Culture of Embodiment and Technology Reflection[1]

By
Arun Kumar Tripathi
Research Assistant
Department of Philosophy of Technology
Institute for Philosophy
Dresden University of Technology, Germany

Summary

Since the human race began, human invents technology: technology invents humans. The characteristics that make us human will continue to be manifest in our relationship with technology. The more we depend on technologies to carry out or mediate our everyday activities, the more we will need to trust than to do so. New technologies lead to a new kind of human being - one embodied in a new technologically enhanced body. Homo is indeed homo faber, and he becomes more so every day. This is the new technologically enhanced human being - who is not an objective artifact (a technology) but a subjective artifact of the new technologically enhanced (perceptually, cognitively, and desire-and institutionally-oriented) human subject. In this article, I will suggest to rethink on how is the role of embodied nature of communication is possible in technological lifeworld. To deal with these issues, it is argued to develop a culture of embodiment and technology relations in the philosophy of technology, where I apply the philosophy of technology approaches of Don Ihde, Bernhard Irrgang, and Carl Mitcham in the technological culture to develop a phenomenology of relations between humans, technologies and the world where technologies are seen as inherently non-neutral. The article examines technological and cultural values through the mediation of science and technology in contemporary philosophy, and employs the perspectives of Ihde, Irrgang and Mitcham.

Keywords: phenomenology, philosophy of technology, tools, users, technologies, embodiment, world, Heidegger, Ihde, technology transfer.

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 technological systems of energy, transportation, waste management,

[1] This is a shortened version of my talk which I gave for Prof. Don Ihde's Technoscience Research Seminar in the Philosophy Department at the Stony Brook University in October 2006. I am grateful to Patrick Heelan, Don Ihde and Naoko Iwasaki for their comments.

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 (Kaplan 2008). 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) (Kaplan 2009 & 2007). This article examines technological and cultural values through the mediation of science and technology in contemporary philosophy, and employs the perspectives of Don Ihde, Bernhard Irrgang, and Carl Mitcham in the technological culture.

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 natural science or as 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.

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 the Hermeneutic understanding of technological practices, 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.

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.

In order to address practical questions in philosophy of technologies, philosophers in Germany such as Hans Lenk, Walther Zimmerli, and Bernhard Irrgang have been developing a hermeneutic understanding of both technology and ethics to teach children and parents the ethical and moral values. The structures of technological practice, professional activity, and everyday life, together with the background of an implicit technological knowledge, are the basis of collective technological action in a cultural context. Today, more than ever before, there is an urgent need to understand the imperative of modernization and its attendant idiom of globalization. We require an understanding of science and technology on the basis of culture, wisdom, ecology and ethical values in schools and colleges. The process of current globalization is emerging into a cultural, historical, and ecological phenomenon. At the same time, this change is adding an ethical dimension to the development of technology, which requires a deeper understanding of techniques, technology and science. The meaning of a technology does not necessarily have to be linguistically articulated in order to be present in a culture. The ways technological practices themselves structure actions include different forms of meaningfulness. This leads to a kind of existential pragmatics of technological action and its models of representation (Corona and Irrgang 1999). Such an approach provides a recursive and reflexive assessment of technological actions. But the impacts of any interpretation of technological actions must also prove successful in psychological, sociological, technical-historical, and cultural-historical terms (Irrgang 2001, 2002).

II. 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 technology, 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 accommodation, not confrontation. A difference of culture promotes and provides for mutual learning and not necessarily entailing clash and conflicts[2].

In the last thirty years our world has seen the emergence of cultural understanding of 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).

[2] 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.

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. 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. Prospect of 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 dialogue 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, revealing, 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 brute fact of technology in modern society is urging philosophers of technology out from under the shadow of philosophers of science. Don Ihde in his book "Ironic Technics" has responded to the "given fact" that we live in a "technological and organizational culture" by sketching a "praxis philosophy" of technologies, where

technologies are multistable. New technologies lead to a new kind of human being - one embodied in a new technologically enhanced body. Homo is indeed homo faber, and he becomes more so every day. This is the new technologically enhanced human being - who is not an objective artifact (a technology) but a subjective artifact of the new technologically enhanced (perceptually, cognitively, and desire-and institutionally-oriented) human subject. "Ironic Technics" (Automatic Press/VIP, 2008) tells us that the social/cultural changes that this brings about are usually neither determinate nor generally foreseeable; and, because of this, the changes will demand special oversight. Ihde early developed his "phenomenology of technics" which describes a series of human-technology relations and which is widely anthologized for last 40 years. In short, from the late 60s on Ihde included technologies in the consideration human experience in its pragmatic-phenomenological sense. The technologies Ihde wishes to question in the philosophy are the radical, new imaging technologies that began to be developed only since the mid-twentieth century and which today are radically transforming the sciences that use them. Ihde found these technologies highly philosophically provocative. It raises questions about constraints posed by human experience and embodiment; and it raises questions about the role of a hermeneutic styled philosophy which arises in both pragmatist and phenomenological traditions. In the field of Philosophy of Technology, the Kierkegaard's "Irony" is best understood by Don Ihde. Don Ihde defends a basic thesis, that a technology is nonneutral. That is, technology transforms human experience. It does not determine human experience in a strong sense; rather, technologies have "inclinations" and it does have a powerful cultural variant. Ihde “Ironic Technics” is highly recommended to everyone who might be interested in understanding the irony of cultural variants of technologies (See more details on ‘multistability in technologies’ cf. Rosenberger, 2009). 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.

