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Romancing the Machine— Reflections on the Social Scientific Construction of Computer Reality

New machinery, especially microelectronic control technologies ("The Computer"), play an important role in upscaling organizational and societal complexities. If people feel they must go along with these changes, this in turn necessitates resymbolizations. And most people do, most of the time. Animation and personification of computing machinery, whether in its threatening or enticing aspects, are part of such necessary symbolizations. Social scientists want to study these processes and even partake in turning structural change into meaningful stories, where "non-humans" like computers, but also lesser machines [1], are given a proper voice. Those interested in the management and governance of complex organizations and political systems will profit from such "re-enchanting" symbolizations of complex new machinery.

Assuming, then, that social scientists' counsel and interpretive support in a world of organizations is shaped by their own "constructions" of computing machinery—how do they themselves conceptually approach "The Computer"? After an examination of the metaphorical bases of conceptual developments in computer science and social science, the main part of my argument concerns an explicit program, in a "new sociology of technology" (NST for short), to conceive of computers as

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something akin to social actors. Some contexts for this "romantic" development are pointed out, and some reasons for caution are offered.

"Marketing the Monster"

"A frequent theme [in computer advertising] is that of the secretary being portrayed as having a love affair with her equipment, or with her boss, for having conferred equipment on her that allows her to function more productively and at a higher plane, letting her achieve her true worth" [2, p. 138]. Computerization of production and communication processes has advanced rapidly, and there is no end in sight. In organizations, homes, and public spheres, there is a great need *to make sense* of those new experiences and requisite practices that inevitably are engendered by the massive pre-structuring of communicative and productive actions effected through computerized technical systems [3].

The history of computer marketing shows how industrial actors respond to this need. In their study "Marketing the Monster," Aspray and Beaver [2] trace some of the industry's persuasive stratagems in a U.S. cultural context of organizing. One central finding is a reinforcement of conventional gender and occupational roles, which is apparent in early marketing images of the machines. Computers are projected as splendid male creatures, "almost always portrayed in roles of scientists, engineers, or executives; while females are portrayed as . . . assistants taking their orders from male superiors" [2, p. 137]. But sexual stereotyping is hardly a surprising feature of computer imaging. How did advertising *change* with the "evolving technology" and with changes both in the social matrix and in the social sciences?

Aspray and Beaver explicitly excluded from their study "the image of the computer as brain and thinking machine." Nevertheless, they provide an instructive sketch of the industry's changing rhetorical schemes. In the early phases of introducing the technology, computers were presented as part of the American "Dream of Success"; they were going to make big business bigger and better. By the late 1960s, however, areas where computing technology promised to provide competitive edge—"organization, communication, and control"—had become, so Aspray and Beaver say, "those increasingly identified as the roots of dehumanizing and alienating modern technology." Think back to the intellectual and social-science atmosphere at the time, then giving rise to large-scale campaigns of advocacy advertising where firms such as IBM presented computers

"as the solution, not the cause, of a wide range of social ills, including traffic problems, pollution, crime, and minority unemployment" [2, p. 139]. Not enlisting the computer, even when it failed to fulfill the dream of unlimited growth, still was paramount to not wanting to improve America.

The role computing technology played in the Vietnam war and in secret surveillance back home seems to have killed off such "corporate responsibility" campaigns in the computer industry. They gave way, according to "Marketing the Monster," to the theme of the "now generation." Computers brought instant gratification and promised to "place at your fingertips answers to any question you need to ask, all you need to know, simply and easily, . . . and to transport that information anywhere in the world—instantly" [2, p. 140].

Interesting parallels can be drawn between this movement and social-science controversies related to understanding the process of modernization. While the early post-war period was dominated by a structural functionalism that saw technology as an unlimited exogenous resource for ongoing differentiation and higher-level integration of "the social system," the 1960s and early 1970s brought a revival of critical theory, neo-Marxist structuralism, and conflict theories of social change. Technology became an internal power resource. But already, at the fringes, symbolic-interactionist, ethnomethodological, and social anthropological formulations were advanced, eschewing almost all notions of "determining structure" behind the ongoing, highly contingent negotiation of locally situated and, in a way, "instant" social realities. Technology became a multiplicity of "social constructions."

Small wonder that authors such as Heinz Bude can diagnose a "dissolving progress" in social-science theorizing from concepts of "The Social" as "external structure" to "internal structure" to, presently, "serial structure." Here, social relations are no longer conceptualized as "necessary" and stable but rather as "extremely localized and ethereal relations which incessantly produce and immediately diffuse linkages" [4, p. 7]. Bude depicts "progress" in sociological thinking as intra-scientific change, entirely ignoring that "serial structure" concepts in turn reflect people's responses to historical changes at the organizational and societal levels.

While Bude's concern is not technology, it is easy to see how perfectly "serial structure" theorizing suits, not only advertising for the "now-generation," but especially prospective campaigns for recruiting into orga-

nizations such advanced computing technologies as "neural networks" and "connectionist machines," with their power to learn and recombine patterns of association incessantly. The motif of the computer's multiple impersonation capabilities is already a standard marketing code.

Emile Durkheim, encapsulating much of his thinking on the relationship between progressive institutional differentiation and meaningful everyday reconstructions of this reality, wrote this much-quoted sentence: "The soldier who dies for his flag, dies for his country; but as a matter of fact, in his own consciousness, it is the flag that has the first place. . . . He loses sight of the fact that the flag is only a sign, and that it has no value in itself but only brings to mind the reality that it represents" [5, p. 264].

If a soldier were to activate, in war, all his knowledge about the complicated (and far from encouraging) workings and dealings in his society, he would hardly be able to sacrifice his life for this society. If a secretary were to activate constantly her knowledge about the complex machinations of the corporation she works for, she would have trouble mobilizing the enthusiasm necessary to sacrifice herself daily for the firm's well-being.

