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Images of Technology in Sociology: Computer as Butterfly and Bat

BERNWARD JOERGES

More than fifty years have passed since Robert Merton formulated, in his doctoral dissertation on *Science, Technology and Society in Seventeenth-Century England,* what he later, in his "Shandean Postscript," came to call the "kindle cole" principle: the "sociological discovery of the distorting effects of public (as distinct from private) polemics among men of science."[1] According to the kindle cole (or "Hooke-Newton-Merton") principle of scientific polemics, scientists ought to avoid engaging in public controversies and try to insulate themselves from the responses of the "excitable crowd," both scientific and other.

Social scientists' attempts to come to grips with computer technology provide a fine example of both the inevitability and the calamities of becoming entangled in the "management of meaning out there." How to solve the dilemma? As Merton demonstrates, "there are almost as many ways to insulate truthseekers from the mob as there are to skin the cat."[2] If the remarks offered here on sociologists' use of computer rhetoric may sound polemical at times, this is not meant to "kindle cole" but rather to draw a slightly different line between sociological, technological, and public discourse than that followed by those whom I shall call "new sociologists of technology."

In a series of essays written some time ago, David Edge looked at the social power of technological metaphors. Drawing on such examples of Durkheimian social anthropology as Mary Douglas's *Natural*

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[1]Robert K. Merton, *Science, Technology and Society in Seventeenth-Century England* (1938, numerous eds.), and *On the Shoulders of Giants: A Shandean Postscript,* 2d ed. (New York, 1985), p. 27.

[2]Merton, *On the Shoulders of Giants* (n. 1 above), p. 145.

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Symbols and *Environments at Risk*, he concentrated on images of society taken "like the cybernetic metaphor . . . from the 'hardware' of control technologies," which then play a role in "establishing and reinforcing moral and social control."[3] In his rather gloomy view, such metaphors serve to foster mainly one reaction to our present-day social problems: to conclude that the existing institutions are defective and more "centralized controls" are therefore needed.[4] Edge evokes the "priesthood" metaphor for scientific elites, citing Ralph Lapp's dark version of the technological predicament: "We are aboard a train which 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."[5] And he advises one to be wary of control metaphors taken from technological parlance in debates about contemporary "crises."

Whereas Edge's concern is very much with the conservative, reconfirming role that control metaphors have in public talk, the following comments focus on the uncertain role of metaphors for technology in the professional talk of sociologists.[6] But the overall context is the same: Images of technology, as advanced in the cybernetic sciences, are very much linked to underlying social theo-

[3]David Edge, "Technological Metaphor and Social Control," in G. Bugliarello and D. B. Doner, eds., *The History and Philosophy of Technology* (Urbana, Ill., 1973), pp. 309–24, 310; see Mary Douglas, *Natural Symbols* (London, 1970), and *Implicit Meanings: Essays in Anthropology* (London, 1975), pp. 230–48.

[4]Edge (n. 3 above), p. 319.

[5]Ralph E. Lapp, *The New Priesthood: The Scientific Elite and the Uses of Power* (New York, 1973), p. 29.

[6]"Metaphor" is used synonymously with "image," as in images of technology. For some time now, social-science interest in the power of metaphors to structure experience has grown considerably; extensive research, based on Cassirer, Wittgenstein, and later structural linguistics, has emerged. For an overview, see A. Ortony, ed., *Metaphor and Thought* (Cambridge, 1979), and S. Sacks, ed., *On Metaphor* (Chicago, 1979), e.g.; for an analysis of the metaphoric basis of social-scientific theorizing, see Richard H. Brown, *A Poetic for Sociology* (New York, 1977); Gareth Morgan, "Paradigms, Metaphors and Puzzle Solving in Organizational Theory," *Administrative Science Quarterly* 25 (1980): 605–22, and "More on Metaphor: Why We Cannot Control Tropes in Administrative Science," *Administrative Science Quarterly* 28 (1983): 601–7; Donald M. McCloskey, *The Rhetoric of Economics* (Madison, 1986). The use of technical metaphors in everyday life has been studied well: see Edge (n. 3 above), with ample references; also Hans Freier, "Uber das Dominantwerden technischer Kategorien in der Lebenswelt der industriellen Gesellschaft," *Akademie der Wissenschaften und der Literatur* 7 (1961): 3–15; Alexander Demandt, *Metaphern für Geschichte* (Munich, 1978). This is not the case for the metaphorics of the engineering sciences; see, however, Karl W. Deutsch, "Mechanism, Organism and Society: Some Models in Natural and Social Science," *Philosophy of Science* 18 (1951): 230–52; also Hans-Dieter Bahr, *Über den Umgang mit Maschinen* (Tübingen, 1983).

ries. And such theories have in turn become powerful elements of popular culture as well as of sociological images of society and historical interpretations of culture.

Considering that scientists and technologists at times misuse their public credit as creators of complex machineries by venturing far-reaching interpretations of societal processes, I find it appropriate to preface my subject proper—sociologists' images of technology, in particular "the computer"—with a few remarks on computer scientists' images of their proper subject.

