Reflections on the Philosophy of Technology
Culture of Technological Reflection[1]

by

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"Philosophers point out the liabilities, what happens when technology moves beyond lifting genuine burdens and starts freeing us from burdens that we should not want to be rid of." (Albert Borgmann)

"The unintended consequences and dangers of technologization are real, and they deserve reflections and replies. Meanwhile the deeper danger of cultural and moral devastation goes unnoticed and is to some extent eclipsed by attention to the overt dangers (which, to repeat, need to be addressed forthwith)." (Albert Borgmann)

I. INTRODUCTION

Human life is thoroughly mediated by technology. It is hard even to imagine a life that didn't involve at least some tools and devices. Today, it is even harder to imagine a life without complex technoological systems of energey, transportation, waste management, and production. Our world is mostly a constructed environment, and our technologies and technological systems for the background, context, and medium for lives. We rely on what we make in order to survive, to thrive and to live together in societies. Sometimes the things we make improve our lives, and sometimes they make our lives worse. Technological devices shape our culture and the environment, alter patterns of human activity, and influence who we are and how we live. Philosophy of technology is a critical, reflective examination of the nature of technology as well as the effects and transformation of technologies upon human knowledge, activities, societies and environments (Umwelt). The goal of philosophy of technology is to understand, evaluate and criticize the ways in which technologies reflect as well as change human life individually, socially and politically. It also examines the transformations effected by technologies on the natural world and nonhuman life and the ecospeheres. The assumption underlying the philosophy of technology is that the devices and substances we make and use transform our experience in ways that are philosophically relevant. That is, technology not only enlarges and extends our capacities and effects of changes in the natural and social worlds but also does so in ways that are interesting with respect to fundamental areas of philosophical inquiry. Technology poses unique practical and conceptual problems of epistemology, metaphysics, moral philosophy, and political philosophy. The task for a philosophy of technology is to analyze the phenomenon of technology, its significance, and the ways that it mediates and transforms our experience in the lifeworld. This article examines technological and cultural values through the mediation of science and technology in contemporary philosophy, and employs the perspectives of Andrew Feenberg, Patrick Heelan, Don Ihde, Bernhard Irrgang, and Carl Mitcham within the philosophy of technology and of technological and cultural hermeneutics.

From a Euro-American perspective technology is viewed to be connected with the sciences, while in South America the technification of sciences is located in the foreground. Thus, technologies can be understood as cultural instruments. Don Ihde as a representative of the North American phenomenology of technology would like to interconnect both traditions. Ihde understands technological development in terms of a social anthropology of technology of ecological systems -- as a technosystem, or as a technologically arranged ecological system. Its hypothesis turns out to be in contradiction to technological determinism: technology as applied

[1] I am grateful to Professor Robert Scharff (Philosophy Department, University of New Hampshire, USA) for

natural science or as a determinism of the technological development itself (Ihde 1990, P. 5). But these accounts are based on the incorrect notion that technological development takes place without any context, whereas the fact of the matter is that the phenomenological underpinning of a technology has an impact on the cultural environment of technological development. The philosophy of phenomenological technique examines the human-machine (human-technology) relations.

Philosophy of technology originated in Europe as philosophy of engineering and the philosophy of mind (i.e., an enlightened rationalism) with a goal of constructing the technological-scientific foundation of the engineering sciences. For the Spanish-speaking countries, however, the two existentialistic philosophers of technology are Ortega y Gasset and Martin Heidegger. Ortega y Gasset anticipates the phenomenological concepts of an environment and its mechanization. Ortega, Heidegger and Fernando Flores, (electrical engineer and industry minister of Salvador from 1970 to 1973) created the beginnings of a Latin American philosophy of technology. Gasset's book "Meditation over the Technology" were first published in 1936 in Chile, in a pirated edition. Heidegger's book "The Question Concerning Technology (Die Frage nach der Technik)" was translated for the first time into Spanish in 1983 in Chile. Among the central works of the Chilean philosophy of technology are: Marcos Garcia de la Huertas's work on "La technica y el estado moderno. Heidegger y el problema de la historia" (Santiago, 1978) and "Critica de la razon techocratica", translated into French in 1996 (Mitcham 1993, pp. IXX XXI).

For Latin American philosophy of technology, the impact is on the cultural dimension of the technology and its development, which are interpreted from hermeneutics as well as from a phenomenological perspective. For

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critics and suggestions on the subject.

the Hermeneutic understanding of technological practices[2], Don Ihde played a crucial role. At the central values one sees, for example, that technology is direct and needs satisfaction. A mythologization-history of technology is necessary in the sense of a cultural-technological way of life. Thus there are for example in the case of funeral rites, certain technical abilities are implied by this phenomenon (Ihde 1990, P. 18). For the phenomenological interpretation to technology, the body as *a priori* of the action is just as constitutive (Ihde 1990, P. 24) as the phenomenological materiality of technical articles. Technology is a certain way of practice and thinking, whereby tactile (tacit knowledge) of dealing with action is stressed. Don Ihde in *Technoscience and the 'other' continental philosophy/ Technoconstructions/ hermeneutics* argues that with respect to trends in Euro-American philosophy there has been a growing disparity between practices on the Continent and North America with respect to technoscience studies. Whereas in, particularly northern European circles, a new canon of topics and authors has risen to prominence with respect to science and technology studies, this same interest is virtually lacking in the institutional programs of North American continental circles. Reasons for the lack of interest in science and technology in North American continentalism are explored. The disparities between Europe and North America include temporal dimensions in which science and technology are read anachronistically in continental circles in North America; canonical dimensions in which different authors are read; and contextual dimensions regarding where technoscience studies occur. There are, however, problem sets such as 'realism and relativism,' 'relations of humans and non-humans,' and roles of 'textuality' which could be seen as overlapping interest areas. The essay attempts to locate and introduce the issues and authors of this 'other' continentally interesting philosophy and recommends that Euro-American philosophers in North America begin to catch up with the newer trends.

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[2] In Germany Hans Lenk, Walther Zimmerli, Hans Poser and Bernhard Irrgang have proposed a hermeneutic

Engineering philosophy of technology (EPT): The term "philosophy of technology" was firstly coined in the end of 19^{th} century by E. Kapp, as part of an attempt by technologists or engineers to elaborate a technological philosophy. Their main assumptions were: 1) the centrality of technology in human life; 2) the need to understand technology internally as a process or phenomenon; 3) human life and culture can be explained in terms of technology; 4) human life and culture should therefore also be organized in terms of technology.

Humanities Philosophy of Technology: EPT, as a focus area of philosophical interest, was a late phenomenon, and as an institutionalised discipline was even later (cf. philosophy of science). An attempt to interpret the meaning of technology through traditional forums (religion, poetry, and philosophical discourses) had these central assumptions: 1) modern technology has become central in culture, but it is potentially obscuring or destroying essential elements of life (connection to the romantic movement); 2) technology should be analyzed in non-technical or trans-technical terms; 3) concern with the moral and cultural boundaries of technology; 4) one should have a moral or political relation to technology.

Bridging the two traditions: Mitcham mentions some examples: The "Mensch und Technik Committee" of VDI Pragmatic phenomenology of technology (e.g. Dewey, Ihde) [Marxism] Mitcham's own project is (Mitcham 1994, P. 157) "to propose and develop a typology that can encourage an active dialogue with such previous attempts, protecting and ordering the insights they contain. While disclosing similarities and differences where necessary and appropriate, this typology should also reflect on ancient and modern making and using as is encouraged by social science studies."

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understanding of technology, which can be defined as technological hermeneutics.

Bernhard Irrgang in his trilogy on *Philosophie der Technik (Philosophy of Technology)* (Cf. Vol. I: Technological Culture, Instrumental Understanding and Technological Action; Vol. II: Technological Practice, Design Perspectives and Technological Development; Vol III: Technological Progress, Legitimation Problems and Innovative Technology) introduces the thesis of a phenomenological and hermeneutics point of view within the philosophy of technology. Based on the problems in scientific theory and technological sciences, and based on the concept of technological action and implicit knowledge, Irrgang uses a concept of the development of technological Know-how (technische *Koennen)* and knowledge -- which deals with social, institutional, cultural and ethical elements in society. In the center of the study, a philosophical reconstruction of technology within historical perspectives is developed. Thereby, question about technological and social progress is examined. Based on the concept of technological action and a hermeneutics of technological construction, Irrgang brought these two aspects together with social examples and the analysis of technical institutions. In his works, Irrgang has evaluated the philosophy of technology within the hermeneutics and phenomenology of technology.

