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ABSTRACT: The "essence" or effect of technological change is more than technological from an agency point of view. But Heidegger argued that the "question" concerning technology is its "revealing." By revealing he meant the setting upon humans to reveal the 'real' as a mode of ordering nature (including humans) to reveal the "truth." However, from the point of view of the oppressed and the exploited in an iniquitous political economic order, technological change conceals more than what it reveals. The literary critic Pierre Macherey pointed out that a literary work's ideological bias often should be judged from not what it says but in what it does not say. The concealing of technology could be the ideological bias or intentions of its promoters or protagonists which is more often concealed than revealed in social theories and analysis of technological change. Using the poison gas explosion at the Union Carbide pesticide plant at Bhopal as a case in point, I will argue that this technological massacre of a city population can be read only as the concealing of the "real" nature of the technology of the so-called "Green Revolution" in India's agricultural modernization program.

The "Revealing" and "Concealing" of Technology

Introduction

Any claim that technological knowledge production and its dissemination is a culturally neutral process which is beyond the realm of political-economy is not a serious proposition in social theory. As Winner (1985) showed, technological artifacts do have politics, and the political manifestations of technologies often tend to be hidden behind their artifactual facades. Although, at the outset, Winner appears to attribute agency and reflexivity to steel and concrete structures, unlike the radical social constructivists of technology, the agency that Winner attributes to artifacts is actually the agency (and ideological motivations) of their designers, developers and patrons. Although one can attribute "ideology" to technological artifacts in the way Winner interprets the politics of artifacts,

the ideological nature of technology is exposed when one tries to unravel the ontological "essence" and essential unity of technology as the unchallenged motive force behind the universal project of modernization. Beyond the totalitarianism of the instrumental rationality embedded in modern technology, as Habermas sees it, the danger of this ideology, attributed to technology, is manifested by the high cost that its supposed "beneficiaries" (of modernization) pay when they are not given a voice in the production and dissemination of technological knowledge. One way to find out this deliberate false authorship of technology is to delve into its ideological and ontological "essence."

In order to understand the "essence" of technology, one needs to look beyond the artifactual and instrumental aspects of technology. One needs to explore its context and content. Heidegger (1977) correctly argued that the essence of technology is more than technological from an instrumentalist and anthropological sense. The "question concerning technology," according to him, is its "revealing." It is meant in terms of bringing forth the hidden potential of nature (including humans) by challenging it, both the physical potential and the hidden "truth." The process of revealing takes place in the form of "enframing" to order and assemble nature and natural resources as a "standing reserve."

Although the Heideggerian conceptualization of technology is a great

stride in terms of accounting for the epistemological aspects of technology, it assumes human agents and agency as homogeneous in achieving this task. This homogenizing of humans as equal participants in the production and reproduction of technological knowledge is ahistorical and often conceals the political economic dimension of technological change. This concealing takes place because of the fragmentation of social realities perpetrated in all forms of development and modernization projects. The central concern of this article is to understand and theorize the process of technological change by highlighting the above concerns pertaining to technological change and social theory using the Bhopal poison gas explosion as a case in point.

The "Revealing" of Technology

Heidegger (1977), in one of the better philosophical tracts ever written on the philosophy of technology, argues that a merely functional and instrumental definition of technology tells very little about technology as a human activity. According to him, more than a mere means to an end, technology, whether ancient or modern, is a "mode of revealing" (1977: 13), and the "revealing that rules in modern technology is a challenging, which puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such" (1977: 14). The mode of revealing is thus a way of challenging nature to "unlock" and "expose" what is left unrevealed

or concealed. The unrevealed need not necessarily be the hidden energy or whatever potential, but the hidden "truth" itself. The essence of the power station as a technological device makes the river whose energy now dammed up, in a hydroelectric project for example, transforms the river's water power in the form of potential energy into electrical energy. The process of revealing as the essence of technology is a continuous process:

"The revealing that rules throughout modern technology has the character of a setting-upon, in the sense of a challenging-forth. That challenging happens in that the energy concealed in nature is unlocked, what is unlocked is transformed. what is transformed is stored up, what is stored up is, in turn, distributed, and what is distributed is switched about ever anew" (Heidegger 1977: 16).