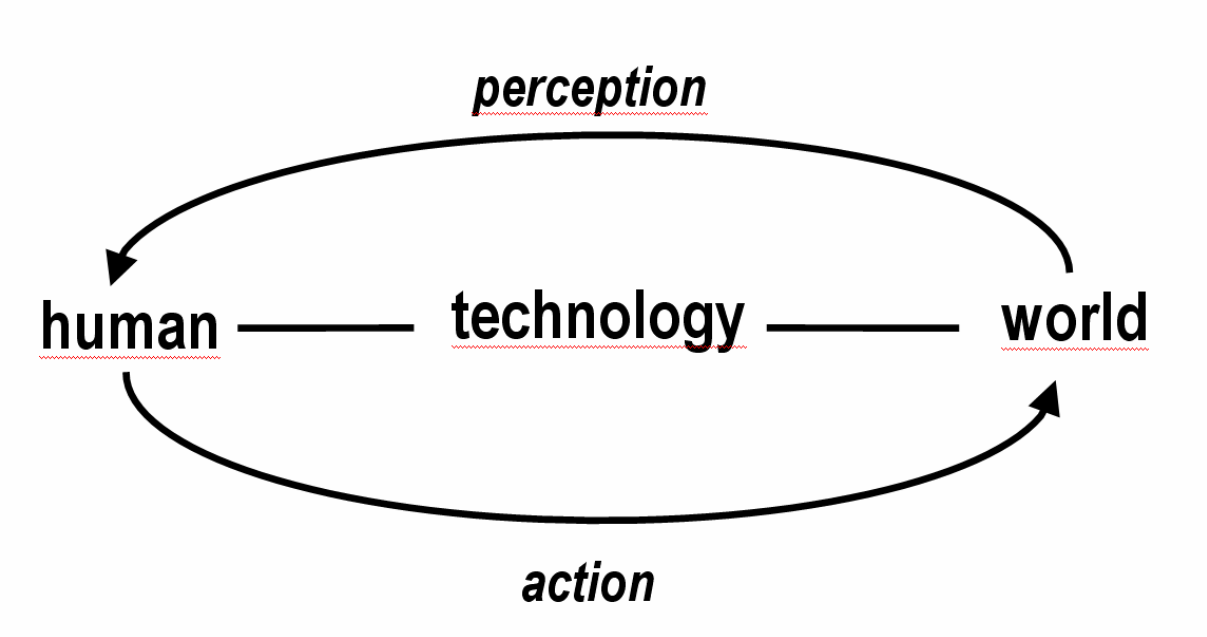

Figure 1: Technological Mediation

Technological mediation is precisely this capacity of technology: technologies can mediate between humans and reality, by establishing specific relations between both. This phenomenon of technological mediation has two dimensions, each of them pertaining to one aspect of the relations between humans and reality. First technologies help to shape how reality can be present for human beings, by mediating human *perception* and *interpretation*; second, technologies help to shape how humans are present in reality, by mediating human *action* and *practices*. The first dimension can be called *hermeneutic*, since it concerns meaning and interpretation; the second is *pragmatic*, since it concern human activities (Cf. Verbeek (Forthcoming)).

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. 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 include 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, shelter, and automatic machines that operate in the background subtly affecting our everyday experience.

Irrgang and 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. Corona/Irrgang's model investigates the meaning and model of technological action with respect to their development from the cultural and social perspectives. In describing post-phenomenology, Don 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 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.[3] 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, 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

[3] Epistemology Engines: An antique optical device has powered several centuries of scientific thought, Don Ihde in Nature, Vol. 406, and 6 July 2000.

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 symbiotic and mediated relation instead of a divided and instrumental one.

Bio

Arun Kumar Tripathi is a doctoral candidate at the Department of Philosophy of Technology, Institute for Philosophy, Dresden University of Technology and working in-collaboration with Department of Computer Science on a European Project, "Future of Identity in the Information Society (FIDIS), Network of Excellence". Tripathi is a member of Association for the Advancement of Computing in Education (AACE) since 1999 and founder member of WAOE since 1998. Arun Tripathi worked for 7 years (2002 – 2009) as the research assistant at the Department of Philosophy of Technology, Institute for Philosophy, Dresden University of Technology, Germany. Tripathi research interests include kinaesthetic aspects of cyberspace, phenomenological concepts of embodiment in computer games, ubiquitous computing, Application of Artificial Intelligence in education, and cognitive aspects of human-computer interactions. Contact address: Karlsruher Strasse 01189, Dresden E-Mail: arun.tripathi@waoe.org

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