II. Technoscientific Perspectives and Technolgy transfer in the Philosophy of Technology

A history of technology that distances itself from the old history of invention and analyzes innovation processes, i.e. the practical use of new technology in economic processes, proceeds from the assumption that adoptions of new technology through transfer, which appear like simple imitations from the macro-perspective, in fact entail the creation of technology, subjectively perceived as new. Technology transfer principally requires adjustment efforts to the conditions of the region, since in a world of varying natural and socio-cultural structures, the preconditions for sheer imitation are missing. The interconnection of Science and Technology seems to open a horizon for philosophy of technology in

European and American continents. But on the other hand, straightforward technologization of science and the scientification of technology again put the cultural dimension out of technological and scientific development. Within the philosophy of technology, the thinking about the relationship in both ways is mutually beneficial to each other. Don Ihde, a North American phenomenologist, contributed greatly, and his phenomenology of technology and cultural hermeneutics play a decisive and crucial role in this school of philosophy.

The approaches of innovation culture and technology transfer as cultural transfer cannot be conceptualized only historically-institutionally, but must also be done terminologically-methodically. A path of technological development is formed by tradition and innovation. Often it describes a certain shift after a phase of technological progress. However, frequently enough it is connected with visions of progress, at least of the technological means. Speed of innovation differs and depends on cultural factors. Acceptance, cultural assimilation and the interaction of technological paradigms are necessary preconditions for standardisation processes and successful technology transfer. The enforcement of a paradigm requires co-operation and co-ordination. Technology transfer without appropriate cultural transfer is not sufficient: it produces more environmental problems than it possibly avoided. Technology transfer also changes the basic cultural conditions of a society. Heteronomous cultural transfer encounters culturally motivated resistance or neglect. Technology transfer does not automatically lead to modernization, but to forms of development that are culturally adjusted. This process can be mastered by taking the embedding paradigm into account (Irrgang, 2005). At this junction, the processes and paradigms are to be analyzed in the proposed project. Adapted technology is a social and cultural status that is not inherently present in technology. Therefore, technology must be modelled on certain culturally shaped ideals of security, on ideals of the user or environment. However, handling is a cultural evaluation criterion, which is frequently shaped by prejudices (e.g. concerning users) or by once own conceptions of security and environment. These unconscious prejudices and cultural orientations have to be admitted, reflected and discussed. This is the main task of technology reflection culture (Irrgang, 2002a; Irrgang, 2002b).

On the other hand, Don Ihde in his paper *Technology as Cultural Instrument* (1992: Phenomenology and Indian Philosophy) argues to the effect that technoloigy, rightly viewed, i.e. phenomenologically understood, is an essential of socio-historically situated human nature. It is basically cultural articulation of man and not an external adjunct. Ihde, then proposes a thesis of *technology transfer is in effect a sort of culture transfer.* Materiality of technological culture does not negate its cultural or human underpinnings. Therefore, whenever some form of technology, agricultural or metallurgical is transferred by way of import of export it carries with it a whole set of human relationships. Transfer of technology is to be understood as a sort of inter-cultural encounter and gradual accomodation, not confrontation. Differences of culture promotes and provides for mutual learning and not necessarily entailing clash and conflicts[3].

Today, more than ever before, there is an urgent need to understand the global imperative of modernization and its atttendent idom of globalisation. We require an understanding of science and technology on the basis of culture, wisdom, ecology and ethical values. The process of current globalisation is emerging into a cultural, historical, ecological phenomenon. At the same time, this change is adding an ethical dimension to the development of technology, which has an orientation to the understanding of techniques, technology and science. In the last thirty years our world have seen the emergence of cultural understanding of

[3] Along the similar line of ideas, Professor Hans Poser (TU Berlin) in (1991-93) in the papers *Die kulturelle Vielfalt und die Förderung wissenschaft-technischer Innovationen* and *Technology Transfer and Cultural Background* argues for technology transfer as a culture transfer.

technology and scientific knowledge. These developments are inspired from the American philosophy of technology and continental phenomenology. Their understanding of technological action as the basis of implicit knowledge and motivated by Martin Heidegger's understanding of technical action as an acquaintance with >>Zeug<< (Heideggerian terminology) and developed into a cultural-institutional understanding of technology -- which has allowed and formed into a new shape and design of technology. This has become the foundation of technology assessment in philosophy, technology and ethics research (Irrgang, 1996; Irrgang, 2001a).

Later, system-theory analysis (employing cybernetics to control technology) has given us a model of social anthropology of technological and cultural development in technological practice. Thus, we can see an adaption and processing of nature as the resource. The development of population, urbanisation and the development of technical institutions can be seen as an esteemed and distinguished central determination of a component of technological development. In the center of our research, we can perceive the reconstruction of industrial revolution as an essential phase of technological development in the two phases: changes of working organization by the use of implementation of implicit technological knowledge in the areas of textile industries and the changes of resource basis by the use of conversion of coal as an energy medium. The central analysis and anatomical artefact is also the integration of technological understanding into everyday life. Thus, changes coming from mass production and the consumer society in the industrial civilization can be witnessed. In the center of study, we have questions of transcultural technology-transfer, eco-social technological modernization and the development of scientific theory of technological sciences and technology. Also in this area, the understanding and meaning of societal issues, for example works, as the guiding principles for technological construction of artefacts can be seen in terms of the conceptual design of technological expression and formation of technological and ethical values (Irrgang 1998; Irrgang, 2002a, Irrgang, 2002b).

Revolution in Techno-Science for the Contemporary World: Imaging Technologies: Science as Visual Hermeneutic: Although optical technologies such as the camera obscura and lenses were known since Medieval times (cf. noted by Al Hazen 1038), imaging technologies became much more central to science practice since the 19th and, particularly, mid-20th centuries. Don Ihde in "Imaging Technologies" examines the trajectories which first were dominated by 'isomorphic' representations in early modern science, to the multiple trajectories of imaging processes in 20th century developments. Don Ihde shows that a philosophical examination of the implicit and explicit epistemologies indicates that there needs to be an account which moves away from modern representationalist epistemology to a more 'praxis-perception' model of knowledge production. Reframing imaging technologies as implicit phenomenological hermeneutics is claimed as a more adequate model for the understanding of science practice. The Development of optics brought about a whole new picture of reality. Early Greek philosophers already knew that what they called "visual rays" had properties: Euclid said that they travelled in straight lines; Aristotle that they inverted themselves, as he observed on the ground the upside-down image of a solar eclipse; and Ptolemy that different materials had different reflectance properties. Only centuries later, when Al Hazen (965-1039) and Roger Bacon (1214-1294) reopened the quest for the properties of light, did instruments specifically designed to use light came to exist.

History of Camera Obscura: The Camera Obscura is derived from the Latin word camera meaning "room" and Obscura meaning "dark" (and translated as "darkroom"). The phrase is believed to have been first used by the German astronomer Johannes Kepler in the early 17th century. The Camera Obscura is a natural effect of physics, such that if a small hole is made in the wall of a completely darkened room, an inverted image of the scene outside the window will be produced on the opposite wall of the room. This is due to the fact that light travels in a straight line and when some of the rays reflected from a bright subject pass through a small hole in thin material they do not scatter but cross and reform as an upside down image on a flat surface held parallel to the hole. This is also true for a very small hole in a dark box will direct light to create an image inside the box turned upside down, which formed half of the basis for the discovery of photography. Light sensitive material formed the other half.

The physics of pinhole reflection of the outside world from a darkened room dates back to the Chinese philosopher Mo-Ti in the 5th century, BC. Mo-Ti called this darkened room a "collecting place" or the "locked treasure room." Aristotle in 384-322 BC, also understood the optical principle of the camera obscura. It was first described outside China by the Arabian scholar Alhazen of Basra in about 1030. Then Leonardo DaVinci more famously documented it in 1490 in his notebooks. Others like Dutch scientist Reinerus Gemma-Frisius used a camera obscura in 1544 for observing a solar eclipse. In 1558 Giovanni Battista Della Porta in his book Magiae Naturalis recommended the use of this device as a drawing aid for artists. Many of the first camera obscuras were large rooms and then compact boxes. Later in the 16th century the box camera obscura's were improved with the addition of a convex lens into the aperture, which provided for better image quality. Then, the later addition of a mirror was used to reflect the image down onto a viewing surface. The developments of the camera obscura's box design matured by the early 1800's so as to make it ready to accept light-sensitive materials without much modification, and this aided in the discovery of photography. Darkrooms, parabolic mirrors, and lenses were objects of amazement if not cult, and many faced prison and death for heretically playing with nature and truth by such means. Bacon in his Opus Magnus had foreseen how "pictures could be projected in the space, into air, where they could become visible to the multitude". Ali Al-Hazen ibn Al-Haytham was an expert in Philosophy, Physics, Mathematics and the knowledge of Medicines. He was a great discoverer in optics. Before Ali, people thought that we can see only for the reason that our eyes emit lights which comes back to our eyes after reflection form the objects. Most of his research work is on light that he describes in earlier of 10-11th century is now tested and proven correct, according to the latest knowledge using latest techniques. He discovered the rule of magnification using concave and convex lenses and mirrors. He is the person who first found the relationship between light source, lens and resultant image. That is why it is called the "Al-Hazen Theorem". He also explained how an eye can see. He said that we can only see when light falls on that object and reflects back to our eyes. The Camera Obscura, translated as darkroom, dates back to the Chinese philosopher Mo-Ti in the 5th century BC. However, it is documented by Leonardo DaVinci in his 1490 writings. Camera Obscura is the physics that a very small hole in a box in a very dark room on a bright day will direct light to create an image, that is outside the hole, turned upside down.

