern. We have *known* for a long time the fundamental dangers facing the world. Some have pronounced early warnings, though unfortunately with insufficient effect. Then, we have begun to *see* the effects that had been predicted: Hunger, overpopulation, recurrent national and economic conflicts, overuse and exhaustion of natural resources, large scale poisoning and deterioration of our natural environment, personal disorientation, social upheavals and interpersonal brutality. Many of us still try to uphold the illusion that we observe all this, while our own life is safe. But we do not just witness from afar a mad race into catastrophe, *we participate*. Our common challenge in this awesome time consists in promoting human survival in dignity on earth.

It is not obvious that ethics is relevant as a social mechanism for addressing these issues. Ethics addresses first and foremost the individual and the felicity of his or her course of action. It is me, and each of you that count. Many argue that the problems facing us are so vast that they can only be tackled by large scale political action. The (only) relevant course of action for individuals to take, then, is to get involved in political struggle in keeping with their values. However, in recent years we have begun to see an important change in public awareness here. There is a growing realization that an understanding of our own role and individual, value-guided action are indispensable as constitutive of all large scale movements such as political decision making and its social enforcement. Starting from our own personal involvement we may, together, find common ways for acting effectively in society.

I shall approach the topic of science and ethics through the notion of responsibility. The key here is the realization that, in conducting our work, we have choices. Choices that we can make responsibly as autonomous human beings. Choices that we can support one another in making, if we succeed in articulating and sharing our concerns.

Reaching out to one another for mutual support in this manner involves taking risks. How can we speak about ethics together in view of the terrible sufferings — past, present and future — that we, our nations, our cultures inflict on one another? In view of the massive threat that we, the human race, bring about for all living creatures on earth? In view of the destructive nature of the industrial/scientific establishment that we as scientists and engineers are part of? In view of our disillusionment with all ideologies and moral authorities? In view of our fundamentally different individual outlooks on life? How can I with my limitated view speak of ethics to all of you in a meaningful way?

My contribution rests on the conviction that there is no one best way to speak about and to socially implement our quest for values. I had one year to prepare this talk. This was a trying process for me, in which I faced some painful truths. I became aware of my limitations and fears and found myself entangled in a mesh of doubts and paradoxes. Finally, I decided to make my troubles explicit. Perhaps this will facilitate your own learning to speak about values. Our chance here lies in articulating and crossing our individual perspectives.

The Need to Overcome Silence

Speaking in public about values in our culture is not customary. It is not done. Ethics is institutionalized. We leave it to politicians or to professionals trained in the tradition of some religion, ideology or philosophical school to say appropriate words on appropriate occasions in a technical language. But the rest of us remain apart from all this. We take the freedom to listen or to withdraw. Some of us, as individuals, have found private platforms for discussing concerns related to values. But for the most part, these are divorced from our professional life.

This holds in particular amongst engineers and scientists, for we have been trained to separate facts from values, and conditioned to a style of interaction, where all questions pertaining to value are dismissed. Referring to values in connection with substantial decisions comes close to breaking a taboo. In this sense, "Science and Ethics" is no topic at all. The title of my talk refers to two basic human ways of relating to the world, each bringing with it its own (sub-)culture. Ethics may offer sophisticated frameworks for discussing values, but science and technology are supposed to be value-free. There is no "And" in this tradition - the two cultures remain separate. The way of thinking associated with this separation has emerged together with the programme of modern science itself, so that the two seem almost inseparable. As a consequence, bridging the gap between the world of facts and the world of values is left to the individual scientist alone.

The silence on ethics has even been postulated as a positive programme by Ludwig Wittgenstein in the Tractatus, which ends in the famous saying: *Worüber man nicht reden kann, darüber muß man schweigen*. It is clear from the context that Wittgenstein referred to the world of values here, but relegated it to the domain of silence. He saw all questions pertaining to the meaning of the world as outside of the world of facts, and thus as unexpressible in our language based on logic. These pitfalls for trying to express values undoubtedly remain, but silence is not necessarily the best answer, since it leaves each one of us isolated and condemns many to resignation. Perhaps we can learn from artists and the great religious teachers to find images and metaphors as workable ways for expressing ourselves.