Metaphors of Technology in Computer Science

Ever since the invention of artificial intelligence (AI), controversies in computer science about the "nature" of AI machines have persistently hinged on the implicit or explicit question of their likeness to human beings (likeness, sometimes softened into similarity, resemblance, or mere analogy).[7] Interestingly, computer scientists, as much as social scientists, philosophers, and popular writers, interpret this question as being almost equivalent to the question of people's likeness to computers.[8] Earl MacCormac's "Computational Metaphor" points both ways, Pamela McCorduck's *Machines Who Think* find their correspondents in "people that think."[9] Having previously studied the cultural influence of Freudian interpretations of human actions, Sherry Turkle notes: "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."[10]

[7]For a strong and positive view, see John McCarthy, "Ascribing Mental Qualities to Machines," in M. Ringle, ed., *Philosophical Perspectives in Artificial Intelligence* (New York, 1979); for a splendid overview of controversies about the possibilities of computer simulation and analog explanation of brain processes, see Daniel C. Dennett, "The Logical Geography of Computational Approaches: A View from the East Pole," in M. Brand and R. M. Harnish, eds., *The Presentation of Knowledge and Belief* (Theson, 1986), pp. 58–79.

[8]Reference is made to studies reporting, among others, results from AI researchers such as Sherry Turkle, *The Second Self: Computers and the Human Spirit* (New York, 1984) and Grant Fjermedal, *The Tomorrow Makers: A Brave New World of Living Brain Machines* (New York, 1987); and to discussions such as Earl M. MacCormac, "Men and Machines: The Computational Metaphor," *Technology in Society* 6 (1984): 207–16; and Carl Mitcham, "Computers: From Ethos and Ethics to Mythos and Religion," *Technology in Society* 8 (1986): 171–201. I am not aware of systematic attempts to analyze computer-science texts for their underlying metaphorics.

[9]MacCormac (n. 8 above); Pamela McCorduck, *Machines Who Think* (San Francisco, 1979).

[10]Turkle (n. 8 above), p. 24.

This question of humans' likeness to machines (computers) in turn appears in three highly intertwined variants: as an epistemic problem of the explicability of human behavior (action?) in terms of natural (engineering?) science; as a historical problem of a progressive "machinization" of human agency; and as an ethical problem regarding the determination of human acts and free will. Turkle poses the question mainly in this last sense, but her central notion applies to all three versions: "At different points in history this same debate has played on different stages. Traditionally a theological issue, in the first quarter of this century it was played out in debate about psychoanalysis. In the last quarter of this century it looks as though it is going to be played out in debate about machines."[11]

The opposite theme, of the computer's likeness to human beings, is, of course, an old one. But while discussions in the early times of AI machines centered on the imitability of very specific cognitive skills ("to win a chess endgame"), they seem since to have entered a new phase. Younger computer scientists talk more literally about, and believe in, the possibility of creating surrogate brains that merit the attribute "creature" or "living." In his book *The Tomorrow Makers,* Grant Fjermedal quotes the Carnegie-Mellon robotics specialist Hans Moravec: "We are on a threshold of a change in the universe comparable to the transition from nonlife to life." And he also quotes a research assistant as saying: "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."[12] For the first time, the question of the "livingness" or "creatureliness" of machines is not only being critically discussed by scientists but asserted. Projected AI machineries are placed in an evolutionary context without ado.

This is amplified in popular work on computers. Geoff Simons, for instance, writing from the National Computer Centre in England, takes a highly benign view: "[T]here is overwhelming evidence that we are now witnessing the birth of . . . the indefinitely superior creatures that machina sapiens will become!"[13]

Metaphors of Technology in Social Science

So far, sociology has not had much to say on technology per se. As Werner Rammert has shown in some detail, "distance to artefacts" is

[11]Ibid., p. 23.

[12]Fjermedal (n. 8 above), quoted from a preprint in *Omni* 9 (1986): 38.

[13]Geoff Simons, *Are Computers Alive? Evolution and New Forms of Life* (Boston, 1983), p. 195.

still characteristic of most sociological studies of technology.[14] This is about to change, however, in a lively social-constructivist research scene that has come much closer.[15] Interestingly, a growing concern in the sociology of science and technology for freestanding artifacts tends to center on computers, too. But the concentration on computers, and the approaches taken, can hardly be understood without a review of the way technology has been treated in received social science. Before taking a closer look at more recent sociological conceptualizations, one may cast a short glance, therefore, at the way ordinary social experience with technology and its metaphors has permeated social-science intercourse with technology in the past.

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

Not surprisingly, the life-death metaphor has been at the root of social-science interaction with industrial technology, too, and the history of this interpretative frame deserves a separate analysis. A few observations may suffice here, starting with the central Marxian image of *living work* as a generic term for all human activity and *dead work* for machine activity. The metaphor is echoed in Max Weber's formulation: "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."[16] Bureaucracy is portrayed here as living, perhaps because it was less obviously machine-operated in Weber's time. But is administration via the written word not bureaucratic rule mediated by a particular information and communication technol-

[14]Werner Rammert, "Vom Umgang der Soziologen mit der Technik: In Distanz zum Artefakt und mit Engagement für die Deutung," *Soziologische Revue* 10 (1987): 44–55.

[15]Representative studies are found especially in D. MacKenzie and Judy Wajcman, eds., *The Social Shaping of Technology* (Milton Keynes, 1985); W. Bijker, T. P. Hughes, and T. Pinch, eds., *The Social Construction of Technological Systems* (Cambridge, Mass., 1987). See also M. Callon, J. Law, and A. Rip, eds., *Mapping the Dynamics of Science and Technology* (London, 1986).

[16]Max Weber, *Die protestantische Ethik und der "Geist" des Kapitalismus* (Tübingen, 1904/1972), p. 332 (author's translation; emphasis added).

ogy? Note, also, the intellectual influence of Jürgen Habermas's categories of system versus life world; again the image of life and death is powerfully at work—and "bureaucracy" no longer stands for "living."