Technoscience has gained enormous presence in the contemporary world, culturally, physically and epistemologically. Ihde argues all science in its production of knowledge is technologically embodied. Human embodiment implies bodily action, perception and praxis. Scientific knowledge production grounded in cultural and historical realities will be the basis of multicultural origins of technoscience. According to Ihde, astronomy and associated cosmology are the latest revolution in imaging technologies (in comparison to Irrgang, who claims the revolution of technoscience had started during the period of Harappa, industhal civilization, and Maya cultures). Telescopes mediate human perception in a new way: the embodied observer now takes up a technology which at first is literally located between one's active body and the object observed. The technological limits remained largely isomorphic with human bodily limits, with visual limits, claims Ihde.

III. Human-Technology Relations in the Lifeworld

Americans tend to think of technology as objects, usually tools or instruments. For example, we talk about a gun as though that in itself were "a piece of technology." People believe the neutrality claim about technology because objects themselves don't act. The neutrality claim is a truism that comes from thinking of technology as objects that are used by humans; hence, only humans are morally responsible for what happens. The objects cannot be blamed; hence, technology cannot be blamed. As the philosopher Martin Heidegger ("The Question Concerning Technology") suggests, this line of thinking leaves us only with the question of when (and how) we will bring technology under moral control. Heidegger asks, however, what is the essence of technology? Perhaps, in essence, technology is far more than mere tools and instruments. It is important to note, "Technology is not good or bad, but they can do bad and good things" -this thesis is the neutrality of technology view (shared in common by Marxists and liberals)that Heidegger undermines by showing that technologies tend to serve technologization, that is, the reduction of all entities to intrinsically-meaningless resources standing by for optimization. I think, for us to be able to use technology without being used by it, we need to recognize that it is not neutral, that it tends to turn us into optimizers. Only then can we use technologies in a positive way that resists this underlying technologization. (This is developed in a dialgoue with Andrew Feenberg (author of "Questioning Technology") in the second chapter of Iain Thomson's new book, "Heidegger on Ontotheology: Technology and the Politics of Education" (Cambridge University Press, 2005).

Martin Heidegger advanced two approaches to technology: first, in "Sein und Zeit" (1927; English trans. "Being and Time" 1962), that of

technology as an implicit or hidden presence in the human lifeworld; second, after the famous "Kehre" (turn), or "turn," that of technology as a form of truth or revealing. The early Heidegger developed an understanding of (technological) experience in "Being and Time", paragraphs 14-18. In the analysis of human existence as a "being-in-the-world" he discovered the everyday character of engagement with equipment as prior to any theoretical presence of objects. As is implicit in the Greek naming of objects as "pragmata", Heidegger argues that technical praxis is the experiential context from which all science is abstracted. It is more
accurate to describe science as theoretical technology than technology as applied science. But this "Being and Time" analysis of human interaction with entities or beings is no more than a moment in Heidegger’s larger attempt to understand the "meaning of Being."

Now, turning from the focus on the meaning of Being that predominates in his early work, Heidegger's later thought develops a more explicit philosophy of technology. In "Die Frage nach der Technik" (1954; English trans. "The Question concerning Technology", 1977) he argues that technology is not just a practical engagement with the world but a revealing, reveling, a disclosure or truth about the world. What modern technology in particular reveals is the world as "Bestand", that is, stock or resources subject to human manipulation. The coming upon the world as "Bestand" that is operative throughout modern technology as such Heidegger names "Gestell" or (enframing), the promotion of which is for contemporary human beings not something that they simply choose to use or not but a "Geschick" or (destiny). Like any destiny, however, technology as "Gestell" carries with it both opportunity and danger. The opportunities provided by technology are pervasive in the modern world, but the dangers
are more hidden and go deeper than the simple risks so commonly associated with technology, such as the risks of automobile accidents or

environmental pollution. The most profound danger is that the disclosure of the world as resource will overwhelm the event of disclosing itself, that the experience of one particular kind of truth will obscure the more primordial truth of Being. The ultimate challenge of modern technology is to be true to the greater human destiny of disclosing in the midst of a technological destiny.

On the other hand, Ihde's *Technics and Praxis* is an introduction to the phenomenology of instrumentation. The essays assembled in the book deals with technology from a phenomenological perspective. Ihde provides many examples of the application of phenomenological analysis to sample tools (e.g. chalk, telephone, telescope, etc.) of technology, which could be important for students studying physics under philosophy of science. At issue is the relation between the human using tools, and either the tools themselves as they present the world (known as "hermeneutic relations") or the world itself as it is experienced through the tools (known as "embodiment relations"). Ihde diagrams these two situations respectively, as:

Human -> (machine -> World)   and (Human-> machine) -> World.

How, Ihde ask, do the tools of technology transform human experience? This, it seems to me, is a central question linking physics or any other natural science to the social sciences and humanities. How does science transform experience in our everyday life? Ihde has more precisely expanded the above thesis of *human experience with tools in everyday life* as *four relations* in his *Technology and Lifeworld* book. Ihde argues in *A Phenomenology of Technics* excerpted from *Technology and Lifeworld: From Garden to Earth*, that human life has always been suffused with technology. Ihde makes no sweeping claims about technology as such. Instead, Ihde provides a perspective and framework to analyse our experience of technology. The method of analysis is phenomenology, a descriptive method premised on the idea that experience is always relational. The "intentionality of consciousness" of which Ihde writes means that every instance of experience has its reference or direction toward what it is experienced. The aim of phenomenological description is to identify the essential or invariant features of experienced phenomena. Ihde undertakes a phenomenological description of several sets of human-technology relations in order to analyze how technologies often mediate and transform our experiences. A phenomenology of human-technology relations shows that the structural dimensions of technological mediation produce a range of possible experiences.

According to Ihde, when we consider the ways our everyday experience is mediated by technological objects, we find several unique sets of human-technology relations, each positioning us in a slightly different relation to technology. One set of relations Ihde calls "embodiment relations" with devices we use to experience the everyday lifeworld and that, at the same time, alter and modify our perception of the world. (Devices, for examples glasses, hearing aids, writing implements, and the handheld tools.) Another set of Ihde calls "hermeneutic relations" that involve instruments that we read rather than use tools. (Devices, for examples clocks, thermometer, spectrographic devices, and other technologies with visual displays, which must be interpreted to be understood.) A third set is "alterity relations", in which technologies appear as "other" to us, possessing a kind of independence from humans as creators and users. (These devices includes things like toys, robots, ATM machine, computer games and visual technologies that we interact with as if they are autonomous beings.) The final fourth set is "background relations," in which technologies form the context of experience in a way that is seldom consciously perceived. (This set of devices includes, for examples the lighting, air conditioning, clothing, sgelter, and automatic machines that operate in the background subtly affecting our everyday exeprience.

Irrgang and Nestor Corona in the book Technik als Geschick? (Technology as Destiny?), elaborate the model of a technological action (technisches Handeln) within a cultural and social context. This kind of model of action also explores the model of a technological development in our society and can be implemented in engineering sciences and be the basis of an ethical act. First of all, Corona/Irrgang's model investigates the meaning and model of technological action with respect to their development from the cultural and social perspectives. Artefacts like tools, machines or technological structures are the consequences of technological action. They are used for certain purposes and to realise certain goals. This process is defined as the forms of collective technological action and is also oriented with respect to certain forms of technological ethics (Technikethik). This model takes the account of implementation of technical-technological action into the automation and digitisation of technological knowledge in the modern technology.