Thus, according to Heidegger, unlocking, transforming, distributing, switching about, and regulating are all different ways of revealing.

But the ultimate form of revealing, according to Heidegger, is "enframing" whereby "the real reveals itself as standing-reserve" to order nature as a system of information and the "chief storehouse" of "standing-reserve" energy (1977: 21-23). Heidegger claims that it is through the concept of enframing that humans understand their relationship to technology's essence. Accordingly,

"Enframing is the gathering together that belongs to that setting-upon

which sets upon man and puts him in position to reveal the real, in the mode of ordering, as standing-reserve. As the one who is challenged forth in this way, man stands within the essential realm of Enframing. He can never take up a relationship to it only subsequently. Thus the question as to how we are to arrive at a relationship to the essence of technology, asked in this way, always comes too late. But never too late comes the question as to whether we actually experience ourselves as the ones whose activities everywhere, public and private, are challenged forth by Enframing" (1977: 24).

But Heidegger reserves the concept of enframing as a way of revealing, which is essentially an act of "ordaining of destining." The idea of unconcealment using technology is to free humans from being "simply constrained to obey" (1977: 25). Heidegger rejects all purported notions of technology as the enemy of human freedom and its alleged cognate that humans are everywhere chained to the technological imperative. "Quite the contrary," he argues, "when we once open ourselves expressly to the *essence* of technology, we find ourselves unexpectedly taken into a freeing claim" (1977: 26). The flip side of this development, Heidegger says, is the danger of humans themselves becoming part of the standing-reserve and foolishly assuming that everything they encounter in nature are their mere constructs. The threat of technology does not come from the tools and their effects, but

from the way the essence of technology has affected human's essence (the very meaning of life) in terms of relating to herself and nature. The problem, he argues, is that humans forget the essence of all revealing, which is to reveal the "truth." Heidegger ruefully notes that "there was a time when the bringing-forth of the true into the beautiful was called *techne*" (1977: 34). But that is the realm of art and poetry, the romantic linking of *techne* to humans. Although technology fails in its mission of "bringing forth the true and the beautiful," as Dreyfus argues, Heidegger nevertheless took solace in the fact that technology is "our latest understanding of being" (Dreyfus 1995: 102).

The "Concealing" of Technology

Heidegger's conceptualization of technology as revealing and enframing has two major problems: (1) it takes all human agents connected to the technological network as a homogeneous entity, and, hence, becomes useless in forming social theories pertaining to technological change; and, (2) the essence of technology as a tool for revealing ultimate "truth" about "man" and his relationship with reality (nature) is patently metaphysical. The second concept can be interpreted in two ways, firstly, in the sense of technology as a way to understand the true nature of social reality, and secondly as a way to understand "Truth" and "Being." The latter

interpretation is a non-starter because being a metaphysical concept it is hardly of any use for social commentary and theorizing on technology, other than as an interesting existentialist philosophical discourse on the meaning of life in a technological society. In this paper, I will concentrate only on the first point and the first part of the second point.

Heidegger's historicist approach to the process of technological knowledge production and utilization in society shows its contingent nature, however, his proclivity to band all human agents involved in this process as a homogeneous entity is problematic. Although the revealing as the essence of technology is supposed to show the process of creating the "standing-reserve," the revealing of the human motivations behind the development and deployment of technology is often incomplete or hidden behind ideological facades. As Pippin (1994) correctly pointed out, Heidegger avoids all notions of an "ideology critique" in dealing with technology, but attributes ideology to technology in the sense of "consummating" and "completing" the project of modernization.

The first fully developed ideology critique of modern technology was formulated by Marx. According to Marx, the claim of political economists that the development and growth of modern technology (in tandem with the concept of the division of labor introduced in industrial production) merely reflect the rationality and efficiency of production of capitalism is ideological.