A related metaphor that regains acuity in contemporary interpretations of microelectronic information processing was the opposition of mind and soul (e.g., Ludwig Klages). Here, soul represented the vital source of human activity; mind, the cerebral alienation from this source. The mind becomes the enemy of all that has life—its product, technology, the medium of a deadly counterprinciple. The soul-mind juxtaposition seems to relate back to what (in the classical worldview) was the more fundamental one of life-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 by dead work—the generating of technology.

The list of such mutually related root metaphors can easily be extended: woman (life, soul)-man (death, mind); east-west; day (sun)-night (moon); above-below; yin and yang. More or less clandestinely, they all inspire recurring attempts to achieve a reculturization of science in the face of a "crisis of the sciences" and apparently overpowering technology. It seems, then, that the social sciences have persistently dealt with modern technology, and continue to do so, in the light of manifold metaphors through which reality is interpreted as a series of juxtapositions of fundamental forces and principles. Technology almost always emerges as peculiarly ambiguous, involved in a tangled way in both domains, even though, all things said, predominantly as an element of secularization and disenchantment.

This interpretative tradition is continued in contemporary social-science arguments critical of computers. Computing machinery is often seen as a new type of technology, wholly different in quality from traditional industrial technology. 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.

Unlike the computer sciences, though, the social sciences' preoccupation with technology has *remained* on highly interpretative, metaphoric levels. Except for ergonomics, it has contributed little to the actual shaping of machinery. And only a few scholars have focused their conceptual work on the constitution of things and, more specifically, of technical artifacts. Those who have done so have had no great effect on social-science theorizing.

Where this road has been taken, however, interesting parallels appear. Jean Piaget, for instance, devoted much of his work to studying the development of action coordinations relating to the physical, outside world and the constitution of things in action. He identified consecutive extended accommodative (objectifying) and assimilative (subjectifying) processes in the construction (as we would say today) of both the actor and that which is acted upon. From the way children build up their external world, he later derived essential arguments that led to a theory of epistemic structures such as logic and mathematics in his genetic epistemology.[17] Ernst E. Boesch, a cultural psychologist, generalizes such considerations to cultural evolution at large, studying the transformations of animistic forms of thing constitution into more rationalized forms.[18] Again, spirals, as it were, of objectifications and subjectifications, under the primacy of the latter, are postulated.

Simplifying and generalizing greatly, I suggest that evidence drawn from animists, children, and natural scientists[19] (a fourth group would, of course, be psychotics)[20] has led to peculiarly similar explanations. Social scientists approaching the constitution of (material-technical) artifacts in an empirical-analytical manner have pointed out progressions of attribution and denial of sentience, of animation and neutralization of technical objects, reflecting a continuous dialectic of cultural, personal, and scientific cognitive-emotional processes. Investing technology with human or superhuman qualities, be they demonic or eudemonic, can be understood as strategies for "reassimilating" (Piaget) problematic rationalizations and resulting disenchantments.

In sum, then, a root metaphor of life and death in the social sciences (where technology stands for death) peculiarly contrasts with an evolutionary root metaphor (where technology becomes an emergent life-form) in computer sciences. Sociologists turning to an empirical study of computer phenomena encounter deep-seated interpretative differences in the two scientific cultures. Not only are

[17]Jean Piaget, *Introduction à l'épistémologie génétique* (Paris, 1950).

[18]Ernst E. Boesch, *Psychopathologie des Alltags. Zur Ökopsychologie des Handelns und seiner Störungen* (Bern, 1979).

[19]Sherry Turkle herself begins her argument with the wolf child of 1800 and carries it through to the worldviews of AI scientists. She also mentions that not only Marvin Minsky, Joel Moses, Gerald Sussman, and other legendary AI scientists but also John von Neumann and Norbert Wiener believed themselves descendants of Rabbi Loew, creator of Golem (Turkle [n. 8 above], p. 260).

[20]See, e.g., Bruno Bettelheim, "Joey: A Mechanical Boy," *Scientific American*, March 1959, pp. 2–9, or Robert W. Daly, "The Specters of Technicism," *Psychiatry: Journal for the Study of Interpersonal Processes* 33 (1970): 417–31.

these differences difficult to reconcile, there are hardly any elaborated research traditions for empirically 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 sociological conceptualizations. But the excommunication of tangible artifacts and their aggregates from sociological theory and their categorization as subject matter of "the other culture" (the natural and engineering sciences) become untenable, so it would seem, in the face of the computer.

Computer Metaphors

While sociologists have long taken little notice analytically of technical artifacts—the hard core of technological systems—some new sociologists of technology begin to accord to complex material-technical artifacts a systematic conceptual status. Computing machinery plays a prominent role here, often justified (while being a matter of funding, too) by the unique character of these machines. This reflects lively extrascientific debates in which radical departures from traditional industrial social forms have widely come to be symbolized by "the computer."

Hence, though machines in general are discussed in the following, the focus is on advanced artifacts capable of the programmed processing of surprisingly large amounts of electrical "signals" at surprising speed—said by their designers to be endowed with artificial intelligence. Note that the programs of such machines, so-called software, are not treated here as somehow "immaterial" but rather as integral parts of the material artifact.[21] The categorical distinction that social scientists commonly make between "material hardware" and "immaterial software" seems quite unwarranted. In engineering terms, the line between hard and soft is an entirely pragmatic matter. The difference between the two comes down to the different technical parlances that engineers, computer scientists, and technicians use for "their" machine components. Any specialist language has its own rhetoric. For obvious reasons the metaphors of software talk are more human than those for hardware talk, and software talk lends itself more easily to "ideologization" and mythologizing association with supermetaphors.