On the other hand in describing post-phenomenology, Ihde displays a vast knowledge of subject areas as varied as the history of mapping and navigation, NASA statistical information, technology transfer data, and contemporary trends in the philosophy of science, enabling him to make insightful and innovative connections between topics of interest. Post-phenomenology is an investigation of the relationships between global culture and technology. Ihde applies the unified theory by what he describes as "a concern which arises with respect to one of the now major trends of Euro-American philosophy—its textism." Ihde writes, "I show my worries to be less about the loss of subjects or authors than I do [there] not being bodies or perceivers." Further, by exploring post-phenomenology Ihde addresses the cultural role of technologies in relations to perception, multiculturalism, and technoscience, and gives special consideration to the impact of image technologies, such as television and cinema, upon the contemporary world. In Body and Identity in Virtual Space, Ihde concludes the body should not be forgotten or separated from the subject in the new media design, because body is an essential part of our existence (Cf. Ihde's whole body perception, based on late works of Maurice Merleau-Ponty). Physicality or corporeality (in other words, it is also defined as natural embodied selves) is something that connects us to the world and other people. The ideas of embodied experience and perception and physicality are carried through the extending process, but much more could have been done with them. In terms of the language of embodiment, Merleau-Ponty took account of the way in which technologies may be embodied, such as the blind man's cane or the woman's feathered hat. In the first instance, the cane/roadway touch is what the walker experiences—his body is extended through the cane, which becomes part of his Here-Body Experience (based on Ihde's concept of extending the here-body phenomenon).

The most important philosophical questions today concern how to live with and criticise science and technology. The merger of science and technology in what is sometimes called Techno-Science, and the influence of Techno-Science on all aspects of life and world, constitute the distinctive character of our historical period. As human beings we strive to realise the good, and we do this in our history just much as in our bodies; our embodied histories are thus realities to be accepted as givens and to be transformed by our actions. The dialectic between acceptance and criticism, between yes and no, in the technoscientific context, is what today constitutes the human condition. The rise of modern science and technology has presented a series of challenges to society. In the 1500s and 1600s (with the Scientific Revolution led by such figures as Galileo, Bacon, Descartes, and Newton) and again in the 1800s (with Darwin) conflicts arose between science and religion; these conflicts have continued into the present. In the late 1700s and 1800s (with the Industrial Revolution led by inventors such as Watt) special problems arose for economics and politics; these problems have been resolved by neither capitalism, socialism, nor democracy. Mitcham claims, "The 20th century advent of nuclear weapons, electronic computers, and biotechnologies—followed by 21st century globalization—have only intensified multiple challenges that range across issues of personal belief and social justice to nuclear risk, environmental pollution, cultural integrity, and self-identify." "Issues of professional ethics and responsibility among scientists and engineers, as well as science and technology policy, are further dimensions of STS studies," says pragmatist Carl Mitcham.

Techno-Science, in its contemporary meaning, applies to the sciences which are technologically embodied and which produce knowledge through instruments and technologies. Thus it is necessary that in addition to the previous histories of theory and speculation, one must also explore the histories of technologies to deeply understand science. Carl Mitcham has shown the interdisciplinary and cultural embeddedness of technologies and Don Ihde has shown how the natural sciences are also framed by technologies and interpretative techniques. Indeed, Ihde has recently argued that even ancient science (astronomy) has since its beginnings entailed the uses of technologies in measuring perceptions to produce lasting knowledge. And although the Renaissance enhanced and re-introduced close relationships between science and technology, earlier periods such as in the Hellenic and Islamic periods also showed this same close relationship. In contemporary times, the interactions of science and technology have become so intertwined that the term 'Techno-Science' seems most appropriate. The increasing popularity of the term 'Techno-Science' as a description of the relations between science and technology is also suggestive of other ways in which science and technology are entwined. Historians of science have a saying: "Science owes more to the steam engine than the steam engine owes to science." Historically, the steam engine developed without much explicit use of scientific theory; yet it inspired the ideas of entropy and the second law of thermodynamics.

The machine, not raw nature, suggested the phenomena.[4] The history of science is filled with important theories and discoveries based upon observations of technologies, for example, thermodynamics comes from the steam engine as historians claim. Phenomenologist Don Ihde develops the concept of Techno-Science by examining several cases of life-world practices which relate to scientific developments, including cannon warfare and ballistics, railway schedules and clocks for special relativity, etc. Later Ihde focus upon technologies which become explicit models for knowledge production. In his philosophical studies, professor Don Ihde examines the role of the camera obscura for early modern epistemology and then the 'return of the book of life' for contemporary epistemology.

In the book "Technology and the Lifeworld" (1990) Ihde focuses on human-technology-relations and the cultural embeddedness of technologies. Following a relativistic ontology Ihde draws a distinction between the "direct bodily and perceptual experiences of others and the immediate environment" and the "technologically mediated experiences (embodiment)" (Ihde 1990, P. 15). And he suggests to look for different degrees of mediation in our technologically textured world. The position to conceive technology as instruments to transform something can be blamed for a Cartesian and subjectivist bias: It is supposed that a self or a subject can use a thing as an instrument to effect something in the outer world. But is it reasonable to speak of a subject, if the technological instruments change the status of subjectivity? Who is the subject in an atomic plant? The clear-cut limits between subject and object become disturbed. "Technics is a symbiosis of artefact and user within a human action." (Ihde 1990. P. 73) The material relation between the humans and the world should be conceived as a symbiotic and mediated relation instead of a divided and instrumental one.

IV. Hermeneutics of Technology

[4] Epistemology Engines: An antique optical device has powered several centuries of scientific thought, Don Ihde

Philosophers and scientists are responsible to give an account of the development of STS relationships and to give an account of the interdisciplinary STS studies field as a scholarly activity. Interdisciplinary researchers compare and contrast different approaches to the analysis of STS relationships. The goal is to develop an informed appreciation of the problematic character of the relations between science, technology, and society.

Coming from the school of critical theory in Frankfurt (where Juergen Habermas, Adorno, Herbert Marcuse and Horkheimer have studied), Andrew Feenberg proposes the solution to the problems of philosophy of technology from the political perspectives. Currently Feenberg is the most prominent and productive philosopher in the area of technology and politics. He has made original contributions both to technology studies and political theory. Feenberg does not hesitate to lay bare the skeleton of his argument in clear and helpful charts in *Questioning Technology*. Andrew Feenberg's recent contribution to the critical theory of technology, *Questioning Technology*, is best understood as a synthesis and extension of the critiques of technology developed by Heidegger and Marcuse. By thus situating Feenberg's endeavor to articulate and preserve a meaningful sense of agency in our increasingly technologized lifeworld, Thomson elaborates that some of the deepest tensions in Heidegger and Marcuse's relation re-emerge within Feenberg's own critical theory. Most significant here is the fact that Feenberg, following Marcuse, exaggerates Heidegger's 'fatalism' about technology. Thomson in his investigations contends that this mistake stems from Feenberg's false ascription of a technological 'essentialism' to Heidegger. Correcting this and several related problems, Thomson reconstructs Feenberg's 'radical democratic' call for a counter-hegemonic democratization of technological design, arguing that although this timely and important project takes its inspiration from Marcuse, in the

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end Feenberg remains closer to Heidegger than his Marcuseanism allows him to acknowledge.

In *Questioning Technology*, Feenberg accuses Heidegger of an untenable 'technological essentialism'. Feenberg's criticisms are addressed not to technological essentialism as such, but rather to three particular kinds of technological essentialism: ahistoricism, substantivism, and one-dimensionalism. After these three forms of technological essentialism are explicated and Feenberg's reasons for finding them objectionable explained, the question whether Heidegger in fact subscribes to any of them is investigated. The conclusions are, first, that Heidegger's technological essentialism is not at all ahistoricist, but the opposite, an historical conception of the essence of technology which serves as the model for Feenberg's own view. Second, that while Heidegger does indeed advocate a substantivist technological essentialism, he offers a plausible, indirect response to Feenberg's voluntaristic, Marcusean objection. Third, that Heidegger's one-dimensional technological essentialism is of a non-objectionable variety, since it does not force Heidegger to reject technological devices in toto. These conclusions help vindicate Heidegger's ground-breaking ontological approach to the philosophy of technology. Professor Feenberg, in *The Ontic and the Ontological in Heidegger's Philosophy of Technology: Response to Thomson* (published in Inquiry, Volume 43, No. 4 / December 1, 2000, pp. 445–450) comments that, Iain Thomson's critique is persuasive on several points but not on the major issue, the relation of the ontological to the ontic in Heidegger's philosophy of technology. Feenberg's reply attempts to show that these two dimensions of Heidegger's theory are closely related, at least in the technological domain, and not separate, as Thomson affirms. It is argued that Heidegger's evaluations of particular technologies, the flaws of which Thomson concedes, proceed from a flawed ontological conception.