In the age of computers, marketing via advertising begins to look a bit old-fashioned, though. Let computers speak for themselves. Implement your message in your software along the lines of that basic formula, endlessly varied, to let computers refer to themselves with "I" and address their users with "You." It is by such clever ventriloquist acts that "instant advertising" has been made possible. Computers "themselves" are made to mimic their producers' projections and to vary them according to preprocessed signals indicating users' "needs."

Computer metaphors and the rhetoric of technology

"We are aboard a train that is gathering speed, racing down a track on which there are an unknown number of switches leading to unknown destinations. No single scientist is in the engine cab, and there may be demons at the switch." [6, p. 319]. Lapp's somber rendition of technology out of control, totally disembodied from its natural scientist creators and taken over by extrasomatic demons, vividly captures popular fears. Curiously enough, organizational and industrial sociologists have long taken little analytical notice of "machinery," the hard core of technological systems. Some "New Sociologists of Technology," as I shall call

them, are by and large the first to accord systematic conceptual status to complex material-technical artefacts.

Computing machinery plays a prominent role here, often justified (while being a matter of research funding, too) by the unique character of these machines. This trend reflects lively debates outside of the scientific community in which radical departures from traditional industrial social forms have widely come to be symbolized by "the computer." While machines in general are discussed in the following, emphasis will be on AI machines—advanced artefacts, capable of the programmed processing of very large amounts of electrical "signals" at very high speeds and said by their designers to be endowed with "Artificial Intelligence."

The example of some of the authors quoted, who exploit metaphors and other literary devices in their texts, has inspired me to use the metaphor of "butterfly and bat" for social scientists' images of computers.[1] It first occurred to me upon reading Sherry Turkle's *The Second Self*, hitherto the most ambitious empirical (ethnographic) study of the cultural implications of computer technology [7]. In an earlier essay, "Computer as Rorschach," Turkle had already formulated her central thesis: computers are projective objects, akin to Rorschach figures, those symmetrical inkblots designed by a Swiss psychiatrist in order to reconstruct the inner worlds of clients from their interpretations of unstructured visual material [8]. Butterflies and bats are common interpretations in the Rorschach test, and I use them, in turn, for interpreting social science images of technology. And, like any proper metaphor, it is meant to evoke several interpretations.

In the first place, it stands for the "projectiveness" of machine technology, quite in tune with Turkle's initial notion that technologies are manifestations of cultural projects. It also indicates the dual face of technology as a pervasive motif of social science interpretations of technology. Beyond this, the image evokes the tenet of symmetry in NST conceptual approaches. Lastly, however, "bat and butterfly" stands for the "fluttering" approach some social scientists take—one time coquettish and seductive, another time frightening and aversive—to the new machines. In this last sense, my argument is critical of taking "*metaphors of the field*," loaded with meanings, as theoretical resources, and putting them to conceptual use in a social scientific study of technology. What happens when social scientists inscribe themselves in the "cultural context of organizing" [9] by becoming amplifiers for voices from the field?

Studies of rhetorical aspects of both organization theory and organizing practice have become an important part of organizational research. In a

related line of research, focusing more closely on technological innovation, the role of (technical) *Leitbilder* (guiding visions) in organizational decision-making and technical design is explored [10]. At yet another cultural level, David Edge has looked at the social power of technological metaphors.

Inspired by such perspectives in Durkheimian social anthropology as Mary Douglas's "Natural Symbols" [11] and "Environments at Risk" [12], Edge pointed out images of society taken "like the cybernetic metaphor . . . from the 'hardware' of control technologies," which then contribute to "establishing and reinforcing moral and social control" [13, p. 310]. In his view, such metaphors support especially one response to contemporary social problems such as unemployment or ecological destruction, namely, to view the existing institutions as defective and to conclude that more "centralized controls" are required [13, p. 319]. Evoking Ralph Lapp's "priesthood" metaphor for scientific elites and his dark image of modern technology quoted above, he argues that control metaphors taken from technological parlance play a dubious role in debates about present-day "crises."

While Edge is worried about the conservative and affirmative functions of control metaphors in public debates, I am concerned with the role of metaphors for technology, in particular microelectronic technology, in professional social science discourse. But the underlying question is the same: how are images of technology, as advanced in the cybernetic sciences, related to social theories, and how do such theories in turn shape public culture, and especially organizational cultures?

Metaphors of technology in computer science

"[T]here is overwhelming evidence that we are now witnessing the birth of . . . the indefinitely superior creatures that *machina sapiens* will become!" [14]. This splendid view, taken by Geoff Simons, speaking to industry and the general public from the National Computer Centre in England, echoes and amplifies a powerful metaphor for computers created by the computer sciences. Computer scientists sometimes exploit their public credit as creators of complex machineries in advancing wholesale interpretations of social issues. It may be useful, therefore, before discussing social scientists' images of (computer) technology, to take a short look at computer scientists' images of their subject proper.

Ever since the invention of "artificial intelligence," controversies about

the "nature" of "thinking machines" have turned around the implicit or explicit question of their likeness to humans. Computer scientists—as much as many social scientists, philosophers, and popular writers—interpret this issue as almost equivalent to the question of human beings' likeness to computers. Thus Earl MacCormac's "Computational Metaphor" covers both sides [15], and Pamela McCorduck's *Machines Who Think* corresponds to an image of people "that" think [16]. Sherry Turkle, after studying the pervasive cultural impact of Freudian interpretations of human conduct, concludes: "If behind popular fascination with Freudian theory there was a nervous, often guilty preoccupation with the self as sexual, behind increasing interest in computational interpretations of mind is an equally nervous preoccupation with the idea of self as a machine" [7, p. 24].

The issue of humans' likeness to machines (computers) is phrased in different, though interrelated, ways. Sometimes the problem is epistemological: can human behavior be explained in terms of natural or engineering science? Sometimes it is posed as a matter of historical process: is there a progressive "machinization" of human agency, especially in the workplace? Or it is seen as an ethical problem: what is the place of free will and moral responsibility in a world of determinate machines? Turkle particularly asks questions of this last kind, even if her central notion applies to all three. She sees a major shift in the "stages" on which these debates are played out. After having long been a theological issue, and then having moved to psychoanalytical debates, "[i]n the last quarter of this century it looks as though it is going to be played out in debate about machines" [7, p. 23].