[21]Exchangeable control mechanisms have been built into machines for ages; see Otto Mayr, *Authority, Liberty and Automatic Machinery in Early Modern Europe* (Baltimore, 1987). James Watt's improvement of the steam engine hinged on what he called the "governor." Cybernetics is originally time technology, and Charles Babbage's programmable computer (parts of which have actually been built) was a purely mechanical, clocklike apparatus.

Sherry Turkle's description of computer languages provides a good example. LISP, for instance, has often been presented as the language of liberalization, as opposed to bureaucratic slave languages: "To the eyes of the hacker, business languages, for example the IBM languages FORTRAN and COBOL, and the 'scientific' language PASCAL, have come to represent the uniformity of mass culture that buries the individual in the crowd. In 'Software Wars' [a popular hacker drama modeled on *Star Wars* films] these appear as the languages appropriate to the totalitarian rule of 'the Empire.' LISP is the language of pleasure, of individuality, a language that facilitates a way of thinking where . . . 'it is easy to live in the world of Gödel, Escher, Bach.' "[22] Similarly, personal computer (PC) connoisseurs propagate different images for different computer makes. IBM PCs are hierarchical command machines, "the Pentagon in a shoebox"; Apple IIs are alternative machines, useful and designed for cooperative and creative activities outside bureaucratic and corporate contexts.

Such images are far removed from the reality of electronic combination devices; they belong to the category of ideology. This is not to say that their study is irrelevant to the present discussion. On the contrary, it means only that adopting such software ideologies for the construction of social-science concepts of AI technology predetermines images of technology that are, as I will try to show, analytically problematic and practically misleading.[23]

Computer as Butterfly and Bat

The image of butterfly and bat came to me while reading *The Second Self*, hitherto the most ambitious empirical (ethnographic) study of the cultural implications of computer technology. In an earlier essay, "Computer as Rorschach," Turkle had already formulated her central thesis: Computers are projective objects, akin to Rorschach tests, those inkblots designed by a Swiss psychiatrist in order to reconstruct, on the basis of their interpretations, the inner world of respondents.[24]

[22] Turkle (n. 8 above), pp. 225–26.

[23] A reverse misapprehension of the nature of electronic machinery can be found in social studies that remain fixated on hardware (installed components like transistors, integrated circuits, and microprocessors) and therefore on inventions and innovations at the level of materials and production technologies, related corporate strategies, state and user interests, and the like. See, e.g., Jost Halfmann, *Die Entstehung der Mikroelektronik* (Frankfurt, 1985), who excludes software as an immaterial component and does not even mention the contributions of logic and mathematics to computer development. One looks in vain for names like Turing, von Neumann, Boole, Shannon, or Wiener in the indexes of such books.

[24] Sherry Turkle, "Computer as Rorschach," *Society* 17 (1980): 15–24.

Butterflies and bats are common interpretations in the Rorschach tests, and I use them, in turn, for interpreting sociological images of technology.

Like any proper metaphor, this one is meant to evoke several interpretations. In the first place, it stands for the "projectivity" of machine technology, quite in tune with Turkle's initial notion that technologies are manifestations of cultural projects. Beyond this, I use it to indicate the "dual face," the ambiguity of technology as a pervasive motif of social-science interpretations of technology. Last, however, bat and butterfly stand for the "fluttering" approach some sociologists take—now coquettish and seductive, now frightening and aversive—in dealing with the new machines.

In this last sense, my main argument concerns the way that metaphors of the field, supercharged with meaning, are put to conceptual uses, as a theoretical resource for a sociological study of technology.[25]

New Sociologists of Technology

In his famous paper, "Computing Machinery and Intelligence," Alan Turing—not a sociologist by far—has answered the eminently social question "Can machines think?" with a behavioristically qualified "Yes!" And yet at least two arguments in his text do not accord with behaviorist creed. It is, says Turing, common, in order to avoid endless discussions about who can think, "to have the polite convention that everyone does."[26] And even before that he ventures a prediction of far-reaching importance for the problem at hand: "At the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted."[27] Hidden in Turing's classically cool text is then a "subtext" that points to the social construction of reality (including machinery) via the use of language

[25]This is certainly not to doubt the importance of metaphoric understanding. On the contrary, Jerome Bruner's advice not to underestimate the power of "just metaphoric" knowledge in creative thinking applies even more to scientific creativity. Even so, I would prefer to continue entertaining the thought that creative scientists, especially in the analysis of scientific-technological developments, should (try to) aim at what Bruner calls producing "effective surprise" through empirical clarification rather than through metaphorical invention. Jerome S. Bruner, "The Conditions of Creativity," in H. E. Gruber, G. Terrel, and M. Wertheimer, eds., *Contemporary Approaches to Creative Thinking* (New York, 1962); see also Bernward Joerges, "Wissenschaftliche Kreativität," *Zeitschrift für allgemeine Wissenschaftstheorie* 8 (1978): 384–404.

[26]Alan M. Turing, "Computing Machinery and Intelligence," *Mind* 59 (1950): 433–60, 446.

[27]Ibid., p. 442.

and common talk.[28] Machines will think when people believe they think. I assume, for the purpose of further discussion, that the beliefs of sociologists are not entirely negligible in this matter.