Philosophy of technology, therefore, promises the possibility of an understanding of technology that may be important not only to public policy but also in helping to conceptualise intellectual approaches to the study of technology and, indeed, to shaping new fields of knowledge and research. Philosophy of technology may also have a role to play in relation not only to structuring a largely disparate and inchoate field but also more directly in teaching and learning about technology. These are only promissory notes to be redeemed, if at all, at the end of the paper after our investigation.

We might make even grander claims for philosophy of technology. Just as economic growth theory now postulates an endogamous model where technology is considered as a factor intrinsic to development, in society and education the notion that technology is an autonomous system operating neutrally has come under increasing scrutiny. Rather than considering technology as something separate from daily life and from society at large, philosophers and sociologists now contemplate the way in which technology structures our institutions and impacts upon all aspects of our existence. Clearly, technology has permanently altered the labour process and our conception of labour in post-industrial service-oriented societies and it continues to transform our notions of intellectual labour. With the environmental movement, as Feenberg (1999) comments, technology entered the charmed circle of democracy.

Yet as a field, philosophy of technology is both a recent and a poor cousin to philosophy of science. Philosophy of science has had little time for either technology or the relation between science and technology. Technology was not seen as philosophically interesting. Traditionally, in standard accounts, technology often has been seen as synonymous with industrial technology that came into existence on the back of Enlightenment science and flourished in the nineteenth-century to develop exponentially and in a myriad of different directions in the twentieth century. On this conception it was seen as the handmaiden of science, a kind of applied knowledge that put into practice the pure theory of science. This standard liberal 'engineering' account is now being questioned, modified, refined and, alternative theories are being developed.

Hans Achterhuis (2001, P. 3) distinguishes between the classical thinkers of technology and the American philosophers of technology, maintaining The classical philosophers of technology occupied themselves more with the historical and transcendental conditions that made modern technology possible than with the real changes accompanying the development of technological culture. Achterhuis (2001) suggests that American philosophy of technology can be broadly characterised by an empirical turn that took a constructivist direction that opened up the black box, analysing the formation of technological processes and describing the social forces acting upon them. Technology was no longer considered autonomous or monolithic but rather comprised of many distinct technologies that needed to be analysed separately. Rather like the empirical turn that philosophy of science took after Kuhn, so too American philosophers of technology began to investigate in actual contexts the ways in which technology and society influence one another. The terms 'technoculture' and 'technosociety' on the one hand speak to the way classical philosophers had disembedded processes of technology, while on the other, recognising how technology itself is a social activity, which is given a particular cultural form.

Herbert Marcuse clearly continues the Heideggerian programme in insisting that technology is the source of most of the difficulties that advanced industrial societies face. Indeed, technology and technological rationality (which has become a form of political rationality) has contained social change, especially progress that comes from the struggle of classes, and extends a system of domination that co-opts all possibility of protest. He also carries through Heidegger's argument that technology can no longer be regarded as neutral: In the face of the totalitarian features of this society, the traditional notion of the 'neutrality' of technology can no longer be maintained. Technology as such cannot be isolated from the use to which it is put; the technological society is a system of domination which operates already in the concept and construction of techniques (Marcuse, 1964, P. xvi). Yet as Marcuse argues in *One-Dimensional Man* (1964) while advanced industrial society is capable of containing qualitative change there are "forces and tendencies exist which may break this containment and explode the society" (P. xv). Here, Marcuse, under the influence of a humanist Marxism, departs from Heidegger to emphasise historical theory and practice, the possibilities of transformation, and historical alternatives based on subversive tendencies and forces. Marcuse borrows a Marxism utopianism based on a concept of human collective agency, although he is quick to point out that the kind of struggles will no longer be necessarily class based because technical progress has "abolished labour" and transcended the realm of necessity, where it serves as an instrument of domination, to become "subject to the free play of faculties in the struggle for the pacification of nature and society."

Feenberg's (1999) *Questioning Technology* is, perhaps, the most comprehensive introductory texts in philosophy of technology. It is the third book in a trilogy dealing with technology, including *Critical Theory of Technology* (1991) and *Alternative Modernity* (1995). In *Questioning Technology* Feenberg takes the constructivist turn against all forms of essentialism. As he writes: The "essence" of actual technology, as we encounter it in all its complexity, is not simply an orientation toward efficiency. Its many roles in our lives cannot be captured so simply. This is the burden of constructivist sociology of technology, which affirms the social and historical specificity of technological systems, the relativity of technical design and use to the culture and strategies of a variety of technological actors. Constructivism, in short, has introduced difference into the question of technology (Feenberg, 1999, P. x). Feenberg argues against both essentialism and its cousin–determinism–to put forward a political theory of technology which embraces the social dimensions of technological systems, including their impact on the environment and workers' skills and their role on the distribution of power.

V. Hermeneutic approach to the Science and Technology

This section provides an overview of the hermeneutic and phenomenological context from which the idea of a "constitutional analysis" of science originated. Hermeneutics and scientific research analyzes why the approach to "hermeneutic fore-structure of scientific research" requires transcending the distinction between the context of justification and the context of discovery. By incorporating this approach into an integral "postmetaphysical philosophy of science", the author argues that one can avoid the radical empiricism of recent science studies while also preventing the analysis of science's discursive practices from collapsing into the frames of radical anti-epistemological critique mandated by some hermeneutic philosophers. The initial obstacle to the development of a hermeneutics[5] of the natural sciences has been the inadequate translation, and thus misunderstanding, of the basic terms of Heidegger's ontological analysis of the protopractical human situation and its progressive technicization.

The hermeneutic-phenomenological approach to the natural sciences has a special interest in the interpretive phases of these sciences and in the circumstances, cognitive and social, that lead to divergent as well as convergent interpretations. It tries to ascertain the role of the hermeneutic circle in research; and to this end it has developed, over the past three decades or so, a number of adaptations of hermeneutic and phenomenological concepts to processes of experimentation and theory-making. The purpose of the present essay is to show how appropriate

[5] Robert Crease on Hermeneutics and the natural sciences.

these concepts are to an important current research program (solar neutrinos) and thus to point out what difference they make to our understanding of science as a whole. This goal is pursued by means of comparison. The program of social constructivism in natural science has produced alternative but parallel concepts, embodied in an alternative and parallel vocabulary. An effort is made in this essay to show the intrinsic hermeneutic nature of the natural sciences by means of a critical reflection on data taken from the history of classical mechanics and astronomy. The events which eventually would lead to the origin of Newton's mechanics are critically analyzed, with the aim of showing that and in what sense the natural sciences are essentially interpretive enterprises.

Ronald Giere on Cognitive Science and its Application to Philosophy: In reading Giere and Hacking, one can agree with their conclusions while having reservations about what their contributions mean for the advancement of the philosophy of science. Both claim to be philosophers but employ mostly logical and empirical (social, historical) arguments. In what sense are their arguments philosophically framed? And in what traditions of philosophy are they working to be convincing or, at least, progressive? Contexts of philosophical discourse can be 'light' or more 'serious'.

By 'light' philosophy, Heelan means, the critique of science from a higher viewpoint than that of actually doing science itself; such as, asking questions about the 'heuristics' of research, or its 'logic', defending 'science' in the public forum against its nay-sayers. All of this has its place and gets it value from the fact that it is widely intelligible to non-philosophers, and re-assures the public that rationality still rules this most important sector of global culture. In this respect, Giere and Hacking are very good, and within the context of 'light' philosophy, Heelan agrees with them. But do they ask or attempt to answer deeper philosophical questions? They are telling us that we don't have to be Enlightenment thinkers to be scientific thinkers. Is this important? Yes! Historically and sociologically! But what replaces the Enlightenment philosophy? This asks for a positive answer ... and it is not easy, largely, because of the unique role that science played in the Cold War to save traditional European values.

By 'serious' philosophy, Heelan means, first of all, establishing the role of philosophy as the most universal (transcendental) context for human intelligent life, and placing science within this largest context. Since Kant, we know that it has to be transcendental, that is, the a priori conditions of possibility of the natural, social, biological, and historical sciences -- or more broadly, of human life and culture. Kant's solution was an important new beginning, but since the turn of the 20th century the history of these sciences has shifted the transcendental question from the emergence of classical natural science to the emergence and development of human embodied subjectivity that is (clearly) the a priori of these later developments. The role of philosophy then is that of defining the emerging shape of the a priori transcendental principles that have made possible the recent history of the sciences and the embodied (technological) human culture that flows from them and is revealed by these developments.

Question: what is the relationship between our physicality and our subjectivity as agents in the world? This is where Hans Lenk is different from Giere and Hacking; Lenk understands that philosophy has to go beyond Giere and Hacking, while welcoming them as contributors to the larger questions but as not yet able to ask the larger questions.