Of course, the converse theme of the computer's likeness to human beings is not new. Yet, while discussions in the early phases of "artificial intelligence" machines were about the reproducibility of certain specific cognitive operations ("to win a chess endgame"), they have since acquired a new tone. Computer scientists of the latest generation talk more literally about the prospect of creating surrogate brains. And they seem to believe that these will merit the attribute "creature" or "living being." Thus the Carnegie Mellon robotics specialist Hans Moravec is quoted as saying that we "are on a threshold of a change in the universe comparable to the transition from nonlife to life." Similarly, one of his research assistants says: "Moravec wants to design a creature, and my Professor Newell wants to design a creature. We are all, in a sense, trying to play God" [17, p. 38]. The question of whether machines share in "life" is, in

other words, not only critically discussed by scientists, but asserted. Projected machinery endowed with intelligence is *being squarely placed in an evolutionary context.*

Metaphors of technology in traditional social science

"A *lifeless machine* is reified mind. It is only this that gives it the power to force humans into its service and to dominate their daily working life to the extent to which this is effectively the case in the factory. Reified mind is also that *living machine* represented by bureaucratic organization. . ." [18, p. 332, translation by author, emphasis added]. Max Weber concentrated on such "living machines" as bureaucratic and legal institutions or monetary economies, excluding "lifeless machines" from the sociological purview for some generations of social scientists. Only recently have tangible technical artefacts attracted interest, particularly in a lively social-constructionist research scene, to which we come later (for representative collections see [19, 20]).

Interestingly, a growing concern in the sociology of science and technology for "freestanding artefacts" tends to center very much on computers. But the concentration on computers, and the perspectives developed, can hardly be understood without looking back to the way technology was traditionally conceived in the social sciences.

People have always breathed "life" into their creations—remember the powerful myth of Pygmalion. Conversely, they have always been afraid that their products may gain power over them, that the relationship between humans and machines may in some deadly way be inverted—think of the Golem theme, or Frankenstein's monster. In the interaction between man and *oeuvre*, between creator and created, the *topos* of Life and Death plays a very important role.

The life–death metaphor has also been, unsurprisingly, at the root of social science interaction with industrial technology. The history of this interpretive frame deserves a separate analysis. Here a few observations suffice, starting with the central Marxian image of *living work* as a generic term for all human activity and *dead work* for machine activity. Weber echoes this metaphor when he contrasts the "lifeless" machine of the factory with the "living" machine of bureaucratic organization. (But is administration via the written word not bureaucratic rule mediated by a particular information and communication technology?) Note also the intellectual impact of Jürgen Habermas' categorization of "System" as

opposed to "Life World"; again, the image of life and death is powerfully at work—although bureaucracy no longer stands for "living."

Another metaphor that regains acuity in contemporary interpretations of microelectronic information processing was the opposition of Mind and Soul. Here, soul represented the vital source of human activity, and mind, the cerebral alienation from this source. The mind becomes the enemy of all that has life—its product, technology, becomes the medium of a deadly counterprinciple. The mind–soul juxtaposition seems to relate back to what was, in the classical world view, the more fundamental distinction between life and death through the metaphorics of Hand and Head: manual work as living productive work; nonmanual work as exploitative work and work intended to replace living with dead work—technogenesis.

In sum, the social sciences have persistently dealt with industrial technology in the light of sundry metaphors through which reality is interpreted as a series of juxtapositions of fundamental forces and principles. Technology almost always emerges as peculiarly ambiguous, tangled in both domains, even though, all things considered, predominantly as an element of secularization and disenchantment.

Contemporary social science debates critical of computers continues this interpretive tradition. Computing machinery is often seen as a new type of technology, wholly different in nature from older industrial technologies. At the same time, it is made into an incomparably more powerful vehicle of a countervailing unnatural and life-threatening principle: computer technology as the medium of an even more far-reaching machinization, digitalization, algorithmization, moral-affective devastation, and expropriation of human capabilities in work and life.

Unlike the computer sciences, though, the social sciences' preoccupation with technology has *remained* on highly interpretive, metaphoric levels. In their avowed "distance to the artefact" [21], social scientists still have not much to say about materialized technical systems. Except in ergonomics, they have contributed little to the actual shaping of machinery. And only a few scholars have focused their conceptual work on the social constitution of things and, more specifically, of technical artefacts. Those who did had no great impact on social science theorizing relevant to industrial and organizational change.

A "new sociology of technology" (NST)

Summing up this short overview, one might say that a quintessential metaphor of life and death in the social sciences peculiarly contrasts with

an evolutionary root metaphor in computer sciences. Social scientists turning to an empirical study of computer phenomena encounter deep-seated interpretive differences in the two scientific cultures. Not only are these differences difficult to reconcile, but there is also hardly any empirical tradition for analyzing the social constitution of things. As the social sciences have unfolded into disciplines, technology as an element of material culture has almost vanished from their conceptualizations. In the face of computers, however, the excommunication of tangible artefacts and their aggregates from social theory, and their categorization as subject matter of "the other culture"—natural and engineering sciences—becomes, so it would seem, untenable. Lately, some social scientists have decided not to ignore machines any more.

I will now trace this newly awakened interest by referring to four sociologists who have advanced conceptualizations of machinery that go beyond traditional approaches. Since new theories have their own organizational contexts, the following account includes a tentative interpretation of relations among variants of NST and their institutional settings.

The University of California at Riverside: space for sociology

"My argument [is] that, if AI is ever going to be successful, it will have to be done by sociologists, who incorporate precisely the bodily situated, emotional, situationally negotiated aspects of real human intelligence" [22, p. 184]. In these words, Randall Collins, responding to critique from Norman Denzin, has recently reaffirmed the position he took in an essay on the state and vitality of the discipline, "Is 1980s Sociology in a Doldrums?" Writing from the University of California, anchored in a solid, old European sociological tradition and, all the same, gifted with the talent of synthesizing a proliferation of unorthodox and heterodox developments in the social sciences, he analyzes promising vistas [23].

