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Encountering Technology

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Starting at the Beginning

I was born in New York City during World War II. My father was a prominent theoretical physicist who studied quantum mechanics in Germany and returned to the US where he participated in the revolutionary scientific developments of the 1930s and 40s. I grew up surrounded by scientists and their apparatuses. Cyclotrons and nuclear reactors were part of my childhood. I have fond memories of visiting "the lab" where the glassblower made toys for me and where later I worked for a summer entering mysterious numbers into an adding machine. I am a rare student of science and technology who was actually raised on the subject.

This gives me a somewhat different perspective than the currently fashionable emphasis on the ordinariness of scientific research. I have always known that science was a human activity – it went on in my house – and yet the scientists I knew believed science to be significantly different from most other human activities. Recent attempts to iron out the differences with a relativistic epistemology seem quite artificial and unconvincing. Science is surely not "pure," but relativism is essentially irrelevant, not much different from the claim that Bach's music is relative to his time. The point is obvious and gives rise to interesting research, but it is ultimately trivial: the music remains, irreducible to the circumstances of its creation. Scientific truths have a similar status as products of supreme crafts that transcend the ordinary events from which they arise.

On a less elevated note, science, especially experimental science, involves a great deal of technical cleverness. Perhaps this is why throughout my childhood I was encouraged to be clever. I was sent to carpentry school as a small boy and learnt to make little tables and wastebaskets under the direction of a very stern old carpenter. Innocently enacting an outdated cliché, I took apart clocks and machines and learned to handle chemicals, use a microscope, make a crystal radio, and suchlike.

On a visit to Hiroshima I was shocked by the realization that the atom bomb which had destroyed the city was a product of the very cleverness I was encouraged to develop as a boy, applied by brilliant scientists and engineers. Truly, cleverness is the greatest human power but not the greatest achievement. After the War, Hans Bethe bemoaned the fact that he and his colleagues at Los Alamos had been clever rather than wise. The course of 20th century technological advance certainly proves him right.

By the time I reached college, I was mainly interested in literature and philosophy. The writings of René Girard and Gabriel Marcel had a tremendous influence on me. I studied Husserl, Heidegger and Western Marxism. This was the early 1960s and the United States still lay under the pall of McCarthyism. The oppressive social and political conformism of the times is unimaginable today. Culture and critique were totally marginal in this environment. I longed to escape America for Europe and spent several years studying at the Sorbonne. But this hybrid identity posed a problem: how to find an authentic relation to my two traditions. Technology appeared to hold the answer in so far as it was a particular achievement of the America in which I was raised, questioned in interesting ways in the Europe where I had studied. This intersection determined my lifelong interest in philosophy of technology.

At first I approached the issue of technology through the concept of dystopia. The elimination of political opposition in advanced industrial society is an effect of technology, both its gigantic productivity and the ideology of progress that accompanies it. In the 1960s it seemed we were headed for *Brave New World*. Marcuse was the thinker of this moment. But paradoxically the dystopian perspective provoked mass opposition in the new left and the counterculture. By the late 1960s the system confronted a significant challenge.

I was studying in France in 1968 with Lucien Goldmann and Jacques Derrida when the most powerful new left movement of the decade broke out and I suddenly found myself at the center of a revolution. During May of that year a student revolt was the catalyst for a general strike that shut down the entire country. The French government came close to collapsing and only the loyalty of the troops saved it.

This movement seemed to me to be the end of dystopia and the beginning of a new type of socialism. In 1968 we fought for a general democratization of economic and technical institutions, not the system that prevailed in communist countries at that time. We substituted the idea of self-management for the orthodox Marxist concept of socialism.[1]

Although the French government still confronted a traditional opposition and was still judged in terms of utopian aspirations it could not hope to meet, France was well on the way to an American style consumer society. And yet it came quite close to a revolutionary transformation under an ideological banner emphasizing solidarity, democracy, and social control over economic and technical institutions. I came out of this movement convinced that there must be a way of reformulating Marxist theory to account for this unprecedented revolt in an advanced capitalist society. I wrote a first book on the early Marx and Lukács in search of resources in the Marxist tradition for interpreting this new situation.[2]

From Lukács I learned to distinguish rationality as a cognitive procedure from rationality as a cultural form. This distinction is fundamental to understanding the "great divide" that separates modernity from premodernity without falling into conservative and ethnocentric self-congratulation. The ability to reason belongs to the genetic heritage of all normal human beings and all cultures exhibit its effects in various ways. But modern scientific-technical rationality, as a specific type of rationality, uniquely emphasizes unusual procedures such as quantification which are not common to all cultures. When these procedures are instituted collectively in technologies, bureaucracies, and markets, a wholly new type of society is created. This society is legitimated ideologically by its rational grounds rather than by narrative myths, and that too is new. Critique must break through the illusion of rational necessity that is the ideological foundation of the system.

Lukács introduced the term reification in the sense in which it has been widely used ever since to refer to the process in which human relations are objectified as things. He understood this process as the production of the social world in a rational form, subject to laws such as those of political economy, and technically manipulable. The relation of the worker to the machine is the model of practice in a law-governed social world. The rational system is autonomous, self-acting, and requires only tending from human agents. The worker cannot change the logic of the machine, only position himself correctly in front of it. Lukács generalized from this example to understand the structure of practice in every area in advanced capitalism. The entrepreneur on the stock market, the employee in the bureaucracy, the intellectual in the discipline, all accept the law of their reified institution and attempt to manipulate it to advantage. But Lukács believed the working class was capable of coming together, recognizing its own role in creating the reified society, and transforming it.

How did Lukács explain the unique cognitive and political potential of the working class? He argued that the type of rationality exemplified by capitalist economics and technology would meet an immanent limit. Rational forms which pretended to autonomy came up against their intrinsic link to a content that overflowed them on all sides. This content was the life process of the members of the society, shaped but not fulfilled by the forms. As Lukács explained, a formal economic category such as wages appears to the businessman as a variable in calculations of profit and loss but from the worker's perspective its quantitative ups and downs are of vital significance for concrete health and happiness. Lukács believed that workers could penetrate the reified veil of the economy on the basis of their experience of the limit of the forms, and uncover potentialities blocked by capitalism.