Another difficulty facing us is the common assumption that speaking about values implies moral authority on the part of the speaker. On one hand we have learned to mistrust those who claim moral authority and make demands on others, but at the same time we have little practice speaking about values without assuming such an authority. Speaking about values necessarily involves speaking about ourselves. It is inherently self-referential. We cannot exempt ourselves from the discussion. I now take the risk to come in the open with all my shortcomings. You are all justified in asking: Is she living up to what she says? If I am truthful, I find myself hanging without protection over the abyss of my own failings. If I am not, I loose my credibility. I have found this scary during the past months.

We have to be conscious of these obstacles in order to be able to communicate as scientists about values. We have nothing but our subjective authenticity to start from. I can share with you my own values and difficulties. I can express myself in order to encourage you to express yourself. I can try to avoid tying myself to any creed that might exclude some of you.

The source of ethics is human relatedness. This takes us directly to the notion of responsibility, which I see as central to our discussion. Responsibility, as Hans Jonas suggests, for all humans including the generations to come, and indeed for all living beings. In my view, it is an important part of our responsibility to learn to articulate ourselves about values in an attempt to share our individual concerns.

Joining in Ethical Discourse: an Invitation

We have no common global notion of what constitutes good life and of what social mechanisms are needed to bringing it about. The very notion of ethics we employ in English is rooted in Greek philosophy and has co-evolved with the Judeo-Christian tradition. All the varieties of ethics developed throughout European history mirror a wealth of assumptions and experiences of our cultural space. In this cultural heritage of Greek philosophy and monotheistic religions, values were traditionally tied up with commands or laws[2]. The authority for them was ascribed to God (represented by the church), the state (later the party), or the moral law within us. The common idea behind all these schemes is to formulate context-free and general principles of action that decide between right and wrong. These principles are to be expressed in terms of timeless values or norms for all to obey and to be enforced with mechanisms of social control.

This idea of ethics is closely intertwined with the establishment and maintenance of hierarchical societies. Ethics for the individual means to properly understand and act in keeping with the perceived law according to one's consciousness. Choice is based on well-defined notions of the *good*. Though the discussion on ethics has undergone a tremendous development in the past centuries, the basic idea that ethics is concerned with universal laws has survived to this day in most people's minds.

However, in the past decades we have seen all authorities collapse in our own culture and we certainly cannot base a cross-cultural discussion on ethics on a commonly accepted authority or a shared set of formulated norms. The people present here are from thirty-eight countries with different religions, cultures and traditions. Unless we would let one notion of ethics dominate the discussion, we must accept that ethics means different things to us, that we subscribe to different values and we have different mechanisms for promoting responsible action available. We need to be aware of this in order to find a common language. The recognition of this lack of a commonly accepted authority has left many with a sense of arbitrariness and of relativity of all values. How come then, after years of disenchantment, we are suddenly looking for ethics again? What are we looking for? Do we seek ready-made answers? Do we seek the next authority to obey?

I believe that such an attempt would lead us nowhere. We cannot go back to the past, we cannot become artificially naïve. The old authorities have indeed failed us and we are left with our own insights. Moreover, the old laws and principles were formulated on the basis of historical assumptions that no longer hold. We are now faced with new conditions affecting any discussion on values in a fundamental manner: overpopulation, exhaustion of natural resources, the danger of destroying the physical basis of life. We have overwhelming complexity to cope with and find ourselves in the midst of rapid change that is likely to shake up the foundations of any discussion on general values before it can be brought to its own conclusions.

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2 This way of dealing with values is not inherently necessary. One can look at the Buddhist tradition, for example, as having no commands, but relying on spiritual practice and personal commitment as the basis of responsible action

The systemic interdependencies that we are aware of now are not amenable to general laws. We cannot hope to address them in explicit rules. However, this does not leave us with arbitrariness. I wish to join those who promote ethics as a discourse, in which we bring in and articulate our own values *locally* in an authentic manner in processes taking place in concrete situations. Then, the *interconnected network of such local decisions becomes of global significance*.

In keeping with the radically new situation today, I see the following as the basic premises for our discussion:

- ethics is an invitation to work together through our situated actions towards common survival on earth;
- ethics is inherently dialogical, acknowledging the rights and the views of others;
- ethics can be shared if we start from our authenticity and express ourselves in a common language across different cultural perspectives.