Not that he would count approaches to science and technology among them—those are not even mentioned. Apart from methodological and strategic theoretical issues, he dwells mainly on gender and a new sociology of emotions. It is in this latter context that his only reference to technology appears. According to Collins, a future sociology of emotions will have major impacts on social science developments. He foresees a theoretical upheaval, "as we have to come to grips with the grounding of language not only in cognitive aspects of social interaction but in what may turn out to be its emotional interactional substrate." And

he expects "a practical contribution to the development of Artificial Intelligence" to be one of the benefits of this.

Collins claims that the computer sciences' disappointment with "individualistic psychology [that] has not cracked the code that will open the way to *a computer that can think and talk like a human being*" now makes AI research turn to cognitive and ethnomethodological sociologists for a better lead. "It may be one of the ironies of the 1990s (or possibly another decade thereafter) that one of the most ivory-tower branches of our discipline will turn out to be connected with sociology's most notable practical applications, the achievement of high-level artificial intelligence" [all quotes 23, p. 1349, emphasis added].

"A computer that can think and speak like a human being"—Collins does not specify the meaning he wishes to give to the term "like." But read in context, he seems to have a homology rather than an analogy in mind. Note also that he adds "speaking" to the capability of thinking. This invites two observations. First, Collins surpasses the central AI debate, where emotionality is made a nobler attribute of humankind than intelligence. The road to functional AI machines will be opened by simulating emotionality, or at least the linkages between cognition and emotion. Second, the tone is distinctly euphoric: sociology may at last unfold as a really practical science. A godsend for sociology, the computer.

Speaking from a highly reputable large university establishment, Collins' rhetoric can be read as aiming at two things, one outside the sociological profession, one inside. In the first place, he argues the superior practical utility of sociology in an electronic future. In the second place, he points to the advantage of internal unity. If only sociology, as a profession, manages to work out intellectual compromises (syntheses) between (in his rendering complementary, not contradictory) old-fashioned empiricist stances and newfangled constructivist views [24], poised like a butterfly on its mirror-image wings, the discipline will hold its own in the struggles for meaning (and more) out there.

The Massachusetts Institute of Technology: more news from the East Pole

"We cede to the computer the power of reason, but at the same time, in defense, our sense of identity becomes increasingly focused on the soul and the spirit in the human machine" [7, p. 312]. In *The Second Self*

Sherry Turkle, working at MIT, proceeds from a strict analogy between the cultural power of Freudian psychoanalytic constructs and the cultural impact of computers. Both are seen as "evocative objects" that "catalyze" dramatic changes in our thoughts, emotions, and actions.

In her research, Turkle untangles the way in which the two diametrically opposed groups of children (including girls) and AI theoreticians (all males) confront computers. She shows that dealing with these machines actualizes fundamental philosophical issues: What is it to be human? For instance, computers seem to force members of both groups to revise their culturally or philosophically taken-for-granted ontologies: hierarchies like "stones–plants–animals–humans," built on schemes like "nonliving–living–sentient–rational," become tangled. How can a new order be achieved where apparently nonliving objects obviously do perform rationally? Should humans and machines move closer to each other as opposed to less noble creatures? But no, are not humans part of all life, high or low, essentially superior to anything artificial, including seemingly noble—because mentally endowed—AI machines? What are the grounds on which to build a new, consistent hierarchy? Turkle fascinatingly introduces us to the epistemic struggles and solutions of small children, adolescents, hackers, hobbyists, players, and computer scientists—and their metaphors.

How does Turkle step from research experience to conceptualization, from being there with the computers to theoretical authorship? In the first place, she claims that computers are machines of an extraordinary, unique kind because, unlike other technologies, they leave endless room for their users' desires, projections, and intentions. Beyond this, she also allows respondents to seduce her into conceptualizing "the computer," the way they do, as a challenging and demanding counteractor of humans. She reconstructs computers as endowed with somehow superior powers of reasoning, forcing us, their counterparts, to recreate our identities through a revaluation of our emotional and spiritual powers.

Turkle's interpretation of computers is pretty well reflected in the image of the butterfly. On the one hand, she is largely optimistic, all in all, about the cultural and social changes and chances opening up with the appearance of this technology.

> As I have worked on this book I have often been asked, "Are computers good or bad?" . . . No one asks whether relationships with people are good or bad in general. Rather we seek out the information to build our own model of a particular relationship. Only then do we make

> judgments about the possible effects of the relationship. We have long experience with this kind of model building of relationships between people, but we are only beginning to think in this more textured way about our *relationship with technology*. Computers are not good or bad; they are powerful. It is a commonplace to say that they are powerful in their *instrumental use*. The modes of relating to computers and the oppositions I use . . . are a contribution to understanding *the computer's subjective power* in a more nuanced way. [7, p. 322, emphasis added]

Note in this passage the analogy (homology?) between relationships to computers and to people. What is more, computers are seen as potentially friendly partners. Turkle differs here from social scientists who have drawn rather dark and at times pandemonic pictures. In her version, the computer is not a bat, really.

Her analyses remain somewhat lofty, on the other hand, swaying between projections offered "out there" and conventional conceptual repertoires. Especially, at no point does she deal with other "evocative" artefacts, and she seems to ignore that new mechanisms, transported from one cultural context to another, have always raised existential issues. Anthropological research in "developing countries," for example, has shown again and again that technologies transferred from one culture to a very different one cease for some time to be technologies in a specifiable sense. Their status as systems of action becomes uncertain. They are experienced simultaneously as pleasurable in themselves or as entirely useless, as frightening machinations without any familiar value reference or as universal vehicles for fulfilling hitherto unsatisfied desires.