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[1] See http://edocs.lib.sfu.ca/projects/mai68/ . I also co-authored a book on the May Events containing many translated documents: Feenberg, A. & Freedman, J. (2001). *When Poetry Ruled the Streets: The May Events of 1968*. Albany: SUNY Press.

[2] Feenberg, Andrew (1986). *Lukács, Marx, and the Sources of Critical Theory*. New York: Oxford Univ. Press.

Of course, by 1968 and certainly by now the traditional Marxist representation of the working class no longer corresponded to reality. But the general idea of a dereification of rational forms, the translation of fixed and frozen institutions back into the processes of human relations from which they arose seemed to be verified by the May Events. The slogans “Everything is Possible” and “All Power to the Imagination” flowed directly from this dereifying impulse.

It was on these terms that I understood or perhaps misunderstood the early work of those in the field of science and technology studies with whom I soon became acquainted. They offered empirical support to the critique of scientism, determinism, and the ideology of progress begun by Lukács and the Frankfurt school long before. And they also placed technology in a central position as a mediation in the process of human relations, both shaping that process and shaped by it.[3]

My rather idiosyncratic appropriation of STS generalized from Lukács’s argument to construct a new theory of technical politics. The problem was still the one Lukács posed of the critical force of the consciousness of dominated groups in technically mediated institutions. Once those caught up in the technical networks of the society realize their own collective role in creating and sustaining those networks, they can criticize and change them. This is not a romantic return to the immediate, to emotion versus reason, but rather a dialectical passage through the rationalized forms to an alternative configuration of the networks they make possible. These insights helped me to see the theoretical interest of my own involvements in technical politics, which I’ll sketch next.

I should warn you that I'm not a sociologist or anthropologist. The concrete cases I've studied were not chosen out of simple curiosity or for their scholarly significance. They have all grown out of my experience as an insider in various unusual organizations. Since I have always been situated within the field of my study, I have a point of view. I have not so much “followed the actors” in Latour’s phrase, as acted, and reflected on the results from my situated vantage point. I can't say whether this is more of an advantage or disadvantage, but I know it is a condition of my own ability to gain insight and do research. In what follows I would like to describe the involvements that served as a background to my theoretical work. These are matters from which we normally abstract in writing up our research, the “backstage” apparatus hidden from the audience. It occurred to me that it would be interesting to bring it forward for once to see what it looks like in the light of day.

I will discuss three cases. They concern medical research on human subjects, online education, and computer networking in France. All three cases have in common a polarity between a technocratic and a democratic logic. In each case I have been involved in democratic initiatives. As you'll see the strategy emerging from these cases does not oppose human beings to machines, but rather attempts to incorporate underserved human needs into the technical codes that preside over design. In these cases a narrowed range is a condition for the exercise of elite power through the technical network. Democratic interventions aim at widening that range and reducing asymmetries of power. Thus the “question of technology” in these cases is not about a substantive characteristic of technology as such but rather concerns the image of the human each technical system presupposes and shapes through the needs it serves. But let me turn now to the cases.

Three Case Histories

1. *Controversy in Medicine*. I was politically active until the late 70s when the American left finally succeeded in committing suicide, a temptation it had had trouble resisting for several years. I still felt like an activist even though my energy no longer had any obvious political outlet. A neurologist of my acquaintance invited me to help him create a medical research foundation to study an incurable disease. The Center for Neurologic Study hoped to find a cure for ALS (“Lou Gehrig’s Disease”) through drug trials organized with particular attention to patient rights. There is still no effective treatment for this poorly understood disease, and most patients die within a few years of diagnosis. The doctor primarily

[3] This is an argument made with particular force by Bruno Latour. See, for example, Latour, Bruno (1992). "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts," in Bijker, W. and Law, J., eds., *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, Mass: MIT Press.

responsible for the Center had already begun holding patient meetings to inform patients about their illness and to promote the exchange of social support and ideas for symptomatic treatments. These patient meetings promised a favorable scene on which to obtain the informed consent required for legitimate experimentation. Through these meetings we organized patients to participate collectively and vicariously in medical experiments with the intention of empowering them with both knowledge and enhanced care.[4]

I studied medical ethics and medical sociology as we worked on developing our innovative experimental system. I gradually came to realize that we were engaged with the same issues that had interested me in socialism. The medical system is a vast technical institution in which individual patients are all too often lost. This is particularly true of experimental medicine which patients sometimes confuse with standard treatment and invest with unrealistic expectations. Yet patient demand for experimentation in the case of incurable fatal disease is very strong. The hope of cure needs to be tempered by a sense of the slow progress of science, but that makes it more difficult to recruit patients and requires a great deal of time and effort to educate them. We felt this challenge was worth meeting out of respect for patients' rights.

It may be difficult to realize now just how innovative we were. Normally, patients have little contact with those who share their disease. They are connected only indirectly by the medical institutions to which they report for treatment. Talcott Parsons described what he called the "sick role" as an informal exchange in which patients are exempted from socially useful performance on condition of seeking a cure. As part of the "deal," the sick role isolates patients to prevent them from forming a deviant social group. But this description makes no sense for victims of chronic incurable diseases. Furthermore, experimentation on patients confined to the traditional sick role easily slips over into exploitation. It is unrealistic to expect isolated and poorly educated patients to exercise their freedom and preserve their dignity in the face of an enticing invitation to experimental participation.

Medicine recognized this problem in a backhanded way by restricting opportunities to participate to a bare statistically significant minimum, paternalistically protecting patients such as ours who had no other hope than experimental treatment. We responded to their demand while addressing the ethical issue. Patients can only offer truly free and informed consent as members of an organized group, educated to understand the experiments to which they are recruited. We designed our program accordingly.

We were unable to obtain support for our innovative work with patients. In fact we were ridiculed by the Muscular Dystrophy Association (MDA) to which we applied for funding for research on ethical experimentation. But the Karolinska institute in Sweden made a supply of interferon available to us and MDA did offer support for treating patients with it.[5] Patients heard lectures by several scientists explaining the experiment. I gave a lecture to eliminate any confusion between experimentation and standard treatment. Eventually we established dosages and the procedure for delivery of the medication and went on to attempt to cure one particularly brave patient, but without success. I took away from this experience a strong sense of the indifference of the medical institution to patients like the ones we were trying to help.