The alienation of the working class from the means of production in the capitalist relations of production is a factor Marx used to theorize about the dialectics between the mode of production and changes in the means of production (technological change). In reality, the social relations of production and exchange become reified in the form of the means of production. He nevertheless argues that the coming of modern science and technology was a progressive feature of capitalist modernization when contrasted with the regressive material conditions of feudalism. Attributing ideological functions to modern technology in capitalist relations of production was also put forward by Lukacs (1971) by essentially expanding on Marx. Lukacs formulates his ideology critique of the rationality and structures of modern capitalism, particularly its technological wherewithal and sedimentation of society and social production under a theory of "reification."¹ Challenging the neutrality of social production of knowledge and engaging in an ideology critique of modern science and technology continued after Marx and Lukacs through the Frankfurt School (including Marcuse), Habermas, and contemporary critical and political theorists of technology, notably Braverman, Feenberg, Noble, Haraway, and Winner, among others.

The claim that the existing technological orders came about as the optimal solution to social needs and problems is untenable. Although

contingency often plays a critical role in determining what particular technological solutions are found, technological choice and the decision-making power pertaining to technological knowledge production do not follow that rule. Technological change following a particular trajectory is not, of necessity, a factor internal to the developmental dynamics of technological knowledge production. It just happens to be following a particular trajectory set by certain social contingencies and arrangements requiring a particular ordering of nature and society. As Pippin (1995: 46) correctly argues, technological rationality ought to be seen as contingent, an option among many which is open to political scrutiny, and not to be falsely understood as necessary and universal. But what is important to be kept in mind is that the "option," in reality, does not become an option for the underprivileged when social power is controlled by a particular group or class of people in society.

Technology is a form of knowledge that evolves within particular social, political, cultural and environmental contexts. The dynamics of the production and dissemination of technological knowledge closely reflect the dialectical relationship between power and class in all societies. When a new technology is developed, transferred, and disseminated into a society which is riven with class contradictions and antagonisms and is not conducive to equity and justice, it only helps to maintain the status quo. It becomes yet

another means for further exploitation of humans and nature. As Winner astutely shows, technologies are "ways of ordering human activity" and controlling humans according to the will of the ruling elites of society (1985: 30). As Feenberg correctly pointed out, in choosing our technology, "we become what we are, which in turn shapes our future choices" (1991: 14). Further, "[T]he values and interests of ruling classes and elites are installed in the very design of rational procedures and machines even before these are assigned a goal" (ibid.). Feenberg claims that it is precisely the power to develop and disseminate the technological artifacts or what he calls "a parliament of things" on which civilizational alternatives are debated and decided (ibid.).

What is striking about most technological innovations is that instead of revealing the real as a mode of ordering nature and society, these technologies often conceal the entire justifications and motivations of their progenitors. Many of the technological innovations that emerged during and after the Industrial Revolution show this facet of technology. The automation of the spinning mule in early nineteenth century textile mills of England was aimed at deskilling and defanging the powerful adult male spinners on whom the mill owners were heavily dependent (Bruland 1982). The introduction of the "self-acting mule" severely challenged the organizing and managerial power, and the ability to strike of the spinners. Cyrus McCormick introduced

the automatic pneumatic molding machines in his reaper manufacturing plant in Chicago in the late nineteenth century to destroy the unionizing efforts of his workers (Ozane 1967). McCormick was successful in nipping in the bud the unionizing efforts of his employees by introducing a less efficient (than his human workers) automatic molding machine. The introduction of a numerically-controlled machine tools system in the machine tool industry of the United States in the 1950s was primarily aimed at wresting control of the skill of highly-skilled machine tool operators for alleged national security reasons (Noble 1984). The deskilling of the machinists weakened their bargaining power, and, thus, retained control of machine production in the hands of the managers and engineers.² Robert Moses, the highly influential New York state public works engineer, designed and built narrow overpasses on Long Island Highways during the 1920s through the 1970s so that buses which were the predominant means of transportation of black Americans of the area would be unable to reach the upper-class white areas of Jones Beach, Long Island (Winner 1985). There are numerous other examples in the annals of the history of technology which can corroborate technology's concealing of the "real" by fragmenting social reality as the interactive dynamics of technological change and social change intensifies in all industrializing societies.