We cannot formulate commands for others to obey, but we can invite one another to join in mutual commitment.

Dealing with Values amongst Autonomous Human Beings

In figure 1, I contrast two basic ways of dealing with questions of value.

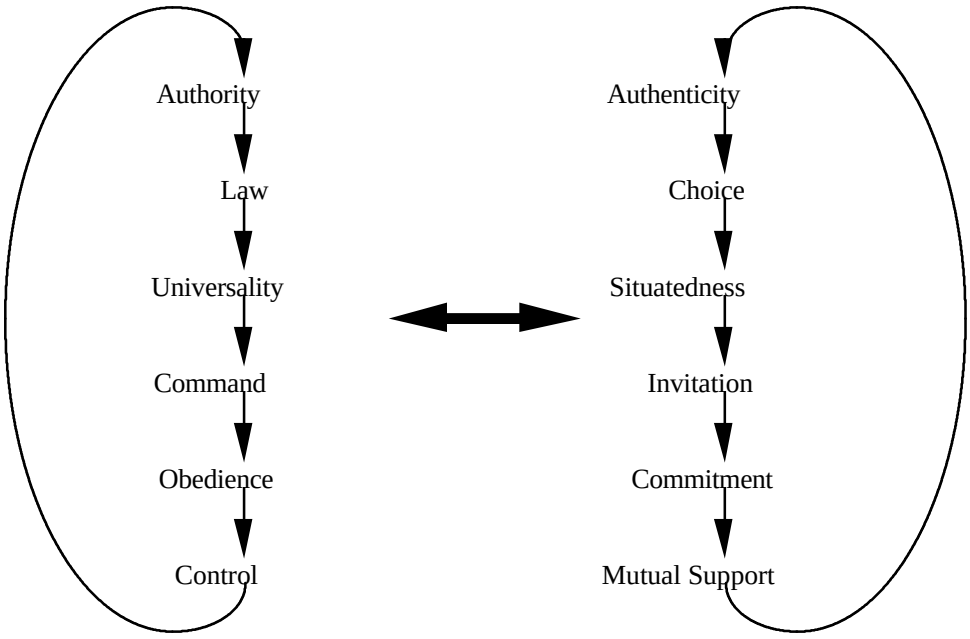

Fig. 1: Authority- and Authenticity-Modes of Dealing with Values

While the authority-mode corresponds to the organization of *hierarchy* and has been implemented in many forms historically, the authenticity-mode leads us to *network*s of

cooperating autonomous individuals[3]. I suggest that we might base the practice of ethical discourse in science and technology on the authenticity-mode of dealing with values.

The shift implied in this paradigm change is profound. It starts by anchoring each one of us as an autonomous being in our situation. Our perception of the world as a whole, including the values we hold, is elaborated from our perspective, against our background. We each have our own limited perspective to draw on and our scope for choice to become aware of and to unfold through responsible action. As autonomous beings we can invite one another to join and re-inforce one another's sense of commitment by mutual support

We need such mutual support if we wish to ground our work in science and technology on values. We know that the practice of ethical discourse is discouraged in various ways: the myth of value-free science, the acceptable ways in the scientific establishment, the drive of our personal ambition, the competition governing research, the loyalty to our research groups and communities, the interest of the profession — they all can stand in the way. After all, funding policies rest on an unquestioning attitude to those who provide the funds, and thus, in our time, on uncritical relations to the military/industrial complex. Thus, in articulating ourselves on values, each of us is taking a personal risk, some small, but others far-reaching and existential.

To be able to do that, we need to step back in the midst of the mad-race, to perceive the mechanisms of destruction that drive us - our mental and emotional programmes as well as our real or imaginary outer constraints - and tap at our sources of gentleness and courage. I hold this to be indispensable for redirecting our course of action and supporting one another in doing so. It is only starting from there that we may form research communities promoting value-oriented lines of research.

Let us begin by enhancing our vision.

The Old and the New Thinking in Science

Most of us have a fuzzy notion of “modern science” as having originated as a research programme in Western Europe in the 17th century.