Some years later as AIDS ravaged the gay community the issues which we had confronted re-emerged to startling effect. Unlike our patients, who were politically unorganized and helpless, the gay community had been engaged in a civil rights struggle before the disease struck. Organized resistance to the standard practice of experimental medicine shocked the medical community. Scientists and physicians discovered patients who refused to occupy the sick role. An organization called Act Up engaged in noisy protests at scientific conferences and meanwhile patients met and educated themselves about the nature of the disease and the science behind the proposed cures.

These protests resulted in significant changes in the technical organization of experimental medicine. For example, to be eligible for some drug trials patients had to have no previous experience

[4] The Center for Neurologic Study web page is located at http://www.cnsonline.org . An article I wrote for CNS is available at http://www.cnsonline.org/www/docs/dublin.html .

[5] One of several plausible hypotheses held that ALS was caused by a slow virus, the action of which might be blocked by interferon.

with treatment. These "clean" patients were presumably best able to give accurate scientific results. Consider the inhumanity of offering a patient with an incurable fatal disease one and only one chance of cure. Obviously the scientists who designed such studies were not ill intentioned. But equally obviously they had not thought through the human implications of their preferred technical design.

Here is a second example. The "gold standard" in medical experimentation is the double blinded controlled trial. This requires extraordinary cooperation from patients. Some will take placebos and will only discover that fact at the end of the experiment. Their efforts as experimental subjects may benefit science and humanity, but not themselves, whereas those taking an effective new drug will also experience a personal benefit. But antagonism between the medical community and AIDS patients eroded the willingness to sacrifice. Patients took their pills to a lab for analysis, and if they were on placebos they dropped out of the experiment. Experiences like these eventually convinced the medical community that it had to work with the AIDS movement rather than against it. The process of cooptation involved significant concessions on both sides.

I wrote a paper on this case based on the point of view I had evolved in my earlier experiences with ALS.[6] I focused on the politics of the research system. The system appeared to be a product of pure scientific rationality and as such inflexible in its design. This explains why scientists' initial reactions to the AIDS movement were so negative. They thought that irrational patients were blocking the path to a cure for their own disease. But in reality many features of the research design were contingent and had no particular basis in a supposedly pure scientific rationality. Some aspects of their experiments were designed for the convenience of researchers or to "protect" patients. Others had scientific value but the price patients were asked to pay for participation was so high compliance required far more education and a far more collaborative environment than was normally available. Eventually the technical code of experimental medicine was altered under pressure from below. This greatly improved access to experimental treatments for patients with incurable disease. This is a good example of a democratic intervention into technology through protest and controversy.

In the article I wrote on this case, I attempted to establish the legitimacy of patient involvement in research design. This approach was incompatible with a scientistic standpoint in which patients would appear simply as objects. On that account patient intervention would be a breakdown in the research process, no different in principle from leaky equipment or a short circuit in the apparatus. I attacked this conception of medical research with a broad reference to Donna Haraway's notion of the cyborg. From her outlandish metaphor I extracted the point that I needed, namely, that the body as conceived in medicine is an abstraction from the person in interaction with the medical institution, and not a "natural" object in the same sense as bacteria or stars.

This observation was then supported by a review of studies in medical ethics and sociology highlighting the impact of symptomatic care, the placebo effect, and social support on medical outcomes. This literature demonstrates that the body conceived in mechanistic terms is only part of the story of health. But how to take into account the rest of the story? The answer cannot be to abandon medical science, the achievements of which are undeniable. Nor can patients await the completion of the scientific project. But in practice medical science proves not to be a closed system. Its openness is due in part to its still imperfect knowledge but also to a reason of principle: the patient is a conscious agent and not a passive object and therefore experience and understanding affect health.

Having established these ideas through the social science literature, I introduced several concepts with which to articulate a solution to the conundrum of the medical body. I defined "participant interests" in a non-essentialist framework as concerns flowing from enrolment in a technical system or network. Participant interests are thus not just pre-existing facts about individuals or groups but arise from technical involvements. Such interests take three forms, first, as informal and scarcely articulated feelings, second, as purely objective facts known to researchers, and third, as articulated and socially recognized matters of concern. In technical politics the second modality is sometimes necessary to pass

[6] See Feenberg, Andrew (1995). *Alternative Modernity: The Technical Turn in Philosophy and Social Theory*. Los Angeles: University of California Press, chap. 5.

from the first to the third, that is to say, only by invoking scientific knowledge are participants able to recognize, clearly state, and gain acceptance for a conception of their own interests.

I introduced the concept of participant interests to explain how health related concerns ignored by the medical institution might provide a basis for patients to struggle over its configuration and procedures. These concerns are essentially communicative. They are under-estimated by a medical establishment increasingly preoccupied by scientific and technical advances.

I introduced a second concept – the technical code – to explain the relationship between the discourse of medical science and that of patients. What appears as an interest to patients must be translated into scientific terms to enter the discipline of medicine. Otherwise, it remains extrinsic to medical practice, a mere environmental condition without properly medical significance. The technical code refers to an ideal typical construction the social researcher can use to trace the translations between social demands of patients and medical knowledge. With this concept, I could now describe at a high level of abstraction how we at the Center for Neurologic Study had translated patient complaints into a new experimental design, and how AIDS patients were able to modify experimental design to meet their needs. The model of translation explains the dynamic of many other technical systems under pressure from the social networks they institute.

We are clearly a long way from socialist revolution with this approach, and yet the basic idea of dereification persists. Today I would call these attempts to change the medical institution “democratic interventions” responding to the underserved interests of those caught up in its operations. To succeed in cases such as this, the democratic intervention must actualize the potential for group formation of patients with a common affliction and common relationship to medicine. We took members of a technical network unaware of their commonality, brought them together so that they achieved self-consciousness, and responded to shared interests ignored by the current configuration of the network to which they belonged. AIDS patients later carried this process through to the point where they were able to force changes on the whole medical community which we and our patient group were too weak to impose.