Turkle's version of "the computer" might spring, at one level, from such transcultural situations. In any case, her analyses tend at times to elevate the enchanting and bewitching, disturbing and frightening experiences with "intelligent" machines at work or in personal life to the status of a core concept in social theory: "Under pressure from the computer, the question of mind in relation to machine is becoming a central cultural preoccupation. It is becoming for us what sex was to the Victorians—threat and obsession, taboo and fascination" [7, p. 313].

Again, one may ask how this account of computers relates to its institutional context, MIT. This "East Pole" of "High Church Computationalism" in AI Research, as Daniel Dennett puts it [25]—from where all rival views are looked down upon as romantically West Coastish—has also generated, in the past, radical humanistic critiques of

computer technology such as Joseph Weizenbaum's. Taking a lead in the "ethnographic" study of computers and their users, Turkle—who has since turned her interest to relationships between humans and animals—does not explicitly support "Minsky-ish" claims that computers will in the foreseeable future become morally accountable entities. And yet her cultural diagnosis fits appeals like Marvin Minsky's to begin to see in computers "our true children," because, unlike our real children who descend from dinosaurs, they are constructed in our own image—which will soon make these creatures of AI labs responsible, and us responsible for them.

L' Ecole Nationale Supérieure des Mines in Paris: embracing non-humans

"[W]e must begin with a world that includes nature, society, and the obsessions and interests of men (instead of evoking a natural world distinct from society). Also we must establish a general map of *resistances* that are met and used by the actors, whoever these actors may be (instead of establishing a map limited to *social interests*)" [26, p. 23, emphasis added]. Michel Callon is affiliated with another citadel of the technical sciences, France's Ecole des Mines. In his study *Society in the Making*, he declares engineers to be the better sociologists, because they treat human and non-human entities "symmetrically" [26, 27]. Drawing on Alain Touraine's action sociology and British social constructionism, he proposes to reconstruct and appropriate their concepts for an analysis of the constitution of technical artefacts. In order to do this he introduces the concept of an "actor-world," consisting of "social" *and* "natural" entities, of non-human and human actors. "One must abandon the easier, conventional analysis that tends to constrain (these) relationships within a tight corset of sociological categories" [26, p. 42]. Taking his empirical material from a case study of the (aborted) project to develop an advanced electric vehicle for Electricité de France (EDF), in a race with Renault's plans to develop "Le Car," Callon does not discuss AI in this study. But his plea for borrowing participant actors'—particularly engineers'—concepts is unusually explicit.

After describing the social backdrop of the controversial R & D project in conventional terms, Callon proceeds by pointing out that this has meant reviewing all the entities familiar to sociologists (consumers, social movements, administrations, and so forth), but that one must not finish taking stock here.

> There are also accumulators, fuel cells, electrodes, electrons, catalysts, and electrolytes. For, if the electrons do not play their part or the catalysts become contaminated, the result would not be any less disastrous then if the users find the new vehicle repulsive, the new regulations are not administered, or Renault stubbornly decides to develop "Le Car." In the world defined and constructed by EDF, at least three new entities that play an essential role must be added: the zn/air accumulators, the lead accumulators, and the fuel cells with their cohort of associated elements (catalysts, electrons, etc.). [26, p. 26]

Conflict and, in the event of success, a mutual balance of power among "the elements of the actor-world" is made a central concept in this view. Callon can ask, for example, whether demand, that is, the potential buyers of a technology, are easier to influence than electrons moving between the two electrodes of the cell or "the world market of platinum."

The approach involves certain methodological issues. The critical one seems to be Callon's proposition to construct "natural actors," next to "social actors," and to substitute voluntaristic concepts, such as "interests," which would make less sense for "natural actors," with "resistances." The switching of terms, for both kinds of actors, is made peculiarly suggestive by placing it in the context of Touraine's political sociology and its imagery.

Are natural actors bad or good, scoundrels or heroes, bats or butterflies? With Callon, this seems to depend largely on who manages to overcome their resistance and to win their cooperation. In the Electric Vehicle he doubtless saw a pretty butterfly (even if it did not unfold). Just as clearly, "Le Car" was an ugly bat. As with sociologists of other persuasions, this author's voice is clearly audible in a study devoted to recording the polyphonous chorus of an actor-world comprising engineers, electrolytes, CEOs, piston engines, ecologists, and many others.

The group around Callon at the Ecole des Mines has definitely generated a new conceptual language for a sociology of "non-humans" far beyond computers, and has even persuaded some other social scientists to go along with such unheard-of conceptual generosity. There is little doubt that this could only be achieved at a healthy distance from the ivory towers and professional politics of academic sociology. "Learning sociology from engineers" by closely associating with them, shadowing their professional activities, and understanding their cognitive stratagems comes easier in a wholly "technological" institution. It remains to be seen whether engineers let themselves be enlisted and whether engineering

science proves more open to this discourse than to older ones in the social sciences.

Brunel University, Great Britain: how reflexive can you get?

"Hitherto abstract concerns in the philosophy of the social sciences can now be *broached empirically by reference to the recent attempts of AI researchers to probe the limit of the distinction between human behaviour and machine activity*. Thus the question of whether there are essential differences between humans and machines can be addressed with respect to attempts to develop a sub-class of machines which are, arguably, endowed with a human capability, intelligence" [28, p. 568, emphasis added]. Steve Woolgar, from Brunel University, named after one of England's great 19th century engineers and builders, belongs to that group of sociologists of science who have mounted, over the past twenty years, the most forceful attack against traditional theories of science. From positions variously labeled ethnomethodological, phenomenological, social-constructivist, interpretive, or discourse-analytical, the ideological nature of orthodox methodologies of science was revealed by providing evidence for the view that observations, conjectures, and refutations in scientific research are as culture-dependent, interest-driven, situated, and highly negotiable as elsewhere in social life.