I use the term “science” in a very comprehensive manner here. It refers not only to the work we ordinarily consider as scientific — dealing ideally with isolated and well-defined problems, with the hypotheses basic to their investigation, the experiments performed to obtain results, with the statement and discussion of results and possible generalizations — but also to the collection of assumptions, methods of inquiry, problems under consideration and goals pursued under this name. Furthermore, “science” stands for the institutions of learning and research where scientific work unfolds, the educational programmes where novices are trained to adopt and continue the tradition, the mechanisms of funding research and the dependence of scientific work on such funds, the technology produced as a result of research and its potential

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[3] In the Judeo-Christian tradition the authenticity-mode has always been of high spiritual importance, but in the social implementation of this tradition the authority-mode has prevailed.

for economic and military purposes, and for the status that science and technology assume in our world.

Science embodies a way of relating to the world. It allows us to pursue certain directions of research and dismisses others. It is based on a platform of assumptions that determines the answers we may get by constraining the questions we may ask and the methods we may employ. It sets the stage for the use of technology in our world. It is closely intertwined with socio-cultural conditions that on the one hand are necessary for making all this possible, and on the other hand are continuously transformed through science.

I will sketch the thinking typical for modern science in terms of the mechanistic world-view, which has spread far beyond its origin in classical physics as a way of understanding the world we live in. Some of its facets are: the nature of reality is atomistic; material phenomena are separated in space and time; there is a clear correlation of cause and effect in terms of linear causality; analytical thinking serves to isolate separable problems; the analysis, based on timeless, universal laws, can be carried out by a detached observer with reproducible results; observers are replaceable as human beings. This mechanistic world-view and the associated processes of social implementation and technology development were situated in a world, now gone, where they seemed justified and contributed ostensibly to human progress..

It brought with it a role model for scientists and engineers with clear notions of their responsibility. One basic distinction was the separation of discovery and invention, of research and technology. "Pure" Research, in particular, was outside the scope of value-discussions. Pure Research was separated from "Applied" research which was connected to technology. In technology, there was also a clear separation between production and use. What was produced, was value-free, its "good" or "bad" use was not the responsibility of scientists.

Let me come back again to the traditional position on science and ethics: Ethical guidelines can be expressed in terms of universal laws. The ideal for science is to pursue dispassionate truth with a clear separation of objective facts and subjective values corresponding to the realms of reason and emotion respectively. Discovery does not interfere with reality, the observer does not enter into the observation, therefore observation is value-free. Invention promotes human progress. Technology with predictable effects for well-defined purposes can be developed and used without affecting the global context. Disinterested development can be divorced from interested use, desirable use is clearly separable from misuse. Nature is subject to exploitation by man, with boundless availability of resources. The use of natural resources is outside the scope of ethics. The ethical stance is: observe general ethical guidelines in using technology, science itself is value-free.

In the meantime, the enormous impact of science and technology on our living conditions has transformed our world so profoundly that the original assumptions no longer hold.

The twentieth century has seen the mechanistic worl-view collapse as a general framework for looking at the world. Its claim to universal validity had to be given up in physics research around 1920, when quantum physics and the theory of relativity brought with them radically new ways of thinking. Since then, the nature of the “problems” treated in many branches of science has changed profoundly. They no longer concern phenomena separable in space and time and amenable to linear causality, but systemic interdependencies between seemingly isolated phenomena which are intimately connected through circular causality. The observer

was found to be constitutive of the observation; we know that the questions asked determine the answers we get. Recursive forms of organization with interrelated levels of description at different levels of complexity come to the fore.

Thus, the notion of "objectivity" has become doubtful in science. There is no dispassionate truth to be mapped by us, but our insights are brought forth by us; our cognition is inherently selective, based on our perspective; it reflects our culture, our history, our personal experience, our priorities. Modern science itself is a culture spreading from Europe and North-America internationally across the globe. Its assumptions, working styles and taboos that have shaped us, still belong to the old thinking and give no room to the new. We now know that invention replaces discovery as a basic concept in science: we do not discover universal laws, but we invent forms of description. All observations are observer-bound, they are expressed in observer-terms and reflect specific needs, values and interests. But the institutions, the education and the evaluation mechanisms have not changed accordingly. We need to act on the basis of the new understanding in dealing with science.

Technology has exploded. We are in it, shaped by it, entrenched by it, dependent on it. It influences the way we perceive the world, constitute our social lives and make our basic human choices. Our choices are technology-based, and the development and use of technology is based on choice. Technology comes with unpredictable systemic effects, the global context being at stake. In all system development the development is intertwined with use, there is no clearly defined desirable use, we have to argue out what is the desirable use during development in keeping with our values.