My article emphasizes the role of ethics in the technical code of medicine. According to the standard view in both medicine and philosophy, ethics is extrinsic to the scientific basis of medicine and concerns only the application of the science in a human context. But this is to reduce medical care to a technical intervention. Communicative interaction is also essential to medical care, especially in the case of experimentation. The subject of research is not an individual scientist nor even the scientific community, but a collective of scientists, doctors, and human “subjects” interacting according to an agreed on framework. The code that describes that framework is epistemological, technical and ethical at one and the same time. The ethical dimension can be ignored by cynical researchers in situations where subjects are weak and ill-informed but the future of research is jeopardized whenever human beings are treated like guinea pigs. Where researchers are conscientious and subjects strong and well informed, ethical, technical and epistemic procedures merge into a single complex that supplies knowledge and protects human dignity.

2. *Participatory Design in Education.* After several years working with this medical institute I moved to the Western Behavioral Sciences Institute (WBSI) where I once again became involved in technical politics.[7] In 1981 the Institute decided to create a distance learning system for executives based on a computer network. This had never been done before. The Internet was still closed to the public and e-mail was still new, used primarily in computer companies and a few university research departments.

In those days, distance learning meant sending printed materials to students who had no contact with each other or their teachers. We invented e-learning in order to add human interaction to distance learning. The technical infrastructure of our project was a mini computer running a computer conferencing program with which we communicated on a proprietary network using early personal computers and modems. We hired faculty from major universities, fascinated by the prospect of using a

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[7] The WBSI website is located at: http://www.wbsi.org/wbsi/index.htm . See also, Feenberg, Andrew, "Building a Global Network: The WBSI Experience," in L. Harasim, ed., *Global Networks: Computerizing the International Community*, MIT Press, 1993, pp. 185-197.

computer for the first time. We opened our program in January of 1982, but with only seven students because it was difficult to recruit for a program so innovative it was practically incomprehensible. The faculty sent out readings by mail, and our students discussed them online, generating hundreds of pages of transcripts each month. This communicative application of computer networking came as a surprise to both educators and computer people, although today it is fairly routine.

This experience put me in touch with leading people in industry and government. I recall being invited to lunch in the early 1980s by a vice president of one of the largest computer companies in the world. He asked my opinion on the future of computing. I thought to myself, if this guy doesn't know and is asking me, a student of Marcuse, to tell him, then no one knows! It became clear to me that technology was highly flexible and unpredictable and not at all like the image of the rigid system projected by the paradigm technologies of the 1930s that had shaped the vision of Heidegger and the Frankfurt school. In fact we were proving this point in practice. By creating the first online education program at a time when computers were understood as tools for calculating and filing data, we contributed to reinventing computer technology as a medium of communication.

But there were many problems. The normal way in which one learns to teach is by being taught. Most people who have studied in a classroom have no difficulty performing the basic rituals of teaching such as facing the class to speak, recognizing those who raise their hands, using a blackboard, and so on. But none of our teachers had ever been in an online classroom and so they had no idea what they were supposed to do. Neither did we. It took a while to figure out how to initiate discussion and build interaction online but eventually we devised a dialogic pedagogy. Students were impressed by successful online classes and spread the word about our program. We were moderately successful for 10 years but never attracted the large scale support we needed to make a major impact and meet our costs.

The complexity of the interfaces to the modems, networks, and asynchronous computer conferencing software then available posed another problem. For example, signing on required the punctilious execution of a whole page of commands. We had to convince executives who had never even typed to engage with this primitive equipment. We decided to program our own simplified interface to help the executives we were recruiting participate more actively. Like the Internet browser, this terminal software was intended to liberate the user from the command line. Our software automated routine tasks such as signing on and uploading messages, which could be composed off-line in a small editor we wrote for that purpose. The software also made it possible for us to implement short-term projects with the Commerce Department of the United States and various corporations.

The WBSI program provoked considerable interest in the business press and in universities in the English-speaking world and Scandinavia.[8] However, large-scale interest in online education only appeared at the end of the 1990s, during a crisis in university funding. Paradoxically what computer companies and college administrators understood by “online education” was quite different from our pioneering program. The meaning of the term slipped according to the best principles of STS and I had an opportunity to watch interpretive flexibility in action. Where we had added communication to a traditional distance learning system that lacked it, the new advocates of online education hoped to automate education on the Internet, eliminating the existing interaction in the classroom.

Of course the ambition to automate education provoked instant faculty rage. I recall feeling targeted by colleagues who blamed me for this monstrous assault on their profession. I could only say, “It's not my fault, I lost control of my idea long ago.” David Noble, the Marxist historian of deskilling, became the principal critic of online education and he and I participated in several public debates on the virtues and vices of the new system.

These experiences led me to change my research focus. I attempted to place the issue of online education in the widest possible context. This had become necessary because I was fighting on two fronts, against humanists who dismissed all electronic mediation and technocrats who saw in it the promise of eliminating the teaching profession. Their values differed but their arguments converged in a deterministic conception of technology as a dehumanizing and commercially profitable alternative to

[8] For example, Rowan, Roy (1983). “Executive Ed. at Computer U,” *Fortune,* March 7.

traditional arrangements. At the same time, I felt it was important to enter into the technical details of the problem in order to secure the points made at the philosophical level. As a result, I discussed the question of online education at three very different levels of abstraction, philosophical, political, and technical.

The philosophical argument begins with Plato, who first contrasted the communicative characteristics of writing to speech and so began the tradition of media critique 2500 years ago. His critique echoes still in Martin Heidegger and Jean-François Lyotard who identify the digital encoding of information in computers as the source of their dehumanizing effects. This argument culminates finally in the attack on online education for substituting computers for humanistic understanding. But the notion that the use of computers will somehow bias language and learning toward the strictly technical is off the mark. The deterministic hypothesis on which this notion rests has been refuted in practice by the predominantly informal communicative usages of computer networks. To judge by the results users have had as much impact on computers as computers have had on users.