Confronted with computers, some sociologists have decided to ignore machines no longer. Some apparatus can evidently perform operations that traditionally were thought to merit the human attribute "mental." One finds that old questions about the life and death of things are no longer asked only by children and premoderns but also by an elite of scientists. In view of the transferability of mental processes to new machines, those who construct and explain them prominently enter debates about the nature and meaning of human life. Should this not concern sociology? In what sense? Surely in some way related to social action. I will try to trace this newly awakened interest by referring to four sociologists who have recently advanced conceptualizations of machinery that go beyond traditional approaches: Sherry Turkle, Michel Callon, Steve Woolgar, and Randall Collins.[29]

Sherry Turkle, of the Massachusetts Institute of Technology (in Daniel Dennett's words, the "Vatican City of High Church Computationalism" in AI research), proceeds from a strict analogy between the cultural power of Freudian psychoanalytic constructs and the cultural influence of computers. Both are seen as "evocative objects" that "catalyze" dramatic changes in our thoughts, emotions, and actions.

Turkle unravels the way in which the two antipodal 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 example, 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 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 humans not part of all living creation, 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

[28] I owe this observation to Charles Karelis, "Reflections on the Turing Test," *Journal for the Theory of Social Behaviour* 16 (1986): 161–72.

[29] I have chosen these authors because I like them best and because they are so different, even if omission of this or that figure may seem rather odd.

and solutions of small children, adolescents, hackers, hobbyists, players, and computer scientists—and their metaphors.

How does she herself conceptualize this material? In the first place, she has a thesis that computers are machines of an extraordinary, unique kind because, unlike other technologies, they leave endless room for their users' desires, projections, and intentions. But it seems to me that she also allows respondents to seduce her into conceptualizing "the computer," just as they do, as a challenging and demanding counteractor of humans. "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."[30]

In a twofold way, Turkle's interpretation of computers is well reflected in the image of the butterfly. On the one hand, she is largely optimistic about the cultural and social changes 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 *relationships 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.[31]

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. Not really a bat, the computer, in Turkle's version.

On the other hand, Turkle's analyses remain somewhat lofty, swaying as it were between projections offered "out there" and conventional conceptual repertoires. Also, at no point does she deal with other "evocative" artifacts, and she seems to ignore that new mechanisms, transported from one cultural context to another, have always raised existential issues.

[30]Turkle (n. 8 above), p. 312.

[31]Ibid., p. 322, emphasis added.

Do we not know, from social anthropology or research in developing countries, 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 entirely useless or pleasurable in themselves *and* as frightening machinations without any familiar value reference or as universal vehicles for fulfilling hitherto unsatisfied needs, or again as an ultimate loss of unrenounceable values.

This cultural figuration can be traced generally, from the medical syringe in the Congo to nuclear energy, or, today possibly only in its beginnings, to AI machines. Pure *Funktionslust* and naked, unreasonable fear, wild hopes for a better life and apocalyptic premonitions about the end of human civilization lie close together. If something like "pure value realization" (all bat or butterfly) and "pure technology" (neutral instrumentality) exists at all, then it exists in these moments when technical potential moves from one limiting cultural context to another.

Could it be that Turkle's version of the computer springs, at one level, from such transcultural situations? Be that as it may, her analyses tend to elevate the alluring, captivating, and bewitching experiences with AI machines in society to the status of a crucial theoretical construct: "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."[32]

Michel Callon works at another high place of technology discourse, the Ecole Nationale Supérieure des Mines in Paris. In his study *Society in the Making,* he declares engineers to be the better sociologists. Drawing on Tourainian action sociology and British social constructionism, he proposes to reconstruct and appropriate their concepts for an analysis of the constitution of technical artifacts. In order to do this he introduces the concept of an "actor-world" and postulates that "[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*)."[33]

Callon leaves no doubt that he wants to count "natural entities" among such actors. "One must abandon the easier, conventional

[32]Ibid., p. 313.

[33]Michel Callon, "Society in the Making: The Study of Technology as a Tool for Sociological Analysis." Research paper, Centre de Sociologie (Paris, 1984), p. 23, emphasis added. (In a shorter version, the study appears in Bijker et al. [n. 15 above], pp. 83–103.)

analysis that tends to constrain [these] relationships within a tight corset of sociological categories."[34] 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.[35]

Having described the social background of the controversial R&D project in conventional fashion, Callon proceeds:

> Up to this point, the entities reviewed are familiar to the sociologist. One finds consumers, social movements, and ministerial services. But it would be an error to close the inventory. 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 than 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.).[36]

An important concept in this view is that of conflict, and in the event of success, a mutual balance of power between "the elements of the actor-world." Callon asks, for instance, whether the potential buyers of a technology are easier to influence "than the electrons moving between the two electrodes of the cell, or the world market of platinum."[37]

I will not discuss further the conceptual difficulties this raises. The critical point seems to be that Callon seriously proposes to conceptualize, next to "social," "natural actors," and to replace voluntaristic concepts such as "interests," which could not easily be generalized to natural actors, with "resistance." 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. (John Law undertakes to further ground Callon's approach within a "non-

[34]Ibid., p. 42.

[35]In the meantime, the group around Michel Callon and Bruno Latour have themselves moved into computer-related research.

[36]Callon (n. 33 above), p. 26.