In the late twentieth century, perhaps the most impressive change is the disturbing evidence that all natural resources are limited, many resources being exhausted already. We now refer to nature as being in need of protection — but we know that this notion is absurd. Nature is not dependent on us, it is the foundations of human life on earth that need to be preserved. These foundations are endangered by the very progress that was brought about by science and technology. Thus, the whole scenario about science and ethics has changed.

At this stage in history, most everyone will readily agree that a general change in attitude is urgently needed. Yet, little seems to happen. We do not know to what extent we are able to change in human terms, and we waste our time in theorizing in terms of the old thinking. Many suggest to use even more technology to control global connections on a systemic level. This, I believe to be a fallacy. We cannot expect to cope with our endangered situation by exerting even more control. I would rather like to propose the notion of *healing* here and suggest that we might adopt attitudes that facilitate healing. We have upset the balance of self-regulation so beautifully manifest in the living world. To restore the balance we need to give way so as to allow healing to happen and to take action based on a healing vision for the survival of humankind.

Elements of a Healing Vision

Ethics comes with utopian scenarios for desirable human affairs. Such scenarios inspire communities and promote paradigms for our life. I would like to propose as a guiding vision for today: *Dwelling Together in Dignity on Earth*. This is a Utopian scenario, no doubt, and yet it is the basic condition for all scenarios worth striving for in our time. It refers to the

human community as a whole and invites us to celebrate, not to abuse our relatedness. It implies respecting the other, promoting autonomy and self-determination, seeking reconciliation between humans and with nature. Maintaining and sharing resources. Sustaining the community. Preventing dangers. Caring for all living beings.

It is not a question of adhering to a complicated set of rules but of cultivating and practicing a sense of belonging. A sense of profound belonging to our dwelling place, the Earth. It is based on our willingness to understand the full variety of distinct perspectives, our mutual dependency on other humans, and indeed on all forms of life, our being part of a world of relationships.

I will attempt here to sketch a healing vision in terms of concepts that were brought to the fore in scientific discussions dealing with systemic properties in different fields - such as biology, ecology, sociology or economy. These concepts have been found to be fundamental in characterizing the conditions for life, the sustainabilty of living systems and their unfolding. The purpose of ethics, as I see it, is to create and maintain felicitous conditions for human life. In relating these scientific concepts to the world of values, we find a fascinating convergence between very advanced notions in science and traditional ethical notions[4]. Thus, science itself motivates new ways of expressing values.

I have chosen the concepts *individuality, variety, relatedness* and *balance* - taken from the scientific discussion - as a basis for a renewed look at ethics. I wish to associate theses concepts with healing attitudes. I know well that this is just a new way of expressing what shines through many ancient religious teachings, unfolded as they are under different names in many ways in various cultures. And I display these connections graphically in a manner that was inspired by the *Sacred Wheel* employed by North American Indians.

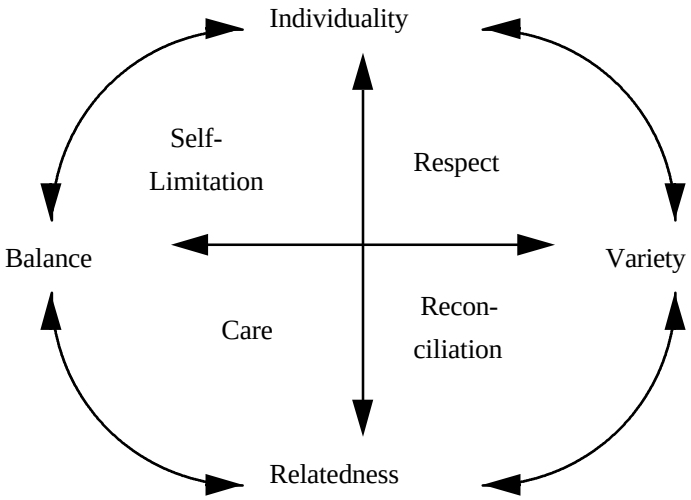

Fig. 2: Systemic Concepts and Healing Attitudes

Let us explore the elements of this healing vision and their relevance to our research and systemic practice.