At the political level, I am interested in the struggle for control of the meaning of online education between actors with different agendas, either automation or electronic mediation of traditional education.[9] This case neatly illustrates the constructivist premise that the same basic equipment configured in different ways can support completely different social relations. Technical and social differences vary independently. Sometimes a slight technical tweak completely transforms the social meaning of a technology. Consider, for example, the role of sidewalk ramps in redefining the life possibilities of the handicapped. Sometimes, significant technical differences make very little social difference, as is the case with hybrid engines in cars.

This argument opens the question of the design of computer systems in education. So long as the computer as such is the problem, design is unimportant. But if the computer is innocent, at least of the charge of dehumanization, then everything depends on how the systems are put together. Automation is only one possible design agenda.

The automation of education responds to the industrial technical code, going back to the early 19th century. The transfer of skills from craftsmen to machines is an old pattern that underlies the industrial revolution and continues through the Taylorist and Fordist developments of the 20th century. The technical code of industrialism aims to centralize control of the workforce and to lessen labor costs by substituting machines tended by unskilled labor for skilled labor.

The previous attempt to automate education was Computer Aided Instruction, or CAI. CAI was delivered by the (ironically called) Plato system, and later by application programs running on personal computers. But it never offered a convincing substitute for live face-to-face instruction. At the end of the 1990s, we were led to believe that the new multimedia features of the Internet could provide a more realistic experience. The Internet promised simulated interaction and video delivery of canned lectures by "star" professors, adding a little life to the sterile programs of earlier CAI.

But would it really work? And if so, would it be desirable? Faculty were skeptical and not only because they feared losing their jobs. No one who has dealt with students' questions believes current artificial intelligence is up to the task of anticipating and answering them. There are subtle interactions that make a difference in real classroom situations and these cannot be duplicated by videos and FAQs ("Frequently Asked Question" lists). Furthermore, informal and to some extent even formal human communication leaves it up to the participants to define the boundaries of relevance on the spot. These boundaries can be enlarged on occasion to include reflection on the communication process itself. Such meta-communicative practices are essential to our idea of freedom. They would be excluded by an automated system in which relevance was inscribed in software.

Our early experiment in online education was quite different. It was based entirely on human communication. At WBSI the computer offered a virtual meeting place rather than a simulacrum of the classroom. But online communication has its own limitations and problems. Its unusual pragmatics differ from their face-to-face equivalent through asynchronicity and the absence of paralinguistic signs. Again,

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9 See Feenberg, A. (2002). *Transforming Technology*. Oxford: Oxford University Press, chap. 5.

actual experience teaching online informed my work, but I also drew on semiotics and conversation analysis for theoretical concepts useful for understanding this new communicative practice. This analysis brought out the dependence of group relations on characteristics of the technologies binding together the group.

Group activity is usually mediated by objects of some sort. The seminar requires its table around which to sit and games require boards or fields. But in online education the semantic flow is carried by the mediation and that has complex implications. We are here in territory explored by media theorists such as Marshall McLuhan. The medium is, if not the whole message, at least a significant part of it. But McLuhan could only observe patterns of electronic mediation in two cases, telephone communication between pairs of interlocutors and various types of one-way broadcasting. The computer network makes possible a third case: asynchronous online interaction in small groups. This new technology opens up a huge range of activities to electronic mediation that had formerly to take place in real time face-to-face encounters.

Small groups are the social settings of much white collar work, education, and a wide variety of social clubs and information exchanges. The social codes for all these activities are familiar and negotiating communication problems in face-to-face dialogue is relatively straightforward. But online group interaction is another story entirely. It is more difficult to work together under these unusual conditions and it requires skilled communicative leadership to accomplish complex goals, including educational goals. I developed a theory of "moderating" to isolate the specifically communicative aspects of online leadership.

As a student of science and technology it occurred to me that I should not merely write about online education but I should do something about it. I applied my own theory of the technical code to conceiving the technology corresponding to the pedagogical practice of our original program. I designed a piece of software and obtained a grant to implement my design in order to reinforce my argument against automation with a different kind of technical intervention. The "moderating functions" were incorporated into the software design in the hope that facilitating the work of discussion leaders would encourage teachers to take an active role in their online classes. This project still continues and has had modest success, although the main reason higher education has not been automated is the patent inadequacy of current technology to the task.[10]

My project is one of a great many that flourish in the educational field. Teachers working closely with programmers devise original solutions to the problem of achieving traditional pedagogical goals in a new environment. This is an example of "participatory design," and it represents a second type of democratic intervention.

3. *Hacking the Network.* My third case introduces yet another type of democratic intervention in a very different social context. In the mid 1980s I was invited by the French telecom to introduce computer conferencing to the Minitel system. I spent some time in France working on this project and learned a great deal about the Minitel in the process.

The Minitel is now a forgotten episode in the prehistory of the Internet. But it was a very important landmark in online communication, proving for the first time that a domestic computer network could reach a wide audience. What made the Minitel so successful was the free distribution of user friendly terminals that plugged into the phone system. Users did not need to know anything about computers to get up and running on the system. Entrepreneurs could easily hook up hosts and their revenues were guaranteed by the phone company which billed customers for each minute of online service. Six million terminals were distributed and the system proved both a social and economic success until it was finally eclipsed by the Internet.[11]

Although the Minitel was originally conceived to distribute information to households, the most exciting application was invented by hackers who broke into a news service to chat online in pursuit of friendship and dates. Very quickly other host services introduced programs to capture and collect revenue

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[10] The latest version of the software is described at http://www.geof.net/code/annotation/

[11] One can still get an idea of the Minitel system at http://www.minitel.fr .

from this new flow of communication. This was the first widespread public use of instant messaging. The asynchronous computer conferencing programs I was engaged to introduce would have enhanced communication on the system by supporting more complex interactions such as business meetings, classes, and other group activities. We were not successful but I do not think this was our fault. We encountered significant obstacles in the social environment and the design of the Minitel.

The main problem was the image of the system. The French educational system was far too stodgy to take up our innovation, but we had hoped that business would be interested. How wrong we were! The very design choices that made the Minitel acceptable to the public and suited it to placement in the home, diminished its credibility in a business context. The image problem was aggravated by "pink" messaging. Who could believe an electronic singles bar had promise as a venue for business meetings?