In *Laboratory Life*, a study on endocrinological research, Woolgar and Bruno Latour (also of the Ecole des Mines) already suggested that there exists "an essential similarity between the inscription capabilities of apparatus, the manic passion for marking, coding, and filing, and the literary skills of writing, persuasion, and discussion." Science, too, is "a system of literary inscription," and scientific instruments produce (author?) texts [29, pp. 51, 245]. The attribution of "inscription capabilities" to scientific apparatus seems to foreshadow Woolgar's explicit program for treating computers as subjects in his paper, "Why Not a Sociology of Machines?"[28].

The argument is modeled on neo-Wittgensteinian, post-Kuhnian "shifts in epistemological preconceptions" concerning the nature of scientific knowledge and practice. Just as the new sociology of science must transcend the distinction between "cognitive" and "social" in order to reveal these and similar dichotomies as scientists' stratagems to perpetuate a privileged image of their enterprise, so must a sociology of AI not

"adopt the distinctions, concepts, and assumptions of AI discourse." In Woolgar's view, the basic feature of AI discourse is the distinction between man and machine in terms of intelligence and non-intelligence, justified in turn by a "distinction between the metaphysical and the epistemological." Taking his examples from the development of expert systems, he interprets AI discourse as entrepreneurial:

> By virtue of their "political" skills . . . , certain individuals have become highly effective salespersons. In particular, they have mobilized the distinction between man and machine in claiming their own particular (human) expertise to speak about expert systems (machines). They thus define the nature and character of the object of study, they establish that these are indeed the proper objects of investigation and they claim to be uniquely competent in speaking on behalf of these objects. The rest of us are obliged to defer to what these privileged spokesmen have to say about expert systems. . . . [T]hey establish themselves as experts on the social order of expert systems. . . . [O]ur uncritical adoption of the man–machine distinction would amount to compliance with the arguments of the entrepreneurs. [28, p. 566]

Woolgar then distinguishes two options for a sociology "for and of AI," depending on "our preconceptions about the nature of machines and human behaviour and . . . on whether we construe of machines as subjects or objects of sociological analysis." He finds a "sociology of the AI community" wanting because not much could be learned about AI researchers' *products*. And he goes on to say:

> [W]e can adopt the more current sociology of science position that the products of AI research are socially constructed. Under this rubric one would develop a sociology of the characterization, design and use of intelligent machines; the machines would be portrayed as socially constituted *objects*. Note, however, that this approach grants *priority to humans as constructing agents, and this implicitly adopts the key distinction between humans and machines* which pervades AI discourse. [Another] sociology of AI would construe intelligent machines as the *subjects* of study. There seem no difficulties of principle in using standard sociological methods in this approach. . . . [T]his project will only strike us as bizarre to the extent that we are unwilling to grant human intelligence to intelligent machines. [28, p. 567]

The latter is what Woolgar seems to advocate, shedding such questions as, "Are artificially intelligent machines sufficiently *like humans* to be

treated as the subjects of sociological inquiry? Or, to reverse the more usual query, in what sense can we continue to presume that human intelligence is not artificial?" [28, p. 268]. But he goes one step further and argues that both approaches still "involve the implicit adoption of the human–machine distinction:" "[W]e need to eschew approaches which are unnecessarily parasitic of participants' dichotomies, and develop a sociological approach which takes as its focus the *human/mechanical language community; the community composed of 'expert machines and machine experts'*" [28, p. 568, emphasis added].

Again, to proceed "symmetrically" is suggested as the basic research strategy. Woolgar stops short, however, of assigning sociologists a practical role in the construction of AI machines, doubting the willingness of "neo-Wittgensteinians" to allow their arguments to be codified and programmed in the computationalist-cognitivist languages of AI [28, p. 566]. In this sense, he does not keep up with the radical thrust of some sociologists of science, like Bruno Latour, who would (at least in principle) see sociologists in a role similar to that of engineers, struggling with "natural actors" [30].

In pursuing this program, one important issue would be to substantiate Woolgar's hypothesis that AI practitioners do not in fact "talk INTELLIGENCE," i.e., do not doubt that machines can think and talk, just as researchers do not, if one trusts laboratory anthropology, "talk SCIENCE," or truth. Another aspect would be to find out just how the public spokespersons of AI "respond to the argument that the achievements of AI should not be evaluated in terms of their relevance for 'intelligence' or any other 'mental' phenomena." Correspondingly, Woolgar concludes, we should take AI machines as an occasion for "*reassessing the central axiom of sociology that there is something distinctly 'social' about human behaviour*" [28, p. 557, emphasis added].

Woolgar's interest here—to open up non-human phenomena for sociological inquiry—is indeed important. So is his query about the extent to which we can "develop a sociological study of the human/mechanical language community where the 'machines' in question are, say, bicycles, missiles, or food processors" [28, p. 568]. And it would be too easy to counter his sophisticated scheme by saying that it might be too rash to strip human activity of the sole right to the epithet "social" in order to be able to ascribe the status of "subjects" to intelligent machines. But I wonder whether his analysis is not—so much for butterflies and bats—a bit tangled or even upside down.

Is the crucial distinction—people versus machines—really a "strategic practice of members of the AI community"? Carl Mitcham concluded from his survey that today there is a consensus among philosophers that machines cannot think, while computer scientists do not agree [31, p. 171]. Whether in the guise of the Computational Metaphor, the Computer as Person image (with Marvin Minsky even as a Society of Actors [32]), or of the evolutionary metaphor—the collapsing of the distinction is an achievement of the cybernetic sciences themselves. In fact, Woolgar's main witnesses for the stark dichotomy are not bred-in-the-bone computer scientists. And notwithstanding his own repeated admonitions to assert sociology's right to deal with machines by not falling into the traps of AI proponents' self-interested metaphysics, Woolgar not only appeals to AI practitioners' suspected non-adherence to the distinction, but, in the end, explicitly to theoretical AI discourse itself: Computer scientists have probed the limits between humans and machines, inscribing a human capability—Intelligence—in the latter; social scientists can now proceed with an empirical critique of metaphysical prejudices concerning essential differences between (the subjects of) machine activity and (the subjects of) human (social) action.