Bhopal, the Concealing of the Green Revolution Technology

The scientific and industrial revolutions and the ensuing Enlightenment Project helped to realize the ideals of the French Revolution in the form of the program of modernization. Along with the modernization project in Europe emerged a new political economic order with the trappings of a new "world system" which was based on the capitalist mode of production (Wallerstein 1974). Vestiges of European modernity reached the colonial enclaves leading to a "time-space" compression of the world (Harvey 1989) as a result of the world-wide expansion and diffusion of the culture and ethos of industrial capitalism. Selected technologies such as railways, telegraph, power-looms, and guns and cannons were transferred to the colonies for consolidating the colonial territories and recovering their treasures and raw materials (Adas 1989; Alvares 1991). The early hope harbored by Marx and other European modernists and social theorists that the transfer of modern technological knowledge to the colonies would render a death blow to the archaic feudal social relations and modes of production existed in the colonies was premature. These expectations were short-lived because the technological change that the ensuing colonial industrialization brought about was partial and unarticulated. Rather, this unarticulated industrialization was meant for normalizing, pacifying, and subjugating the native populations and their lands.

When the former colonies gained independence and began to take their "destiny" into their own hands, they were neither equipped to develop and modernize following the foot-steps of their erstwhile masters nor prepared to follow a new path of their own despite some early ambitious starts. For the decolonized nations, the two "natural" models of economic development and national reconstruction were the capitalist free-market and the planned state capitalist models. While many chose one or the other, aspects of the two were chosen in countries like India. In the 1950s, the Indian leaders planned to set up large-scale industrial ventures ("the temples of modern India," according to Jawaharlal Nehru, India's first Prime Minister) to modernize the country. However, for lack of capital and technological know-how, few industries were set up to absorb the "surplus" labor from the rural sector who were migrating to the urban areas in large numbers. Neither large-scale industrialization nor rapid agriculture modernization took place to lift the majority of Indians from poverty and deprivation. In fact, the agriculture sector was left to fend for itself in India's development programs. The neglect of the agriculture sector along with failed monsoons created near-famine situations in most parts of India in the early 1960s, to be averted by the shipment of massive amounts of food-grains from the United States and elsewhere. The country was at its lowest in terms of its ability to survive economically, and, even, politically. It was during this period, under pressure

from the aid donors, that an ambitious plan was drawn up to modernize India's subsistence agriculture with an objective to increase food production. The plan was drawn up by the World Bank, the United States Agency for International Development, and the Rockefeller and Ford Foundations in collaboration with the Indian government to modernize the agricultural sector by introducing aspects of western, particularly American, agricultural practices to India. This agricultural modernization program that began in the 1960s is called the "Green Revolution".³

The thrust of the Green Revolution package, as propounded by the concerned policy-makers and donor agencies, was to persuade the peasant-farmers to adopt the newly-developed high-yielding varieties (HYVs) of rice and wheat seeds, chemical fertilizers and pesticides, irrigated water, and some mechanically-powered agricultural implements like tractors, threshers, and pumps. The new technological package was intended to replace the traditional one which included local seeds bred and selected over centuries, wooden plows and other tools driven by human and animal power, rain-fed water, manure and natural fertilizers. The objective of the policy-makers was to increase agricultural production by increasing the technological know-how and factor endowments of medium-to-large-scale peasant-farmers. Radical changes in land reforms were not part of the agricultural modernization policy. The policy was to procure the extra production from the peasant-

farmers by the state after meeting their subsistence requirements. The government and its agencies implemented an elaborate incentive scheme to attract the peasant-farmers to adopt the HYV-fertilizer-irrigated water-based agricultural practice.