There was also a technical issue. I recall one incident that clarified the problem for me. The Minitel was conceived for consulting databases stored in videotext pages and accessed through hierarchical menus. The keyboard was designed by a telephone manufacturer to punch in the numbers of menu items, but this is not what communicating users of the system required. I wrote a short note on the keyboard for the directors of the telecom in the hope that a new terminal would be designed more suitable for typing and hence for professional communication. There was no response to my recommendation and soon I learned that the telecom was ashamed of the communication on its system since so much of it revolved around sex. They had inscribed informational usages in the Minitel hardware and had no intention of changing that even though the users had reinvented the technology around a new social form.

Once again I confronted the alternative: technocratic "rationality" versus communication as conceived by users. This alternative reflected different social visions of modernity, a vision focused on the narrowly conceived goals of organizations such as government agencies and businesses, and a vision focused on a broader range of human needs evident to users but not to the technocrats in charge of designing and implementing the system. I wrote an article about this contrast as manifested in the history of the Minitel.[12]

In my article I developed this contrast at several levels. My purpose was to show that one can trace an ideology "all the way down" in the sense that discursive expressions of social visions can be found reflected in details of technical design and vice versa. The identification of congruencies at all levels would verify the basic constructivist thesis that technology and society are not two separate domains but intricately imbricated. But it verifies this thesis in a rather different way from the usual STS formulations since it does not presuppose an individualist or empiricist methodology but instead treats social forces of many different types as equally "real."

I identified three main levels, at each of which alternatives appeared: social theories; social imaginaries, expressed in policies and popular sentiment; and technical specifications and practices. The first level includes various theories and critiques of post-industrial society. The second level includes the government policies that led to the creation of the Minitel system and the unexpected transformation that invested the technology with social and sexual connotations. The third level includes such design features as user friendliness, the keyboard, and the hacker initiative that introduced instant messaging. The argument shows how the technical code translates between levels and signifies the Minitel as a compromise between contrasting interpretations.

In this case the democratic intervention took the form not of a social movement or professional resistance, but the action of a few hackers. Yet that action would have been without significance had it not been seized on by millions of users. In this sense it can be said to be democratic. But in a deeper sense, democracy is at stake in any intervention into technology that enlarges the scope of human communication and serves a wider range of legitimate human needs than those represented by the technocracy.

What needs were served in the Minitel case? In one sense the answer is obvious. Users pursued friendship and sexual encounters. But the role of anonymity in this case raises interesting questions about post-industrial society. The increasing impersonality of rationalized interactions opens up a vast sphere of

[12] Feenberg, A. (2010). *Between Reason and Experience.* MIT Press, chap. 5.

anonymity in everyday life. The efficiency of these official and economic transactions appears to validate this new social form. But the functional role of anonymous encounters does not exhaust their significance in the psychic life of the individuals. Rationalized interactions are not a perfect substitute for other more personal interactions in the lost communities of earlier times. The affective surplus shows up in longing for community and, more ominously, in fantasies of sex and violence in popular culture.

The Minitel was introduced to enhance post-industrial efficiency by enabling users to personalize anonymous requests for information relevant to the pursuit of "rational" ends such as business or academic success. But unwittingly the technocrats also made it possible to personalize other less "rational" requests, among which the most urgently pressing in an atomized society concern human relations. Thus the system almost invited the hack to which it was submitted. In the process, its socio-technical form was altered: from a hierarchical system in which individuals connected individually to central hosts rich in informational content, it was effectively transformed into a commutative system in which everyone connected with everyone to communicate about personal affairs. Conceived as an electronic library accessed through the telephone network, the system took on the social form of the telephone network as well.

Critical Theory of Technology

These experiences brought me to the realization that most of the Marxism I had learned as a student did not apply to the world in which I was living. Toward the end of the 1980s I decided to write a book in which I would settle accounts with my past beliefs. This became *Critical Theory Of Technology*, published in 1991. The book was written on the cusp of the breakdown of communism. In fact the page proofs came back with a request that I eliminate "USSR" except as a historical reference. I had made the transition from Marxism to philosophy of technology just as the Communist world disappeared.

The lessons of my work with medicine and computers showed up in this book. These experiences demonstrated that issues Marx had associated with the factory had now spread throughout the society. David Noble and Harry Braverman had argued that deskilling was the social imperative central to industrial innovation. But Noble and Braverman were talking about factory work. The factory was no longer the sole locus of technical activity. We encountered the same pressures for deskilling and automation surrounding the introduction of the computer into education. Related problems appeared also in relation to online communication in France with the Minitel and in the US with the Internet. The contested shape of the online world testifies to the continuing differences between technical agendas corresponding to different interests and visions of life.

These differences are still the occasion for struggles, but struggles of a new type. In my book I generalized the Lukácsian theory to take account of the tension between technically rational forms and the life process of the individuals shaped by those forms in technical networks. The concept of participant interests generalized the earlier notion of class interest in response to this new situation. Technical politics meant the democratization of technological society, a theme that relates significantly to the socialist project without being precisely identical to any earlier doctrine.

Looking back on this book today, I find in it four fundamental ideas that continue throughout my work. I introduced the concept of "formal bias" to understand how a rational system could have discriminatory consequences. This is a difficult point since we normally think of bias as the result of irrational emotions, false ideas, and unjustified privileges. The theory of the bias of technology depended on an idea I originally found in Marx but which I refined with concepts drawn from STS.[13] Marx's critique of political economy showed that market rationality produces class inequality despite its appearance of fairness and reciprocity. STS could be interpreted to extend a similar idea to technical rationality. Like the market, devices serve everyone equally, but their design is accommodated to the interests and visions of specific actors, sometimes at the expense of other actors with less power.

[13] See, for example, Pinch, Trevor and Bijker, Wiebe (1984). "The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology Technology Might Benefit Each Other," *Social Studies of Science*, vol. 14, 1984.

The concept of formal bias depends on another fundamental idea drawn from STS. Technical disciplines describe the workings of technologies in causal terms drawn from natural science, but design is clearly underdetermined by the conformity of technologies to natural law. Social factors intervene in the selection of successful designs from among a wide range of possible configurations. The underdetermination of design leaves room for a variety of socially biased solutions to the problems of an industrial society, including, potentially, a socialist solution.