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4 This has been pointed out by a great many scientists belonging to the New Age Movement.

Individuality, of persons, of communities, of countries, classes or societies, stands for a distinct perspective at the root of all action and experience. It enables us to think, to act, to make choices, to assert our interests and seek satisfaction of our needs. We live in a world believing in individuality and in growth based on individual needs. Our notion of growth is linear, referring to partial needs whose fulfilment is supposedly unlimited. Limitation in our culture has a negative connotation: it is associated with resignation and loss. The possibilities for asserting our needs are extremely unequal - out of balance.

In nature, all harmonious growth is based on limits and on keeping connected aspects in theit proper proportions. On the conscious level, many of us feel driven to maximize the fulfilment of some specific needs or desires. We can learn here from the unfolding leaf which maintains its beautiful proportions within its limits throughout the process of its growth. In this spirit, I wish to suggest *self-limitation* as a positive orientation. Self-limitation, on the one hand, results from viewing our own different needs as connected and striving for proportionate growth of the individual. On the other hand, it is in keeping with viewing our needs as individuals in relation to those of others in a global situation of limited resources. Growth in quantity is necessarily limited, but self-limitation promotes growth in quality.

Variety is inherent in life and makes for its richness, and yet we strive to suppress and crush variety in many ways. Intellectually, we insist on universally encompassing views and forms of explanation, dismissing all others. Culturally, we maintain the hegemony of Western civilization at the expense of all other cultures. In our interaction with nature we threaten the variety of living forms, pushing only those that serve our needs in the narrow, utilitarian sense that we are able to perceive.And, though we claim freedom and individuality, we implement an all too homogeneous culture, restraining many valid forms of individual expression. But without the requisite variety, life cannot unfold.

Therefore, I wish to associate variety with the healing attitude of *respect*. Respecting amongst human beings the different view, the strange culture, the unaccustomed way of explanation. Accepting the variety of perspectives in discussions requires tolerance and a conscious effort for mutual understanding. Respect for variety in our dealings with nature means promoting the continued survival of our fellow-life forms. It is based on human self-limitation and relies on seeing ourselves in a garden of mutual dependencies with all living beings.

Relatedness is the *essence of the sacred*. This statement by the anthropologist Gregory Bateson was his attempt to characterize the core of all religions without resorting to any explicit teachings. Whatever creed we subscribe to as individuals, whatever teachings provide us with inspiration or guidance, perhaps this simple notion can help us in communicating across our perspectives. The notion of relatedness encompasses all levels and forms of human relationships between individuals, groups, communities, nations and societies. It is also meaningfully employed in connection with all living beings. Celebrating our relatedness would mean to acknowledge our mutual dependency and enhance one another's potential for unfolding.

Our relatedness, however, is distorted in so many disastrous ways. Therefore, I wish to propose with the healing attitude of *reconciliation*. Reconciliation beyond past abuse, reconciliation based on mutual respect, reconciliation as a prerequisite for the continuation of life. We can no longer risk war. We can no longer afford destroying nature. We all lose by persisting in recurring conflicts with their age-long history, horrid memories and mutual blame.

We have to find peaceful ways for going beyond patterns of abuse implemented in relationships, in communities, amongst ethnic groups, on the international level. We need to support one another in learning to celebrate our relatedness.

Balance in living systems does not refer to a static equilibrium but to dynamic flow. This flow changeing back and forth between related opposites and polarities takes place constantly. When, under pressure, the system gets out of balance, changes in quality may arise. These changes may be important steps in evolution, but they may also lead to catastrophe for the system or some of its elements. Thus, balance within an appropriate scope is basic for maintaining the foundations of systemic survival. In the present condition of humanity, it is basic to the survival of human beings.

Thus, I have associated balance with the healing attitude of *care*. This notion, stressed particularly by Martin Heidegger connotes *caring for, caring about* and *being careful*. The interplay of all these dimensions of care is meant is necessary in striving to restore the balance, to avert catastrophe, to sustain our common resources, and to provide a livable community for all. This implies seeing science and technology in relation to other human needs, to balance the needs of research with those of other spheres of life.

Let us design for common survival. Which brings us to: Daring to Act.

Levels of Assuming Responsibility in Science

In connecting science and ethics, we can distinguish different levels. We can assume responsibility by thininking and acting

- *in* science,
- *about* science,
- *on* science.