In the beginning, the new wheat and rice varieties imported to India were developed at the International Wheat and Maize Improvement Centre (CIMMYT) in Mexico, and the rice varieties developed at the International Rice Research Institute (IRRI) in the Philippines. A significant research capacity in agriculture was created in India as a result of the transfer and establishment of numerous agricultural universities and agricultural research institutes. In the beginning, chemical fertilizers and pesticides were mostly imported. In order to meet the mounting local demands and to reduce foreign-exchange drain, multinational corporations were allowed to set-up turn-key fertilizer and pesticide manufacturing plants. The Union Carbide Corporation (UCC) factory that exploded in December 1984 was set up in 1969 to manufacture chemical pesticides for the Indian Green Revolution. The explosion of the methyl isocyanate (MIC) tank and the rapid spread of the gas (which is the basic raw material for manufacturing the pesticide Sevin also known as carbaryl) killed 8,000 people and injured 300,000 people of Bhopal (Morehouse and Subramaniam 1986; Bogard 1989; Jones 1988; and Kurzman 1987)⁴.

Methyl isocyanate (MIC) is a highly volatile, flammable, and poisonous liquid that reacts with many other substances, including water. The explosion occurred because water somehow got inside one of the MIC tanks causing a violent explosion and spread of MIC engulfing the city of Bhopal killing and maiming people and other living things on its path. UCC has another similar plant in Institute, West Virginia which also produces Sevin. Although both plants used the same technology, the Bhopal plant did not receive the same routine maintenance and housekeeping of its pipes, valves and machinery, compared to its Institute counterpart.⁵ The water leakage into the tank occurred because of corroded pipes and valves (Unger 1994). There were a series of accidents at the Bhopal factory from gas leaks from leaky valves causing death and injury, and union complaints were never taken seriously by the factory management (Unger 1994). The Bhopal gas explosion was the result of criminal negligence on the part of the Union Carbide Corporation and Indian regulators who failed to adhere to the established safety standards.

No account of the technological change in the Green Revolution, including the author's own previous works, mentioned the Bhopal technological massacre of a people as part of the Green Revolution network. Bhopal is normally read as another technological accident and, as an abberation of a large Third World nation's effort to get on to the road of

modernization and economic growth. Blaming all modern technologies as inappropriate because of the Bhopal disaster is an understandable position. However, that does not help us understand the process of technological change and its relationship to political economy. There is still hope ingrained in modern technological knowledge to lift Third World nations out of poverty and deprivation in an alternative socio-technological ordering. One must locate Bhopal within the context of the technology transfer and agricultural modernization of India undertaken on the conditions and models provided by transnational entities like the World Bank.

A careful deconstruction of the story behind the Green Revolution will show us the configurations of international political economy involving numerous players outside India. For the international donors and powers behind the policy to introduce the Green Revolution package of technology in India and other Third World countries, the objective was not only to prevent potential famine by increasing food production, but also, in the process, to prevent a large country like India from following the "wrong" economic and political trajectory during the heyday of the Cold War.

The consequences of the technological change that ensued as a result of the Green Revolution was far-reaching in India, the Bhopal disaster being at the acme. The Green Revolution was generally read as a "successful" policy in terms of making India self-sufficient in food grain production,

despite the fact that millions of Indians go hungry every day because of their inability to buy enough food. It spread to only about 25 percent of the arable land in India where land tenure and the relations of production was conducive to semi-capitalist agricultural production. India's recent emergence as a net food exporter is an important achievement, no mean thing for a country branded as a hopeless basket case in the 1960s. But at what cost was this achievement attained? What sort of counterfactuals can we pose to argue how India could have achieved this food self-sufficiency without a Bhopal or mini-Bhopals occurring when peasants spray pesticides or when they use mechanically-powered machinery for weeding and threshing without protective gears?⁶

Toward a Renewal of Social Theory of Technological Change

How should one read and theorize from a social studies of technology perspective the Bhopal disaster and its connection to the Green Revolution? How should we conceptualize the essence of the Green Revolution when its effects are fragmented in the discourse of Third World modernization? Heidegger argued that technology is a mode of revealing, and the essence of revealing is to reveal the real thing -- "truth." Does the Green Revolution reveal the truth about the social reality of India's agricultural modernization program? Why did it take a Bhopal tragedy to reveal the real essence of the

Green Revolution beyond what is revealed by the proponents of India's agricultural modernization program as a huge success? Are there other Bhopals still hidden behind the Green Revolution?