Debate over the nature of science has recently moved from the halls of Academia into the public sphere, where it has taken shape as the "science wars." At issue is the question of whether scientific knowledge is objective

and universal or socially mediated, whether scientific truths are independent of human values and beliefs. Ronald Giere is a philosopher of science who has been at the forefront of this debate from its inception, and Science without Laws offers a much-needed mediating perspective on an increasingly
volatile line of inquiry (Giere, 1999).

Giere does not question the major findings of modern science: for example, that the universe is expanding or that inheritance is carried by DNA molecules with a double helical structure. But like many critics of modern science, he rejects the widespread notion of science--deriving ultimately from the Enlightenment--as a uniquely rational activity leading to the discovery of universal truths underlying all natural phenomena. In these highly readable essays, Giere argues that it is better to understand scientists as merely constructing more or less abstract models of limited aspects of the world. Such an understanding makes possible a resolution of the issues at stake in the science wars. The critics of science are seen to be correct in rejecting the Enlightenment idea of science, and its defenders are seen to be correct in insisting that science does produce genuine knowledge of the natural world (Giere, 1999).

Giere is utterly persuasive in arguing that to criticize the Enlightenment ideal is not to criticize science itself, and that to defend science one need not defend the Enlightenment ideal. Science without Laws thus stakes out a middle ground in these debates by showing us how science can be better conceived in other ways.

Don Ihde says many interesting things, mostly about technology-studies; Heelan argues, that, Ihde glosses over how and why they are -- or should be -- relevant for philosophy. Philosophy is the higher comprehensive context for all such scientific and sociological studies: how do these latter, in themselves fine scholarly works, fit into philosophy, or rather: what is this thing, philosophy, and how does it query technology and how it is used?

Heelan agrees with Ihde about Heidegger's importance as a critic of (scientistic) technology; but technology need not be looked at scientistically; it can be re-contextualized and looked at philosophically -- and even in Heidegger's own terms. Though Heidegger himself did not do this formally; it was not an inquiry that interested him. He did, however, indirectly point out how to go about it.

Blackwell Publishers, long recognized as a major publisher of philosophy, recently published another of its philosophy anthologies, Philosophy of Technology: The Technological Condition, edited by Robert C. Scharff and Val Dusek (2003). This anthology takes its place alongside previous volumes on metaphysics; epistemology; and analytic philosophy; or, if more appropriately one should list philosophy of technology alongside newer fields, then it takes its place alongside volumes in bioethics; minds, brains and computers; and environmental ethics." Ihde correctly wants a philosophy of technology to address the materiality of its object. Materiality, however, has two poles, objective and subjective. Science studies address the materiality of technologies–the reproducible effects technologies cause in the sensible physical and cultural environment. There is also the subjective materiality or 'embodiment' of the human user whose embodied use of technology shapes the categories of sensible inputs and in so doing unconsciously shapes the subject-agent him/herself while at the same time opening up a new 'window' through which new physical objects can be prepared/produced/recognized/used.

Heelan agrees with the importance of the resources that Ihde refers to, but he argues the review of Scharff/Dusek's Technological Condition as *Has the Philosophy of Technology Arrived? A State-of-the-Art Review* does not explain how philosophy can address them in a positive fashion.

Heidegger is correctly a key figure, but his positive philosophical importance is not brought out, only the negative importance of his critique. The basic 'technology' we humans are endowed with is our own bodies and senses -- these have to be understood first, as the principle subject matter of any philosophy of technology. To the body and senses we can then add extensions, such as, artifactual 'technologies' (instruments, tools, media, etc.).

Why is there a hermeneutical philosophy of the natural sciences? It is necessary to address the philosophic crisis of realism vs relativism in the natural sciences. This crisis is seen as a part of the cultural crisis that Husserl and Heidegger identified and attributed to the hegemonic role of theoretical and calculative thought in Western societies. The role of theory is addressed using the hermeneutical circle to probe the origin of theoretic meaning in scientific cultural praxes. This is studied in Galileo's discovery of the phases of Venus; the practice of measurement; the different theories and practices of space perception; the historicality and temporality of scientific research communities which ground paradigm change; and the process of discovery. Heelan's paper draws particularly from the work of Heidegger. Though envisaging all science and scholarship, the highlighted theme is research in the natural sciences.

In principle, philosophy of technology is concerned with questions of a fundamental understanding of technology and its various reciprocal effects on human existence. The development of philosophy of technology in principle, based on the assumption that substantial questions of philosophy are posed against the technology either not yet available or in the view of new organisational, economical and technological developments such as globalization, economics, population growth, ecological crisis, north-south conflict, world-wide communication technology and information distribution– is attempt to answer new techniques. Thus the questions philosophy of technology refers to are:

"Have we access to the techniques or technologies that we need?" "Do we need the technology that we have?" -- affect in the long run everybody and everything. Questions of concern to me in the context of philosophy of technology are: Are the new technologies in fact helping to create a more informed and communicative society, as well as more cohesive communities? Or are they more of a diversion (in education or in other fields)? Are they inhibiting genuine human interaction and understanding as much as or more than they are helping? How can we think more precisely about this issue?

In the creativity and multidimensionality of technology, we are usually encouraged or compelled to use some definite artifacts in a definite way in order to solve some problem when we want to be a rational being. It is therefore natural to think that the main task of the ethics of technology, if there should exist such a thing, lies in clarifying the rational way of making and using technological artifacts.

But on the other hand, the situation in which we are involved consists of so many factors and so ambiguous that a definite way of using an artifact is not always realizable. Sometimes artifacts can be used or need to be used against the original intent of designers, and it happens sometimes that a completely new purpose is added to an artifact. For example, a hammer can be used as a murder weapon, a paperweight, or even an objet d'art (Ihde, 1999). Except for the difference of degree, every artifact has this kind of multidimensinality, and we can find many examples of this kind in the history of technology, in which invented artifacts bring us a new end-means network against the original intent of designer.

We can also find in the history of technology many similar cases in which the results of technology are interpreted not positively but rather "negatively". In the book Why Things Bite Back: Technology and the Revenge of Unintended Consequences, Edward Tenner gives many interesting examples. One example illustrates that, against the prediction of a futurist who says that networking will make paper copies unnecessary in offices, networking multiplied paper use. Another example shows that the introduction of a cheaper security system at home leads increased false alarms caused by user's errors and made the security level decline. With these examples Tenner points out the revenge character of technology, saying "Things seemed to be fighting back" (Tenner 1996, ix).

Junichi Murata argues, "..These examples show impressively the "otherness" of technology, which characterizes a technology more than a simple instrument but which cannot be reduced to the role of co-actor for a certain problem solving. The "otherness" in these examples shows rather the creativity of technology in the broadest sense of the word, as the technological development is realized against the original intent of designers and producers."

In order to clarify this creative character of "otherness" of technology, Murata takes up an interesting perspective, in which this character is developed in an interesting way, is the view of a Japanese philosopher, Kitaro Nishida, who emphasized the creative character of technology and characterized it as "from that which is made to that which makes". According to Nishida, Murata argues, that, our real world has a feature which cannot but be characterized with contradictory concepts, and therefore it moves incessantly and is always unstable in a transformational process. Nishida calls our world historical and also technological. Our world is technological, because it is a world of "poiesis" or production which is a self-formative act of the world that moves from the created to the creating. What Nishida emphasizes in the technological process is that the process does not end at the time when an artifact is produced and is handed to users. Being left from and becoming independent of the designers and producers, a product sometimes begins to obtain a new meaning and tendency against the intent of producers, and exactly in this process lies an origin of creativity of technology. Nishida also calls this process "reverse determination". This does not mean that in this process users take an initiative to orient the process of new production instead of producers. The process is oriented and controlled neither by producers nor users, but rather by the interaction between both of them, through which an unintended process begins and a new meaning and value are created. As the technological development can neither be predicted by using a causal law nor be intended by having a definite purpose, it is thoroughly a contingent process, and in this sense it is considered a creative process.

On the other hand, in the literatures, we have been reading that recent philosophy of technology[6] has taken an *empirical turn* away from the transcendental orientation of early philosophy of technology toward a more practical, contextual interpretation. Technology is not seen as interdependent in relation to society but rather as independent of it. Technology and society form an inseparable pair, but neither is intelligible without reference to each other. This new generation of philosophers[7] reinterprets the relationship between technology and society to explore all of the different ways that our devices and systems mediate our lives. To most people, technology has been reduced to computers, consumer goods, and military weapons; we speak of "technological progress" in terms of RAM and CD-ROMs and the flatness of our television screens. In *Human-Built World*, Thomas Hughes restores to technology the conceptual richness and depth it deserves by chronicling the ideas about technology expressed by influential Western thinkers who not only understood its multifaceted character but who also explored its creative potential.