On the first level of responsibility in science we experience science as given. We we find ourselves “thrown” in science (a term borrowed from Heidegger). Science makes demands on us, and our role is unclear. We are faced with personal question such as: Can I distiniguish what I hold to be ethical and unethical demands on me? How can I find my own scope for autonomous choice and responsible action? Will I comply with or will I refuse what I consider to be unethical? It is a decision to assume personal responsibility or join with others in common action of resistance or political struggle locally, while considering science itself as stable.

The second level implies becoming aware of the world-view and the interests underlying science as we know it and the relation of science to society. It involves questioning the demands made on us, the constraints imposed on us, the assumptions we build on and the privileges we hold. It implies stepping out of the framework of science and relating to different ways of experiencing life. It requires us to consider that we might leave science altogether and that remaining in science is our choice. It is important to become conscious of that choice, no

matter what our constraints may be. It makes us aware of the compromises we subscribe to and the alternatives we do not seek.

The third level involves assuming our own active and responsible role in shaping science. Choosing topics for research. Choosing methods and forms of cooperation. Making our choices explicit. Informing the public truthfully. Building up research communities with an orientation to responsibilty. Adopting new ways of thinking carefully. Finding our own ways of combining the orientation towards values with clear thinking. Supporting one another. Forming networks of responsible action.

I neither mean to rank these levels as requiring more or less responsibility, nor to claim that they necessarily relate to temporal stages in the personal development of an individual scientist. However, I consider them useful in discussing science and ethics amongst scientists, because science is the common theme between us. But how well-defined is science? In distinguishing the levels above, I consider science embedded in the human world, and itself to be evolving and changing in time. I also see each one of us constituting science as it is in the process of becoming. Thus, the levels refer to a vast range of potential personal action profiles, ranging from individual decisions pertaining to specific scientific endeavours, to political activity pertaining to the public use of technology and to bringing about what is called a paradigm change in the philosophy of science.

Design for Preservation and Development

There are several disastrous trends associated with science and technology today:

- allowing individual unlimited growth,
- suppressing variety and upsetting the natural balance,
- destroying the physical conditions for life as we know it,
- attempting global control of non-masterable complexity,
- delegating human responsible decision making to machines.

Designing for survival takes the cooperation of all of us bringing in our different ideas, while each taking the perspective of the other seriously. That means respecting one another's cultural perspective as well as the needs connected with physical survival in dignity.

Some concerned scientists have proposed simple and effective notions for discussing the defensibility of technological options against the stark background of todays dangers. Very early on, the Club of Rome discussed the notion of *limits to growth*. Kurt Schumacher has proposed the notion of *small systems* as an alternative to the claim of global control. Ivan Illich has coined the notion of *convivial tools* as a basis for evaluating the merits of a technology in

human terms. Heinz von Foerster has proposed the ethical guideline: *Always act so as to increase the number of choices*. It relates directly to design.

These are examples for notions that we can use as language elements in our cross-cultural, value-oriented discussions. They need to be made concrete and tailored locally to the individual issues at stake. I can't attempt to do this for the variety of disciplines represented at this congress and whatever principles we would set up can only serve as a guiding image which needs to be made concrete and argued out by the participants in the actual situation.

Due to my specialization, I am most familiar with ethical questions arising in computer science. The driving force behind computer science was the rapid advance in technology, accompanied by a public willingness to attribute far-reaching powers to the computer. From the beginning, this development has given rise to questions about the relationship between human beings and computers in terms of their capabilities and their desirable interaction. These questions remain unsettled to this date and have a strong bearing on our thinking and decision making. The stand we take on them profoundly affects our development and use of information technology.

Computer science implicitly adopts a position according to which human beings are alike and in many ways inferior to computers. Equating human beings with computers rests on singling out the human faculties for rational thinking and functional behaviour, considering them on their own and abstracting from their connection with other modes of human experience. The fundamental assumption here is that human cognitive faculties can be meaningfully discussed in isolation, without taking account of our embodied and social nature constituted in the process of co-evolution with all living beings.