[37]Ibid., p. 45.

reductionist sociology." His technical star is a sailing ship, the Portuguese caravel, which, in battle against mighty natural actors such as Cape Bojador on the African Atlantic, helped to carry forward Portuguese maritime expansion.)[38]

Are natural actors good or bad, heroes or scoundrels, butterflies or bats? With Callon this seems to depend largely on who manages to overcome their resistance and win their cooperation. In the electric vehicle he doubtless sees a pretty butterfly (even if it did not unfold). Just as clearly, Le Car is an ugly bat. As with sociology in general, this author's preferences are not entirely irrelevant to his analysis.

Steve Woolgar, at Brunel University, belongs to the group of predominantly British sociologists of science who have mounted, over the past ten or fifteen years, the most forceful attack against traditional theories of science. From positions variously labeled ethnomethodological, phenomenological, social-constructivist, interpretative, 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 neuroendocrinological research, Woolgar and Bruno Latour had 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 form of literary inscription.[39]

The attribution of inscription capabilities to scientific apparatus seems to foreshadow Woolgar's explicit program, in his paper "Why Not a Sociology of Machines?" for treating computers as subjects.[40] 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."[41] In Woolgar's view, the basic feature of AI discourse is the

[38]See, e.g., John Law, "On the Social Explanation of Technical Change: The Case of the Portuguese Maritime Expansion," *Technology and Culture* 28 (1987): 227–52.

[39]Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Beverly Hills, Calif., 1979), pp. 51–52, 245.

[40]Steve Woolgar, "Why Not a Sociology of Machines? The Case of Sociology and Artificial Intelligence," *Sociology* 19 (1985): 557–72.

[41]Ibid., p. 565.

distinction between man and machine in terms of intelligence and nonintelligence, justified in turn by a "distinction between the metaphysical and the epistemological." Taking his examples from the development of expert systems, he interprets the AI discourse[42] 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 . . . they 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.[43]

Woolgar proceeds by distinguishing 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 continues:

> [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.[44]

[42] 'Dis-cursus'—originally the action of running here and there, coming and going, measures taken, 'plots and plans,' " as Roland Barthes puts it in *A Lover's Discourse* (New York, 1981), p. 3.

[43] Woolgar (n. 10 above), p. 566.

[44] Ibid., p. 567, emphasis added.

In a way, this seems to be what Woolgar proposes, shedding questions like "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?" 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.' "[45]

On the other hand, however, Woolgar stops short 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.[46] In this sense, he does not keep up with the radical thrust of some sociologists of science who would see sociologists in a role similar to that of engineers struggling with natural actors.

One important aspect of this program would be to substantiate Woolgar's claim that AI practitioners do not in fact "talk INTELLIGENCE," that is, do not doubt that machines can think and talk, just as researchers do not, if one trusts laboratory research, "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.*"[47]

It would be too easy to counter this 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. Woolgar's central interest here—to open up nonhuman phenomena, insulated by their proponents, to sociological inquiry—is far too important, as 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,

[45] Ibid., p. 568.

[46] Ibid., p. 566. Bruno Latour's *Science in Action* (Cambridge, Mass., 1987), which was not available to me when writing this paper, seems to go furthest here, even if he, too, tends to remain on the level of technological designs.

[47] Ibid., p. 567, emphasis added

missiles, or food processors."[48] But I wonder whether his analysis is not a bit tangled or even upside down. (So much for butterflies and bats.)

The crucial distinction—people versus machines—may not just be a "strategic practice of members of the AI community." Carl Mitcham concludes from his survey that today there is a consensus among philosophers that machines cannot think, while computer scientists do not agree.[49] Whether in the guise of the computational metaphor, the computer as person image[50] (with Marvin Minsky even as a society of actors), or of the evolutionary metaphor, the collapsing of the distinction is an achievement of the cybernetic sciences themselves. 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 nonadherence to the distinction but, in the end, explicitly to theoretical AI discourse itself: "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 subclass of machines which are, arguably, endowed with a human capability, intelligence."[51]

Randall Collins, of 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 sociology, has recently joined the debate. In an essay on the state and vitality of the discipline—"Is 1980s Sociology in a Doldrums?"—he analyzes promising vistas.[52] Not that he would count

[48]Ibid., p. 568. For a similar plea to embrace all technical artifacts within a semiotic approach, see Jim Johnson's (alias Bruno Latour's) delightful "Mixing Humans and Nonhumans Together: The Sociology of a Door-Closer," *Social Problems* 35 (1988): 298–310.

[49]Mitcham (n. 8 above), p. 171; in fact, Woolgar's main witnesses for the stark dichotomy are not bred-in-the-bone computer scientists.

[50]Not *Computer as Poison,* as Stuart Brand titled an issue of his *Whole Earth Review* (December 1984/January 1985); for an unusually outspoken plea to conceptualize computers as persons, not only to understand better but to actually design better computers, see Lars-Erik Janlert, "The Computer as a Person," *Journal for the Theory of Social Behaviour* 17 (1987): 321–41. From the philosophical viewpoint, the problems of this commitment have been exposed early in the debate by Donald MacKay; see, e.g., "The Use of Behavioural Language to Refer to Mechanical Processes," *British Journal for the Philosophy of Science* 13 (1962): 89–103.

[51]Woolgar (n. 40 above), p. 568, emphasis added.