But unlike earlier Marxist arguments for the replacement of one system by another, the critique of formal bias leads to an additive pattern of gradual change. The addition of care to cure or communicative functions to informational functions parallels many similar episodes in the history of technology. Technologies are not unified works of art, fixed at their origin once and for all. Rather, they consist in layers of functionality that gradually accumulate in response to the demands of the different actors with the power to influence their design.

The French philosopher of technology Gilbert Simondon described two layering patterns.[14] On the one hand, functions can be served by separate structures, each new function requiring a new structure. This pattern results in undesirable complexity and inefficiency. Consider, for example, the catalytic converter, which responds to new environmental constraints with an expensive attachment to the exhaust system. On the other hand, the structures of the artifact may be reconfigured to perform multiple functions as new functions are added. This pattern, which Simondon calls “concretization,” avoids needless complication and represents a progressive path of technological development. In my social appropriation of Simondon’s concept, I emphasize the role of concretizing innovations in reconciling actors with different agendas.

The Center for Neurologic Study and the AIDS movement achieved concretizations in experimental design by seamlessly combining care and education with the search for new knowledge. Scientists and patients were reconciled in the new configuration. Computer conferencing is a concretization of transmission and filing technologies, combining in a single act sending messages and making them available to a user group. We designed terminal software in order to extend access to this system from the engineers who created it to executives with few computer skills, reconciling two very different types of users. A more serious conflict appeared at a later stage at the level of multi-media systems for education. The question concerned which of several alternatives was to serve as the core medium, text, as in our version of online education, or video, as in proposals for automation. It is still uncertain how this contest will play out. In the Minitel case the concretization was blocked at the keyboard. Although official actors and users could have been reconciled in a redesigned terminal suitable for both information retrieval and communication, this did not occur.

Concretizations are particularly important in environmental politics. They make it possible to address environmental regulations without degrading technical performance. Victims of pollution, workers employing polluting technologies, and users of their products are reconciled in innovative designs that reduce the environmental impact of production without raising costs excessively.

Since writing *Critical Theory Of Technology* I have written a number of other books on social aspects of technology in which I have examined everything from James Bond films to the Japanese game of go, from ecology to technical democracy. In each case I explore the themes I have laid out here in one or another setting. Most recently I have begun writing at greater length about Heidegger, Marcuse, and the early Marx and Lukács. I am trying to revive radical social theory of modernity around the theme of technology which has been ignored with few exceptions by major theorists.[15]

Now that I have briefly explained my personal trajectory and these three case histories, I need to address a final question that has surely occurred to you. Are the similarities between these three cases due to the subjective orientation of the researcher, or do they reflect a general polarity between technical elites and users? I believe that in fact modern societies have a common structure over a very wide range of

[14] Simondon, Gilbert (1958). *Du Mode d’Existence des Objets Techniques*. Paris: Aubier, chap. 1.

[15] See *Alternative Modernity, Questioning Technology, Transforming Technology, Heidegger and Marcuse, Between Reason and Experience.*

institutions rooted in the history of capitalism. It is therefore not surprising that it reappears in each of the cases I studied. In an attempt to get beyond the traditional Marxist focus on economics, I have taken a fresh look at the imbrication of power and technology in Marx's theory of capitalism.

This phenomenon appears most clearly in the origins of the factory system. The factory appears in Marx's work as a system of technological domination, contradicting the standard deterministic view according to which industrialization was motivated entirely by the pursuit of efficiency and could not have developed otherwise. But determinism ignores the social dimension of the development, characterized by class tensions that orient it in a specific direction.

As leaders, capitalists are restrained minimally by society, for example by laws against theft and competitive pressures. Within the factory the owner is fairly free to act as he wishes. The capitalist's extraordinary freedom defines a new type of ownership, quite different from most earlier notions of property. For example, the owners of large estates were expected to fulfil religious, political and charitable obligations to their tenants. But the capitalist version of ownership imposes only narrow responsibilities. The owner is granted the *right of legitimate indifference* to his workers and to the community in which his factory is located. This is what I call "operational autonomy," the owner's right to make decisions without consulting any overriding normative considerations or constituencies. Note that operational autonomy does not require private ownership. The same type of control may be exercised in a state owned or non-profit institution.

The power and indifference associated with operational autonomy has consequences for the progress of technology. Before factories were built, the textile trade in northern England was carried on through the putting out system. The capitalist supplied raw materials to village workers, each with his own cottage and tools, and returned later to pick up the finished goods which he then sold on markets in larger cities. The factory system shifted work from the family and the home to a central location owned by the capitalist. This new situation led to control problems. Supervision by business owners and their agents became necessary in order to prevent slacking off and theft. Once in charge of the work process capitalists imagined various improvements that resulted in a much more parcellized division of labor. Work was deskilled to eliminate the need to hire skilled males. Soon women and children displaced them at lesser cost.

The process was explained by Andrew Ure in 1835. He wrote, "By the infirmity of human nature it happens, that the more skilled the workman, the more self-willed and intractable he is apt to become, and of course, the less fit a component of a mechanical system, in which, by occasional irregularities, he may do great damage to the whole. The grand object therefore of the modern manufacturer is, through the union of capital and science, to reduce the task of his work people to the exercise of vigilance and dexterity."

Mechanization follows the manufacturing pattern. Some of the tasks divided between unskilled workers were assigned to machines. Control was also delegated to machines as we see especially in the case of the assembly line. According to Marx production achieves its fully capitalist form through the mechanization of industry and the adaptation of technology to the requirements of capitalism. Thus the industrial model is the result of a social process and the technology emerging from that process is class bound.

As inheritors of this history, contemporary capitalist and communist elites have an unusual degree of autonomy. Premodern rulers' were limited by custom and religion and their responsibilities to the community extended far beyond those of a modern corporation or government agency. Apart from markets and laws, these modern elites are subject to few constraints. But there is a more subtle intrinsic constraint arising from their hierarchical position in the organizations to which they belong: they must maintain that position in systems in which the subordinates have no intrinsic interest in their success.