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[6] American Philosophy of Technology: The Empirical Turn. Ed. Hans Achterhuis, trans. Robert Crease (Indian University Press, 2001): The six American philosophers of technology whose work is profiled in this clear and concise introduction to the field – Albert Borgmann, Hubert Dreyfus, Andrew Feenberg, Donna Haraway, Don Ihde, and Langdon Winner – represent a new, empirical direction in the philosophical study of technology that has developed mainly in North America.

[7] Albert Borgmann, Philip Brey, Hubert Dreyfus, Paul Durbin, Andrew Feenberg, Larry Hickman, Don Ihde, Carl Mitcham, Peter-Paul Verbeek and Langdon Winner.

VI. Hans Lenk criticism of Don Ihde's Visualism and Instrumental Realism

In his important book *Instrumental Realism: The Interface between Philosophy of Science and Philosophy of Technology* (1991) Ihde developed the American discussion among five Anglo-American Philosophers and phenomenologically oriented Euro-American Philosophers of technology and science (mainly Hubert Dreyfus, Ian Hacking, Patrick Heelan, Robert Ackermann and himself) who would criticize classical positivist philosophy of science which studied science without perception, technology and experimental instruments. Ihde explicitly decided to include these latter essential factors in the newly integrated subdiscipline Ihde calls "*technoscience*". (Whereas Dreyfus and Heelan as well as Ihde himself are considered the Euro-American, i.e. phenomenological, subgroup as a loosely working collaboration arriving at parallel results, Hacking and Ackermann were representatives of the more analytically minded Anglo-American representatives of this new "school" of the "Philosophy of Technoscience" which Ihde explicitly calls "'The school' of instrumental Realists" (Ihde, 1991, P. 97).

Whereas some of these representatives differ according to the problem of perception and seeing by and through or *via* instruments and with regard to the role of social "praxis" (social embedding of technological practice) or the integration of technology in science in general, they all see the "embodiment", as Ihde calls it, of science in technology via instrumentation and development of the experiments and experimental science by necessarily relying on its instruments, development of its instrumentarium and the respective history of imaging and pictorial representation etc. (e.g. Ackermann 1983, 87). (Indeed this topic of *perceiving* and *seeing* "by" or "through" instruments (only) had been somewhat underestimated by continental philosophers of technology, although they clearly saw the accumulating integration and interconnection between technology -- including Rapp, Ropohl and myself

--, science, and society as well as economy (Cf. Gottl-Ottlilienfeld, 1913, 1923)).

Ihde epitomizes "the focal point at which instrumental realism emerges" as being "the simultaneous recognition of what I have called the *technological embodiment* of science, which occurs through the instruments and within experimental situations; and of the larger role of praxis and perception through such technologies" (Ihde, 1991, P. 99), whereas traditional, sometimes wrongly so called "positivist" Popperian critical rationalists and philosophers of science did have a contempt or even "disdain for, or ignorance of, praxis", social praxis, and the embedding as well as of experimental procedures, pre-formations and constrains (ibid.): "*Any philosophy of science, which is limited solely to linguistic, logical, or propositional methods* will not be able to adequately account for large sectors of scientific activity which entails more than such 'rational' procedures alone" (ibid. P. 100). Instead, "scientific objects are differently constituted" (than ordinary objects in our everyday connections): "Scientific objects" and -- for that matter, also effects, processes and procedures as well as some so-called "theoretical" entities -- "are often, if not typically, *instrumentally* constituted. Technology -- instrumentation -- makes the difference" (ibid. P. 102 f): Indeed, the "American instrumental realists" (represented by the five selected philosophers mentioned) entertain a really "instrumental realist consensus... at the interface between science and technology -- and between the philosophies of science and of technology": "In its broadest sense, the instrumental realist consensus points up the importance of science's technologies as the means by which discovery occurs and knowledge is expanded"[8]. Ihde goes on to generalize "that contemporary science is more than accidentally -- it is *essentially* -- embodied technologically in its instrumentation" (ibid. P. 103). Heelan (1983) would

[8] "The means" seems to be a little bit of an exaggeration, since also so-called "progressive problem shifts" after Lakatos (s.,e.g., Einstein's designing of the Theory of Relativity) seem to be possible and necessary: theory should not be totally underestimated, too.

even think that "*only* those phenomena which have been instrumentally 'carpentered' and 'constituted' can have claim to scientific 'reality'" which means that the *necessary connection* between scientific observation and its technologies" (Ihde, 1991, P. 105). He concludes that contemporary and even modern science since Galileo "is and has been essentially and historically technologically embodied" (ibid. P. 107). For instance, as Heidegger had already stressed stating that "technology reveals a world", the instrumental realists rightly put emphasis on the fact, that "technology reveals the micro- and macroworld which lies beyond unaided sense" (Ihde, 1991, P. 107) (see also Rom Harre´'s 1986 with the emphasis on material practice and reference hunting and experimental science as well as his R2 realm of theoretical entities which can be transformed to become visible or graspable, instrumentally speaking.)

May this be as it is, Ihde indeed puts the finger on a very important phenomenon of a methodologically necessary process of the preforming of scientific experimentation and instrumentation by the available instruments and the history of their development as well as the impregnation of scientific concept formation, "perception" as well as experimental practice by make-up and structuring effects of the apparatuses and instrumentation as well as the respective theoretical foundations including the very methodological preconditions of experiments.

Lenk argues, that, Ihde seems to underestimate a little bit the "action-impregnatedness" or "activity-ladenness" of experimentation besides the instruments by tendentially overaccentuating "perception". The extant theories of action and the activities of model designing, structuring or schematization of action–also in forming knowledge and perceiving–seem to have been underestimated to some degree, although implicitly all this is certainly somehowinvolved and unnoticeably accounted for.

With all of this, we are at the point of reaching an approach which Hans Lenk had developed since three decades by now, namely a realism of what Lenk defines a methodological interpretationist provenance or methodological scheme-interpretationism. In short we may say: We conceive of the world as being real, hypostatize it, for practical and theoretical reasons, as real: The world is real, but any grasping of it or of parts of it or entities in it is always impregnated by or bound to interpretational perspectives, i. e. is interpretational, interpretatory, or interpretative, schematized, theory-bound or "theory-impregnated", "theory-laden" or what have you as rather common descriptions of the shaping role of theories or perspectives in the building of scientific insights and knowledge. Any "grasping" (in the double sense mentioned) whatsoever is to be understood from a scheme-interpretationist approach and is beyond that to a large extent also shaped and structured by actions, action-forms, or presuppositions. This is the main idea (Cf. Hans Lenk, 2003).

Very important is also the insight, that we need knowledge and action as well as experimentation and that we know that knowledge or gaining knowledge is a sort of action, at times an higher-level activity, namely e. g. indeed exactly the acting with models, preparations or experimental arrangements (think of quantum theory and the measurement problem in it): To be sure, we need constructions, we know that all our "graspings" are structured, schematized, to a large extent "constructive" indeed, but it is equally true that knowledge and insights in experimental science are not but constructions and interpretations or interactivities at will just fitting to arbitrary models whatsoever, but as, e.g., Giere (1948, 1999) rightly stresses the models and their fit are *not* relativistic or arbitrary. Indeed, they are bound to strict and stringent requirements of experimentation, objectivity, repeatability, etc., according to the traditional rules and norms of "good" scientific practice. This is the element of realism in the otherwise rather perspectival and constructivist model-making and theory-building activity of the scientist or group of scientists frequently described by using a certain Kuhnian "*paradigm*". As German pragmatist Hans Lenk had stressed time and again, e. g. in his *Introduction to Theory of Knowledge* with the subtitle "Interpretation, Interaction, and Intervention" (1998) gaining knowledge, constructing, acting and intervening as well as interpreting go necessarily together. Instead of misleadingly just introducing and highlighting models and falling victim to some kind of dichotomizing strategies, philosophy of science has to take seriously the insights that we need models and laws *as well as* theories. It is then certainly an interesting problem to analyze and discuss how these analytic differentiations hang together with the real world or the respective evidences or resistances or make-ups ("preparations") in the situation of experiments. I think indeed that the idea raised by quantum mechanics that the initial preparation is of very much import, may even be or feature as *the* rather *general case*, i. e., there usually is a certain kind of interplay generally not to be neglected between questioning, preparing experiments and relevant perspectives in order to deal with experimental reactions from a perspectival approach (see Lenk, 2003).