But how can we find out about them before it is too late? How could we theorize about the technological change in the Green Revolution, given the contingency of all knowledge claims and consequently of the theorizing process itself? The theory-ladenness of observation espoused by Darwin and other great scientific practitioners show that one can observe only through the lens of a theory (Parayil 1997). And, theories cannot be proved true or false as Popper (1992) argued. They can only be corroborated as better problem-solvers or explanatory devices through better evidence. There can never be any absolute certainty for any of the theories expounded to capture the relationship between causes and events as there is no non-circular way of affirming it. But does not mean that anything goes when constructing models and theories of technological change?

Thus the question concerning technology that I want to pose is "is technology a mode of concealing?" Lukacs theory of "reification" might offer some headway in understanding the concealing of technological change and capitalist economic development process. A concealing of Bhopal as an unique technological tragedy occurs because of the fragmentation of social reality as economic development and modernization becomes intense in

catching-up countries like India. In the head-long rush to increase food production to stave off social unrest and national disaster, understanding the consequences of technological change takes a back seat in the order of things. Ways to find a connection between the Green Revolution, the Bhopal gas explosion, and transnational corporations and their agents is missing in all the models of technological change, including all radical social constructivist models.⁷

The literary critic Pierre Macherey (1978) argued that a literary work's ideological bias can be found out by examining not what it says about social reality, but precisely what it does not say about social reality. In theorizing about technological change what is most crucial is to look for the hidden and concealed "spectres" of the experience of modernization and technological change. One needs to expose the ideological motivations behind the portrayal of modern technological artifacts as mere value-neutral tools. If social theories pertaining to technological change in the Green Revolution does not talk about the Bhopal disaster as an integral element of Green Revolution's network, in addition to rejecting the theory, we need to find out the real reasons behind such deliberate misrepresentation of the facts pertaining the social history of the Green Revolution. What is required is strong theory and narrative modes that can capture the presence of local and trans-local political-economic forces that impel technological change within

the orbit of global and local economic development process, either in its "free market" or "state capitalist" variation. Social commentators and theorists need to show the ability, as Stephen Jay Gould (1995) aptly puts it, to "find legitimate and unforced connections" among apparently disparate details.

One possible way to theorize technological change is to be reflexive about the practical realities on the ground. All theories of social phenomena, including the phenomenon of technological change, should reflect the contextual practical realities of the economic structures and social relations. The idea is to be able to theorize by a careful observation and evaluation of facts. In theorizing about the Green Revolution and the ensuing social change in India, one needs to include the Bhopal disaster and its context to reveal the real, such as to find out under what context did a transnational corporation, Union Carbide, build a pesticide factory in an urban area.

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Endnotes

1. Feenberg (1986: 61) argues that Lukacs develops his concept of reification based on three principal sources: Marx's concept of economic (commodity) fetishism, Weber's concept of rationalization, and Hegel's concept of appearance.
2. The fact that the numerical control system of machine tools turned out to be functionally superior over the record-playback system it replaced was contingent. The legitimation of the technological choice was based on management's ideological bias against the workers who retained the intelligence of production in the record-playback system.
3. A detailed account of the Green Revolution is beyond the scope of this paper. There are hundreds of publications available which describe different aspects of the Green Revolution. For a historical reconstruction of the technological change in the Green Revolution, see Parayil (1992).
4. Since thousands of injured people have succumbed to their injuries, the exact death toll of this Hiroshima of the chemical industry is difficult to assess from the available publications on the Bhopal disaster. However, a

claims court in Bhopal has ascertained that more than 15,000 people have died in the 13 years since the explosion. See, "Bhopal Victims Protest Ruling," *International Herald Tribune*, November 27, 1996.

5. However, one should notice that in August 1985, 130 residents of Institute were hospitalized following the release of poisonous chemicals from the Sevin plant (Unger 1994: 74).

6. Using World Health Organization and United Nations Environment Programme statistics, Bogard (1989) calculated that half million Indian agricultural workers are poisoned each year by pesticides, of which 22,000 die. Also, this figure is growing at the rate of 5 percent per year.

7. For an astute criticism of the politically neutral stand some recent radical social constructivists of technology have taken, see Winner (1993).