In a double sense, Woolgar ingeniously builds his argument so that studies from a marginal sociological specialty—a (post-?) theoretically ambitious sociology of science and technology—can be read as *the* avant-garde texts of the discipline at large in an era of reflexive modernization [33]. For one, it is claimed that radically "reflexive" approaches like his show the way out of the epistemological, political, and moral perplexities that plague all of contemporary social science. For another, the legitimate dominance of the computer professions in a crucially important domain of societal development is challenged by "deconstructing" their social constructions.

Institutional settings

Sociological and anthropological conceptualizations are always part and parcel of disciplinary struggles for institutional autonomy and societal recognition (usefulness)—as Wolfgang Krohn and Günter Küppers have shown, in no way contradictory but rather complementary objectives [34]. Indeed, the four exemplars of NST can be seen as falling into a certain institutional pattern.

Collins, speaking from a high place of institutionalized social science,

aiming at a synthesis of sociological mainstreams, carefully opens a window for social science to future technological challenges. Turkle, located in an institution where the social sciences, albeit proudly established, are more closely tied up with economic and technical complexes, confronts the issue of social scientific contributions to the technological predicament more directly; all the same, her positively critical edge as to the cultural impacts of computers is still largely phrased in conventional (including Freudian) conceptual terms.

Callon, by contrast, housed in an almost "purely technological" institution of great reputation, sheds encrusted methodological restraints and develops a new sensitivity for "ways of world making" that have, to date, remained strange to practically all of social science. And Woolgar, finding his way from science studies to AI engineering at a school with a strong polytechnic orientation, opens the gates to the multiple currents of "post-Wittgensteinian" conceptual and literary experiments.

Without making too much of it, a more general conjecture as to the institutional contexts of NST may then be hazarded: The closer its practitioners are to engineering science institutions and the further from established social science institutions, the less orthodox and the more open and unconventional styles of theorizing the making of technical worlds they pursue.

Romancing the machine

NST proponents, having rediscovered freestanding artefacts mostly in the form of computers, make these machines into something like social actors. How has this come about? In combination with a more or less radical epistemological relativism (albeit not in Collins's case), ethnographic research is impressed with evidence that "out there" computers are "constructed" as creatures, as rational and powerful counteractors, in any case as somehow autonomous agents. Special significance is given to the finding that such notions are seriously entertained, not only in everyday life or public imagery, but in theoretical and applied science and engineering discourse. What is more, images of, say, humane machines are painted in generally optimistic colors by their inventors and constructors—not least by the most prominent among them. But why should sociologists of technology begin to appropriate such interpretations as theoretical resources?

Social scientists who argue along these lines unwittingly may enter the

strange business of a "reenchantment of disenchantment." To exploit one more time my simile: a certain intellectual flutter may be building up—at first sight, light and elegant; at second sight, rather batty. The historical process of disenchantment, in Max Weber's understanding of the term, is closely linked to the capability and admissibility of experimentally decontextualizing material objects and events—according to a program of science oriented toward technological control since the Renaissance. Decoupling natural processes disciplined in apparatus ("socially normated natural events," as Norbert Elias calls it, talking about time and clocks [35, p. vii]) from those normative and symbolic contexts that orient social interaction is part and parcel of this program and its manifestations. Rather successfully, if not linearly, such operations have been subsumed under their own proper norms and symbols—scientific and technical.

Relevant normative orientations include, for example, the desire to freely repeat, calculate, control, expand, and refine appropriate operations—and, above all, to achieve thereby a splendid indifference toward activities that cannot be normated, symbolized, and kept under control in this manner. The power of these orientations is great and not without its own magic. Yet, periodic disillusionments are just as great: aggravations and disturbances, not only in society's natural metabolism but also in the maintenance of ultimately more powerful orientations, and reenchantment sets in.

Whether they want or not, social scientists will always be involved in such disenchanting–reenchanting spirals, as it were. They cannot help taking part in the recontextualization of the technologies they study. Sociology cannot offer a meta-discourse that is itself insulated from technology. That is why distancing oneself and self-critical control of unavoidable and unwitting involvement seemed appropriate for a social science rooted in the Enlightenment and oriented toward an ethos of disenchanting that which can be disenchanted—including "the human machine." For the same reason, social science rooted in a critique of the Enlightenment has called for conscious partisanship to and participation in a program of human betterment. In critical organization theory, for example, technical innovation has long been interpreted as an instrument of "depersonalizing" control processes in the interest of those in power.

The new sociologists of technology, so it would seem, are not pleased much with either strategy. Their theoretical recourse to everyday images and myths of technology and to engineering science discourse leaves the

status of their arguments and their theoretical objectives uncertain. Are they acting as "private ironists" [36], exposing the hidden games of cognitive politics in computer science and its practical organizational applications by "deconstructing" them? Or could it be that a *Zeitgeist* of "romancing the machine" is getting the better of sociologists who are just beginning to venture into the world of technical things? In any case, the confusion of humans and non-humans (as if computerized expert systems had begun to publish their articles about the cognitive and emotional deficiencies of computer engineers or computer sociologists in their [whose?] learned journals) seems to land NST in a somewhat nervous epistemological state. What could be their aim (in Clifford Geertz's words, talking about new anthropological rhetoric): "Factual accuracy? Theoretical sweep? Imaginative grasp? Moral depth?" [37, p. 133].

Technology as disembodied practice

The new sociologists of technology I have cited have not shown that people actually treat computers as actors in the sense of sustaining some form of social relationship with them. Their findings rather point to an ongoing process of change in the forms and meanings of social relationships occasioned by committing human activities to machinery.

In the case of computers, this process may be particularly dramatic or obvious. The coming of electronic computational machinery has produced immense cultural perturbations and has contributed to a rediscovery of a world of enchantment where older sociologies saw major sources of rationalization and disenchantment. It has also given momentum to a project of "revising sociology's concept of the actor," explicitly or unwittingly put forward in otherwise divergent sociological approaches. Appeals to language conventions and beliefs of those who make and use technical artefacts, conscious attempts not to insulate sociological discourse from public debate, and proposals to use the images of technology "out there" as conceptual resources play important roles in this undertaking. Specific conjunctions of internal and external institutional environments influence its course.