[52]Randall Collins, "Is 1980s Sociology in a Doldrums?" *American Journal of Sociology* 91 (1986): 1336–55.

approaches to science and technology among them; those are not even mentioned. Apart from methodological and theory-strategic 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 consequences for social-science developments. "The time is ripening for 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 continues:

> One of the payoffs of this is likely to be a *practical contribution to the development of Artificial Intelligence.* It is becoming increasingly clear that individualistic psychology has not cracked the code that will open the way to *a computer that can think and talk like a human being,* and AI leaders are already turning to cognitive sociologists, including ethnomethodological ones, 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.[53]

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, too, seems to have a homology rather than an analogy in mind. Note also that he adds talking 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. Responding to criticism from Norman Denzin, Collins reaffirms: "My argument [was] 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."[54]

The Reenchantment of the Disenchanted

Sociology has rediscovered freestanding artifacts, mainly (and maybe regrettably so) in the form of computers. All at once, these

[53] Ibid., p. 1349, emphasis added.

[54] Randall Collins, "Reply to Denzin," *American Journal of Sociology* 93 (1987): 181–84, 181.

machines are made into something like social actors, and sociology is expected to take them seriously as such. What has happened?

Ethnographic research, in combination with a more or less radical epistemological relativism (not in Collins's case, though), is impressed with the finding that computers are "constructed" as creatures, as counteractors, as rational and powerful, in any case somehow autonomous, actors. Special significance is attributed to the fact that such notions are seriously entertained, not only in everyday life or public imagery but also 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? It seems to me that a certain intellectual flutter is building up—at first glance, light and elegant; at second glance, rather batty. (To repeat: the argument is not wholesale against taking over metaphors of the field; rather, in McCloskey's words, "[s]elf-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.")[55] Sociologists who argue along such lines unwittingly may be entering into the strange business of a "reenchantment of disenchantment."

The historical process of disenchantment, in Max Weber's understanding of the term, is closely linked to the capability (and admissability) of experimentally decontextualizing material objects and events, according to a program of science oriented since the Renaissance toward technological control. Decoupling natural processes disciplined in apparatus ("socially normated natural events," as Norbert Elias calls it, talking about time and clocks)[56] 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 ones. Relevant normative orientations are, among others, the good to be had from being able to freely repeat, calculate, control, expand, and refine appropriate

[55]McCloskey (n. 6 above), p. 81. Social constructivist science research itself has shown that natural scientists use very different conceptual repertoires, depending on the context. According to Nigel Gilbert's and Michael Mulkay's *Opening Pandora's Box* (London, 1984), e.g., they tend to activate "realist" codes toward students and laypersons (which includes social scientists), as opposed to "factionalist" forms of representation among themselves.

[56]Norbert Elias, *Über die Zeit. Arbeiten zur Wissenssoziologie II* (Frankfurt, 1984), p. xii

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: irritations and disturbances not only in society's natural metabolism but also in the maintenance of ultimately more powerful orientations. That is why attempts at relativizing past decontextualization and disenchantment, at resubjectivation in the sense suggested above with reference to Piaget and Boesch, will always occur and will certainly be more marked in times of desultory technical change.

Sociologists are involved in this process willy-nilly. They always take part in the recontextualization of the technologies they study. Sociology cannot offer a "meta-discourse" that itself is insulated from technology. This is why distancing and self-critical control of unavoidable and unwitting involvement seemed appropriate for a social science rooted in the Enlightenment and oriented to an ethos of disenchanting that which can be disenchanted. For the same reason, social science rooted in a critique of the Enlightenment has called for conscious partisanship and participation in a program of human betterment. The new sociologists of technology, it seems, are not much pleased 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 quite uncertain.

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?

But What to Do with AI Machines?

It is true, there is much more "mind in the machine" than is realized by sociologists evading concern with machinery. But it is the same mind, or spirit, that is in *all* machines. The fundamental question is not Turing's "Can machines think?" but rather "Do machines act?" Whether sociologists of technology can escape the noise around the "thinking machines" and still come up with a reasonable approach to them depends on the way this question is answered. Do machines act? Yes, they do in a specific sense. Does this make them actors—subjects? No, indeed not.[9]

[9] For a systematic attempt to conceptualize effectively functioning technical artifacts as specific systems of action and to analyze their multiple integrations with other action systems, see Bernward Joerges, "Technology in Everyday Life: Conceptual Queries," *Journal for the Theory of Social Behaviour* 18 (1988): 219–41.

Computers are, like all machines, devices for decontextualization: that is, products of the transmission of specific patterns and processes of action, including the calculations underlying them, to freestanding artifacts in order to free them from cultural and personal peculiarities and differences. In the case of computers, complex logical operations are transmitted. In the case of so-called work machines, for instance, operations requiring power and manual skills are transmitted. Computers, however, decontextualize in a more sensitive domain than other machines, and they can quite universally be linked back to human actions. They have, to use Elaine Scarry's notion, vastly greater "leverage."[58] Yet these assertions, seemingly easy to agree on, warrant rethinking. What about nuclear plants, space technology, engineered organisms? The decontextualizing effects of such technologies are enormous. If the responses they elicit from sociologists are not similar to those produced by AI machines, it may only be yet another indication that sociological images of technology are borrowed from the field without sufficiently being examined within some "metalanguage of the social sciences."[59]

As pointed out, the history of the discipline explains this well. A dematerialized concept of social action in the Weberian tradition, but also the esoterics of action à la Niklas Luhmann or the lofty sign acrobatics of semiology, has rendered access to real operating machinery difficult or impossible. Machinery in these traditions does not represent significant activity and therefore cannot be dealt with significantly. What is social about machinery surrounds it; its inner social structure remains covert. While the technical sciences have advanced further and further into the outer material world, the social sciences have moved further and further away from it. The level of direct practical concourse with things, where doubts regarding their social nature cannot easily arise, has progressively been lost as a level for conceptual reference. Émile Durkheim began his *Rules* with the requirement that sociological analyses be performed from things to their images, not from images to things: "Living in the midst of things, men cannot but make them subject to their thoughts, and orient their conduct accordingly. Only because such conceptualizations are closer to us . . . than the realities from which they spring we tend . . . to put the former in the place of the latter and make them

[58]Elaine Scarry, *The Body in Pain: The Making and Unmaking of the World* (New York, 1985).