Generally speaking the approaches by Ihde, Hacking, Giere comprise in a certain sense a technology-shaped philosophy of science, notably affected by (the existence and development of) measuring instruments and measuring technology. These however are the vehicles of the respective interactions and interventions into nature and reality as such. Insofar we can even talk about a *technologistic* or *technology-oriented philosophy of science* in that sense. Technology (technological instruments, measurement appliances, technological approaches and models as well as technical procedures, processes and artifacts) would shape the scientific possibilities of knowledge and gaining knowledge in a decisive degree. This is not only true in the narrower sense, as the above mentioned New Experimentalism in philosophy and sociology of science would say, but in a far more general and larger sense as entertained by methodological scheme-interpretationism and also (although still narrowly restricted in scope) by Giere's modelism ("constructive realism") and Hacking's "technological realism" as well as Ihde's "instrumental realism". In the future, certainly such interactions between approaches of a rather technologistic and action-theoretic provenance with philosophy of science analyses will reach center stage in philosophy of science debates. Thus, the indivisible connections between knowledge (gaining knowledge), experimenting and action-orientation will lead the way (as Lenk emphasized in 1998). Insofar the approaches outlining the connection between scientific models and real systems by the vehicle of technology, technological manipulation and intermediary instances like measuring instruments and machines have to be extended by the *action-theoretic* interpretation. This would even be interesting for construction engineers and design theorists as well as the design of software models and respective computer simulations of theories in addition to or instead of the full-fledged analytic theory in the traditional style. With regard to the traditional approaches of philosophy of science it is true, that usually the propositional approach wrongly interpreted theories and hypotheses as well as models as just linguistic entities. In a similar vein the pure axiomatic or even the so-called structuralist approach suffered from too formalist a meaning understanding theories and their structures exclusively as mathematical structures.

VII. Thinking about Technology and Culture in contemporary philosophy[9]

Thomas Hughes draws on an enormous range of literature, art, and architecture to explore what technology has brought to society and culture, and to explain how we might begin to develop an "ecotechnology" that works with, not against, ecological systems. From the "Creator" model of development of the sixteenth century to the "big science" of the

1940s and 1950s to the architecture of Frank Gehry, Hughes nimbly charts the myriad ways that technology has been woven into the social and cultural fabric of different eras and the promises and problems it has offered. Thomas Jefferson, for instance, optimistically hoped that technology could be combined with nature to create an Edenic environment; Lewis Mumford, two centuries later, warned of the increasing mechanization of American life.

Such divergent views, Hughes shows, have existed side by side, demonstrating the fundamental idea that "in its variety, technology is full of contradictions, laden with human folly, saved by occasional benign deeds, and rich with unintended consequences." *In Human-Built World*, Hughes offers the highly engaging history of these contradictions, follies, and consequences, a history that resurrects technology, rightfully, as more than gadgetry; it is in fact no less than an embodiment of human values.

Technology surrounds us: millions of homes have digital cable and wireless internet connections; telephones can also serve as cameras, music players, and personal organizers; and everything from stereos to computers grow more sophisticated every year. This, of course, is the technology that most of us encounter and even embrace. But lurking behind these gadgets is an arena in which the topic of technology raises troubling questions. Cosmetic surgery, chemical weapons, and cloning are just some of the more recent examples of the uneasy results of our technological progress, and they remind us that technology is Janus-face; something capable of immeasurable good as well as a test of the limits of human morality and power. Thomas Hughes, the eminent historian of technology and acclaimed author of *American Genesis*, wrote *Human-Built World* as a similar reminder, revealing the concept of technology as it was framed historically by thinkers who ran the gamut from horrified to

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[9] For a detailed study on the subject see: Hughes, Thomas P. Human-Built World: How to Think about

euphoric. For just as Henry Ford's factories were revolutionizing the productive capacity of the American automobile industry, social critics were warning of the increasing dehumanization" of machine-age culture. And just as Ralph Waldo Emerson was celebrating the transformative power of technology and its ability to express the ultimate creativity of the human race, the steam engine and coal production were beginning to ravage the nineteenth-century landscape.

Exploring such competing perspectives, Human-Built World is a concise intellectual biography of the tool of technology. Drawing on a vast body of work created over the centuries by philosophers and architects, social theorists and web designers, politicians and engineers, Hughes charts the multiple ways that technology has been views; sometimes with elation, sometimes with sceptics; by various thinkers. Technology, as he shows here, has not been a slow and steady march to the ever-increasing complexity and sophistication of objects; it has been the subject of debate for centuries about the human will to create, the inherent danger of progress for its own sake, and the Mephistophelean urge to alter everything from the natural landscape to the daily activities of millions. "In its variety," Hughes writes here, "technology is full of contradictions, laden with human folly, saved by occasional benign deeds, and rich with unintended consequences." Hughes' mission here is to restore to technology these contradictions and unintended consequences, and his *Human-Built World* is a necessary and original guide that recreates technology as the philosophical, moral, and social dilemma it rightfully is.

Is the promise of technology real this time? Thomas Edison and many others thought that motion pictures would change forever the role of the teacher and learner. Radio was heralded in the late 1920s and 1930s as the savior of our education system. During World War II Disney Studios developed animated learning systems designed to teach very specific

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Technology and Culture. University of Chicago, 2004.

tasks. After World War II overhead projectors and audio filmstrips were to become the meat and potatoes of learning resources. Television seemed to promise that one good teacher could reach the world. As a matter of fact, these innovations not only provided interesting lessons, but people actually learned from them. They have all proven to be effective in the teaching process.

However, even with their record of success they have not significantly changed the patterns of learning and teaching now present in most schools around the world. The effective measures of educational innovations are: 1) Does the innovation increase the master skills of the learner? 2) Can the same level of learning be accomplished in a shorter period of time? and 3) Can a teacher teach more students to the same level of accomplishments? Technologies up until this time have been used as supplemental tools to the classroom. In this respect they are an added expense to regular classroom activities that becomes difficult to justify in cost accounting.

How then can we say that networking and computers will change learning and teaching? Are they just another fad that will fade away like the other learning technologies? New digital technologies have the potential for being very different because they merge all of the previous resources into one accessible unit, following the classical futuristic perspectives:

-The new technologies can provide real world simulations.
-Learning modules can be accessed at anytime and from any place.
-Virtual teams of learners can work together to solve problems.
-Effectively designed programs can provide immediate assessment and evaluation to the learner.
-Learners can work on real world problems and have access to experts.
-New technologies can give provide voice-activated dialogues between the learner and the computer.

However, I also caution against thinking that the technology alone will bring about the change. The technology only allows us to think of new ways of learning. Just as books require good authors, the new technology will require new kinds of learning design engineers. Professionals will evolve who can take the research from learning theories and blend it with the technologies. It is not a simple or inexpensive task, but we already see some glimpses of what the future may bring. Technology extends our communications ability beyond face-to-face talking. It expands it beyond the printed page and reading to a new dimension. It is building a new and more efficient means of sharing ideas and information among all people.

What sits in the background to this phenomenological description is a technology that constituted a new type of cultural system that restructured the entire social world as an object of control. Technology now is an environment and a way of life. As individuals we adapt to life in a technological environment -- "It took two elevators and an escalator just to grab coffee" -- and our subjectivity is shaped and formed by the technological mode of life. Contemporary life is thus "technologically mediated life." The humanities represent a source of fundamental human skills much needed in a technological age, and the study of humanities in technology shows the interconnection between technology and arts and engineering. Our work on the philosophy of technology (cultural hermeneutics) and ethical hermeneutics should made a plea that the task of the philosophy is to work out suggestions concerning such basic conditions of technological and economic development. These tasks must lead to the conditions that make life worth living in all the single economic areas, that help to realize regionally valid values, that facilitate income and ensure the surviving of families in the Culturally and Technologically Mediated Lifeworld. Technology is always constructing its own norms, traditions and values in the technology and scientific civilization and building its own worldviews. The problem is not with techniques and technology; rather, the problem is that we need to develop completely a new mode of action to deal with the technology, which implicits the ethical risks.

Further points to be investigated within phenomenology of technology and cultural hermeneutics

First person and Third person person perspectives of human knowledge & technological action (Teilnehmer- und Beobachter Perspektive menschlichen Erkennens).

Concept of Tacit Knowledge (Konzeption des Implizites Wissen).

Role of Embodiment in the understanding of knowledge, cognition and action (Rolle der Leiblichkeit in die Verständnis von Wissen und Erkenntnis und Handeln).

Need and Dealing with the knowledge with technological development (Gebrauch und Umgangswissen mit der Technologie).

Concept of a technological culture, with a concept of technological action for the instrumental understanding (Konzept einer technischen Kultur, ein Konzept technischen Handelns auf der Basis Instrumentellen Verstehens).

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