One will have to see what comes of this and whether computers will turn out the butterflies or the bats of a sociology struggling to come to grips with technology. (Of course, Thomas Nagel has demonstrated, in his essay "What Is It Like to Be a Bat?" [38], that this question cannot be answered for the time being—for the same reasons that some enlight-

ened computer scientists stubbornly remain skeptical of the emergence of humanlike machines. May bats then excuse me for potential metaphorical misuse.) Another program would be to look out, in the first place, not for the stories people (including computer scientists) tell us about machines—"technology as text"—but for what people *do* with machines, and machines with people—silently: "technology as a body of 'disembodied' collective practices." And then to ask why accelerated complexifying of those special practices occasions, indeed requires, recontextualization—metaphoric understanding and narrative fiction.

Of course, we must keep inventing conceptual languages for talking about these practices sociologically. Both interpretive and more conventional empiricist conceptual repertoires will have to be used in doing so. But even if in Anglo-American social science a certain readiness to give up uncompromising attitudes between the two "camps" is apparent [24, 37] (while at least in German-speaking sociology, social constructionist approaches to technology remain to be acknowledged), I do not think that this will be possible within a unified conceptual scheme [39, p. 233]. The hope seems vain to bridge the vast semantic differentials—between "machine languages" (should one decide that they have a language, even generate texts, after all) and the languages of those trying to make magisterial sense of "technological society," say Mumford or Ellul or Latour—within one and the same discursive domain.

If one must, in order to remain convincing, choose a definitive conceptual repertoire, the "realist" assumption that what machines do lends itself easier to unequivocal factual descriptions than people's actions, that here—to put it crudely—"faction" is superior to "fiction," seems to me worth maintaining. To apply the paradoxical tenets of post-structuralist discursivity to computers and other machines (for instance, the notion that the entities "studied" should be made the true authors of one's studies?) is a romantic idea, familiar in the present epistemic state of affairs in the social sciences and beyond. But one wants to be persuaded by more evocative reports from the field that computers can be thus enlisted.

In fact, recent research on the impact of computing technology on management and organization draws a "predominant picture of relatively hard-headed, instrumental rationality" in advanced computer applications [40, p. 232]. Rule and Attewell conclude from their field studies that computing, in its more sophisticated forms, "encourages managers to rationalize their practices" and effectively to control those broad

patterns in the workings of their firms they always wanted to devise regular policies for but didn't know how. "The ability of the computer to assimilate and condense large amounts of discrete data is essential for such changes. In this respect, computing offers yet another force on behalf of the mastery of a chaotic universe . . . , or another step in what Weber . . . called the 'disenchantment of the world' " [40, p. 239]. (Of course, this is yet another piece of rhetoric from an admittedly non-ethnographic encounter.)

The question to be asked, then, is not Turing's (in)famous "Can machines ~~act~~?" (adding unbehavioristically that to avoid endless discussions as to who can, it is common "to have the polite convention that everyone does" [41, p. 446]) but more generally: "Do machines act?" Yes, machines act. But those ensembles of the most minimal and trivial of actions they perform—actions invented because they could not be performed within our bodies in similar quantity, speed, and precision—may better be conceived of as part of collective human practices than as a *society of homunculi* in their own right. For better or worse, machines—and particularly computers—act for or against us. Attributing them sentience of one kind or another is inevitable as long as they cannot be totally disembodied. Attributing them "symmetry" as "actors" would be warranted, I should think, once this has been achieved *and* once they start "talking back" in a discourse that deserves to be called existential—if not moral.

Technological metaphor and the cultural context of organizing

"Metaphorical personification, which has probably existed since the advent of human speech, has become extensive among computer scientists and everyday users. . . . Primitive man often personified natural objects by giving them divine status; perhaps we have shifted the deification from nature to technology" [15, p. 215]. Drawing attention to the demonic quality of the phenomenon, MacCormac leads us back to Lapp's "no single scientist in the engine cabin and there may be demons at the switch" metaphor and Edge's theme of the "control" uses of technological metaphors. The evolutionary imagery and social actorship rhetoric for computers, translated from the cybernetic sciences into (parts of) the social sciences, perpetuate the definitional and interpretive powers of technological institutions and protagonists they both criticized.

All things said, the problem of whether computers actually think or act like human beings (and whether they should therefore be treated analytically like social actors) cannot be taken care of by *empirical* argument—no more than deciding whether humans are really merely "a mass of cells and things" is an empirical matter [42, p. 97]. But technological metaphors transmitted by social scientists are used in organizations as linguistic devices for controlling members' interactions and for managing the meanings they attribute to technological context [43]. To this extent they become part of the cultural context of organizing and subject to empirical analysis.

Here one might pursue a "symmetry principle," too: Let us treat those in control and those controlled in organizations—or, more precisely, controlling actions and controlled actions—in the same conceptual terms. And let us then find out which kinds of distributions of control power (which configuration of control/controlled activities over organization members) are bolstered or countered with what kind of technological metaphor. Presumably, the locus of a rhetoric of animation and personification tends to be control activity; in turn, those members whose actions are pre-processed by computerized control systems might profit from understanding the processes that produce a need for reenchantment, if not mystification.

Ending this exercise on some aspects of social scientific constructions of computer realities, I should like to recall Donald McCloskey's good advice concerning metaphors in social science. "Self-consciousness about metaphor would be an improvement on many counts. Most obviously, unexamined metaphor is a substitute for thinking—which is a recommendation to examine the metaphors, not to attempt the impossible by banishing them" [44, p. 81]. This applies, of course, to my metaphors as much as others.

Note

1. This essay is based in part on "Images of Technology in Sociology," *Technology and Culture*, 31 (2), 1990.

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