[59]Anthony Giddens, *New Rules of Sociological Method* (London, 1976), p. 162.

the object of our considerations. . . . Instead of a science of realities we only practice ideological analysis."[60]

Durkheim explicitly includes material-technical systems (e.g., houses, traffic networks) among things (or social facts) because we should consider them to be of a "moral nature, even though they have their basis in physical nature, too."[61] In the meantime, sociologists have largely come to prefer going from images of images to images of things. Theoretical focus is on signs to the extent that they signify signs. And then come these deceptively intelligent microelectronic machines, who can themselves manipulate signs and symbols, think and talk, even develop theories, and they demand theoretical attention.

Machines will think when people come to *believe* they think. There is little chance to settle the problem of whether they actually think (or act) like human beings, and should therefore be treated analytically like social actors, empirically, just as the issue of humans being merely "a mass of cells and things" is not an empirical matter. MacCormac, in observing that "[m]etaphorical personification, which has probably existed since the advent of human speech, has become extensive among computer scientists and everyday users," also draws attention to the demonic quality of the phenomenon: "Primitive man often personified natural objects by giving them divine status; perhaps we have shifted the deification from nature to technology."[62] 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.[63] For sociology, it seems to me, the question is whether there are good reasons to justify commitments to technical artifacts as actors *conceptually*—and thereby to underwrite the definitional powers of technological institutions and protagonists.

[60]Emile Durkheim, *Die Regeln der soziologischen Methode*, ed. René König (Neuwied, 1965/1985), p. 115; author's translation.

[61]Ibid., p. 113.

[62]MacKay (n. 50 above), p. 97; MacCormac (n. 8 above), p. 215. Perhaps the priest metaphor for modern social scientists could in fact be taken more literally again: an upcoming generation, dissatisfied with old European dogmas and refined Thomism, seems to turn to millennistic and syncretistic cargo cults, where technology reappears as magic symbol. Enchanters' delight?

[63]Including "rights"; see Phil McNally and Sohail Inayatullah, "The Rights of Robots," *Futures* 20 (1988): 119–36.

How to "skin the cat"? Not wishing to resort to pure polemics or to dogma, I suggest, regarding the "actorship" of advanced technical artifacts, a kind of "defensive agnosticism" (MacKay). In the meantime, one could try to move closer, sociologically, to what machines actually do and how this is achieved—epistemically and technically, not metaphorically. So-called thinking machines can be conceived of as one class of machines among many others. One has only to realize, conceptually, that all machines share in and control our actions, not only thinking machines. Without belatedly mystifying historically older machines, this strategy saves us from assigning human capabilities to computers any differently than to clocks or sailing ships. Analyzing the concept of the "responsibility of things" in Anglo-Saxon law and its Roman and Germanic roots, Oliver Wendell Holmes noted that, while anything moving is traditionally held to be particularly alive, ships are considered "the most living of inanimate things." And he observes, "It is only by supposing the ship to have been treated as if endowed with personality that the arbitrary seeming peculiarities of the maritime law can be made intelligible, and on that supposition, they at once become consistent and logical."[64]

Conclusion

The advent of electronic computational machinery has doubtless produced immense cultural perturbations and contributes 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 artifacts, 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. One may look forward to the manner in which this program is carried further and to the way AI machines evolve as either butterflies or bats of a sociology devoted to technology.[65]

[64]Oliver Wendell Holmes, *The Common Law*, ed. Mark de Wolfe Howe (Boston, 1881/1963), p. 25, quoted from Scarry (n. 58 above).

[65]In his paper on "What Is It Like to Be a Bat?" (*The Philosophical Review* 83 [1979]: 435–51), Thomas Nagel has shown that this question cannot be answered for the time being (for the same reasons that some enlightened computer scientists stubbornly remain skeptical of the emergence of human-like machines). I beg pardon of bats, then, for a potential metaphorical misuse.

Another program would be to look out, in the first place, not for the stories that people, including computer scientists, tell us about machines—"technology as text"—but for what people do with machines, and machines with people—silently. In other words, "technology as a body of practices." Of course, we have to invent a language for talking about these practices sociologically. Jonathan Swift's solution to the meta-problem (and to kindle cole) of just "carry[ing] around such things as are necessary to express [this particular] business at hand" may work with the technology stories people tell us but hardly with the doings of computer systems or nuclear installations or gene-splicing equipment.[66]

Machines represent actions. But those ensembles of most minimal and trivial of actions they perform, actions invented because they could not be performed within our bodies in similar quantity and with similar speed and precision, are better conceived 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 against or for us. Attributing to them sentience, or "life," of one kind or another is inevitable as long as they cannot be totally disembodied. Attributing to them "symmetry" as "actors," it seems to me, would be warranted once this has been achieved *and* once they start "talking back" in a discourse that deserves to be called existential—if not moral.

[66]See Swift's account of this vastly effective method in his description of one of the projects in the grand Academy of Lagado's school of languages, aimed at the abolition of all signs for things in order to achieve a code understood universally across different cultures (*Gulliver's Travels* [London, 1726/1967], p. 230).