This exemplifies a distinct use of a mechanistic world view as a frame of reference in science. It is reflected in the self-understanding of the field as a whole, as well as in several of its sub-disciplines, notably Artificial Intelligence, Human-Computer-Interaction and Software Engineering. In my research, I have come across deep ethical questions pertaining to the design of computer-based systems in organizations. The core of these questions is: *how do we see human beings in relation to computers*? There is little discussion in computer science about how we can promote human needs or enhance subjective faculties in the context of computer-based systems. It is technology — for its own sake — with no clear relation to human concerns that is at the core of the discipline. But, in design, we relate the human world to the technical resources available in a way that creates conditions for human beings to live in.

I consider these design issues to be paradigmatic for many ethical questions arising in science and technology. I would even go so far as to say: we live in the age of design. Design, using our limited resources with care for preserving our conditions of life and with a view to the unfolding of higher quality; design with a dialogical attitude taking the needs of the other seriously, this seems to me the obvious way to go. The very core of science and ethics. Designing loosely coupled, small systems, fostering the human community and allowing responsible human action to take place.

But I can't, and no one can, give general answers to ethical dilemmas in scientific work: Will whatever has been thought sooner or later be done? Must we refrain from certain directions in research? Could we commit ourselves to a humanistic orientation in research and development? Can (must) lower goods be neglected for the sake of higher goods? Is nature a subject for ethics? Which ways of interference with nature are safe? Where does my

responsibility start and end? What good is it, if we abide by ethical standards, while others....? In my opinion, these questions are in principle undecidable. We decide them by taking our own stand, starting here and now and continuing in our daily practice.

The relevant question, then, is: *how can we promote ethical practice* ? In our specific milieu? In our scientific community? In society at large? Clearly we have to start at home, working daily on slowly transforming our own work and our dealings with our colleagues. Learning to perceive the choices we actually have. Stopping to let ourselves be driven by competitive power games. Changing our style of interaction. Working together towards transforming our research.

We may also formulate ethical guidelines to pledge ourselves to and to make our commitment explicit in our milieu. This needs to affect our teaching as well as our research, the distribution of funds, setting research goals and employing research methods. In order to be of use, such precepts have to become part of the work tradition of a community. Ethical guidelines do not in themselves guarantee value-guided action, but they provide a linguistic platform for discourse on questions of value. In figure 3, I offer an example for such guidelines which I have proposed for design in computing, orienting it explicitly to human concerns. Of course, this is only one of many ways to formulate such concerns. In the specific case, I have formulated these guidelines for a software firm in Germany who attempt explicitly to base their work in practice on value-oriented discussion. They have included these guidelines in the teaching materials for their new employees.

Observe a human measure

Place humans above technology

Foster community between human beings

Enable humans to act responsibly

Use technology to promote life

Respect human bodily nature

Enhance human potential and faculties

Make truthful claims about technology

Strengthen human autonomy

Enrich human work

Fig.3: Ethical Guidelines for Design — A Suggestion

I suggest that you might discuss the value of such precepts in your environment, develop your own, discuss them with your co-workers and use them as a guiding orientation in your professional practice. If we all work on orientations of this kind, each in our way, we will become effective.

The spirit of ethics is hope. The hope that we, through our actions, can contribute to the human community. It is very difficult to maintain this hope in our time of conflict, war and misery. Precepts pertain to commitment and self-limitation. They are compatible with discursive social mechanisms. governing research milieus, scientific communities, funding organizations, cooperation with the public, decision on technology design and use. Let us start by adopting ethical guidelines in science and design. Let us form networks of concerned scientists. If we join in common action, we do not know whether we will succeed. But we may support one another in trying seriously. And we may hope.

Suggestions for Further Reading

In view of the wealth of literature available on ethics, I confine myself to pointing out a few books dealing with questions at the borderline of science an ethics in a spirit similar to the one presented here.

Morris Berman: The Re-Enchantment of the World. Cornell University Press, Ithaca and London, 1981.

Gregory Bateson: Mind and Nature — a Necessary Unity. Bantam Books, Inc., Toronto New York London Sydney, 1980.

Ivan Illich: Tools for Conviviality, Harper & Row, 1973.

Humberto Maturana, Francisco Varela: The Tree of Knowledge, Shambala, Boulder CO, 1987.

E.F. Schumacher: Small is Beautiful, Abacus, London, 1974.

Heinz von Foerster: Observing Systems, Intersystems Publications, Riverside CA, 1984.

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