The structure of top-down control that evolved under capitalism reflects this imperative of modern organization whether it be in the public or private sector. The forms of sociability that impose this pattern emerged with capitalist manufacturing which shattered the traditional structures and ethos of artisanal production. It continued with the bureaucratization of the state apparatus in both capitalist and communist countries. It has shaped the culture of the technical disciplines which serve the enterprise and the bureaucracy, and the technical codes in every field reflect these origins.

The requirement of what I call "operational autonomy" dictates the style of technological design characteristic of industrialism. The goal is to inscribe top down control in design and especially to perpetuate control over future technological choices. Such strategies prove "efficient" under the conditions that preside over their selection and implementation, closing the circle and giving the illusion of neutral technical rationality. For example, where profit is the measure of success, technologies such as the assembly line easily prove their worth. But were the success of a worker-owned enterprise measured in terms that reflected workers' interests, the boredom of assembly line work might be counted against it and another technology chosen. This approach shows how the formal rationality of the system is adapted to its social bias.

One of the great questions of our time concerns how far the technological system can evolve toward a more democratic configuration as its bias is challenged from below. The cases I have described are moderately encouraging. They have in common the effectiveness of user agency in the dynamic situation of the introduction or development of new and complex systems. In each case users widen the range of needs the system represents.

Our standard conception of politics today is inadequate because it does not recognize the political nature of such interventions. Politics is about war and peace, law and taxes, and is based on geographical representation. Today many of the most controversial issues that affect our lives involve technology but the affected "communities" belong to technical networks that stretch across political jurisdictions. The concept of politics needs to be revised to take account of this new situation.

Political theory has not yet made this adjustment. It has no answers to questions about technical representation. More worrisome still is its inability to grasp the anti-democratic implications of certain technological designs. Philosophical speculation on the nature of totalitarianism often overlooks the role of new techniques of surveillance, information management and communication in making possible the one party police state so disastrously prevalent in the 20^{th} century. Instead the blame is laid at the feet of Plato and Rousseau! And few political theorists worry about the single most undemocratic feature of modern democracies, namely the use of broadcasting to spread lies and propaganda in the interests of established elites and their policies. Is the ambition of business to control the Internet an issue for democratic theory? It certainly should be although there is not much philosophical literature on this topic. Research in STS should address this situation and encourage a major reorientation of democratic theory.

I should say a few words in conclusion about the relation between my work and the mainstream of STS. I clearly do not belong to that mainstream although I have learned a great deal from the field. What I find especially important is the dereifying impulse that lies behind the attempt to bring science and technology back into the human world. But I am astonished by the ambitious claims made on behalf of STS by many of its prominent advocates. I'm thinking especially of Bruno Latour whose work I have followed with interest for many years. I sympathize with his intent to transcend the antinomies of culture and nature, subject and object and I have learned from him the inextricable association of people and things in the social process. But I do not believe the antinomies can be transcended by a new terminology and a new method of empirical research. What is more, the cost seems to be giving up the entire tradition of social theory. This is where I have real problems.

I do not believe the tradition is exhausted. There are rich analyses in the tradition and valuable concepts that we should develop further rather than junk. If I were to put my argument in Latour's terms, I would say that he has underestimated the methodological implications of one key difference between modernity and pre-modernity, namely the fantastic success of modern societies in converting "mediators" into "intermediaries," that is, in stabilizing certain key social relations in so many different ways that a "shorthand" for the results is not only perfectly adequate but essential to understanding.

Democratization involves destabilizing those relations in smaller or larger ways, a process that is almost impossible to conceive without acknowledging and criticizing the stability that has been achieved. This is why sociological concepts describing these stabilized relations, notions such as modernization, rationalization, capitalism, management, class, power, interest, ideology, propaganda, racism, are more important than ever.

Is it possible to work with these concepts without recapitulating what many in STS now see as the humanistic and essentialist mistakes of the past? I believe it is, that basic sociological concepts can be reconstructed in new ways. Indeed, sophisticated Marxist theorists such as Marx himself and the early Lukács undertook this task long before STS, albeit in a different theoretical context. In conclusion, consider the six concepts I have introduced here to formulate my own critical approach, rationality, participants interests, technical codes, operational autonomy, formal bias, and underdetermination.

1. *Rationality*: Rational procedures embodied in social institutions and technologies are distinguished by characteristics such as precision, standardization, and rules of equivalence. Rationality in this sense cannot be understood on the same terms as other social activities because its logical form makes possible unique achievements such as technical disciplines and the technologies based on them, large scale markets, etc. At a certain density these achievements give rise to modernity.

2. *Participant Interests*. These interests do not presuppose an essentialist definition of agents independent of their technical involvements but are relative to the networks in which the agents participate, either actively as users and workers or passively as victims of pollution or other side-effects.

3. *Technical Code*. This concept refers us to culturally and socially established regularities shaping the design of technologies and systems. Technical codes are secured at many levels -- ideological, normative, technical -- and therefore persist with great stability from one situation to another, one generation of technology to the next.

4. *Operational Autonomy*. The Foucauldian critique of power as a substantial attribute of individuals was anticipated long ago by certain aspects of Marx's work. Power is a function of the organization of the collective of workers and tools which distributes it more or less symmetrically. Operational autonomy is the highly asymmetrical distribution inscribed in the industrial technical code. It describes a system in which coordination requires top down control.

5. *Formal Bias*. This concept articulates the political implications of unequal control over technological design exercised by the relevant (and irrelevant) actors. With this concept it is possible to attribute socially specific "values" to technology without falling into essentialist condemnation of technology as such. Operational autonomy determines a bias that is strictly formal, dependent only on the structure of the collective and not on particular substantive interests, with the exception of the interest in perpetuating operational autonomy itself.

6. *Underdetermination*. This concept makes it possible to explain the intersection of participant interests and the established technical disciplines in technically sound solutions to technical problems. Underdetermination makes room for structural constraints such as operational autonomy and actors' preferences, both in the form of technical codes and more punctual interventions in the design process.

These six concepts form a bridge between the methodological apparatus of STS and the insights of the critical tradition in social and political thought. They open the way from what Wiebe Bijker has called the "academic detour" of STS back to the main road of democratic political theory.