ECOLOGIES OF TECHNOLOGICAL METAPHORS AND THE THEME OF CONTROL

Dvora Yanov, San Jose State University

> I'm afraid that by crying wolf about dangers which we have no reason at all to worry about, we are becoming indistinguishable from my two small boys. They love to talk about monsters because they know they will never meet one.
>
> —James Watson

This paper explores the theme of technologies out of control as it is reflected in the metaphors of two cases: 100 years of theorizing about organizations, and th e development of recombin ant DNA techniques and their regulation as the development played out in Cambridge, Massachusetts, between 1975 and 1985. Each cas e illustrates an "ecology" of metaphors, emphasizing the relationship between th e metaphors and their societal value environment. The ecology metaphor suggests that the theme of control comes out of the value environment, rather than out of th e metaphors themselves. In my view, metaphors are both models *of* prior thought, reflecting societal concerns ab out control, and models *for* ensuing action, shaping how we think, feel, and act with respect to these concerns.

The notion of technologies out of control appears in technology   studies as a theme in contemporary Western political life (e.g., Winner, 1977; Nelkin, 1979 ; Zuboff, 1988; Edge, 1990; Volti, 1992). The purpose of this paper is to furthe r explore this concept as it played out in two instances of technological use, payin g particular attenti on to the metaphors which reflected and guided thought and action in the two cases.

The paper is complex. Part I presents some ideas about metaphor use. Part II focuses on theorizing by academics and practitioners over the last century. Part III traces the development of re combinant DNA techniques and the accompanying debate about regulatory guidelines that un folded in Cambridge, Massachusetts, between 1975 and 1985. Part IV draws the several strands together in a conclusion about ecologies of metaphors.

I intend to explore questions a bout metaphors of control against the following backdrop: that "ecology" itself has become a widely-used contemporary metapho r which, when applied to the subject of metaphors, is itself informative about the notion of control in contemporary society. Metaphors reflect concerns about control, whil e they themselves "control" how we think about control. In this way, we have not only ecologies of metaphors—that is, metaphors which exist in a relationship with th e values of the society or polity that s pawned them and which are mutually dependent on other metaphors—but also metaphors o f metaphors—seeing organizational theory and rDNA policy-making in the same context illuminates both in a metaphoric process. [1]

The analysis of metaphors has, especially in the last decade, moved beyon d seeing metaphor so lely as a literary device—a figure of speech—to examining its role in cognition and reasoning—a "figure of thought" (Lakoff, 1986) underlying even that language we regard as conventiona l. Appreciation of the cognitive aspect of metaphor allows us to attend to its role in shaping public feeling, thought, and action with respect to technologies.

In the social sciences, recent metaphor analysis has focused on matters of both theory and action: how metaphors shape resear chers' categories and concepts, and how in everyday usage they shape public thought and act ion.[2] My interest here is in how the metaphors used by academic theorists, managers and administrators, scientists, an d politicians have expressed societal views about technological development which show consistency across th e two cases from the perspective of control, and how these views have further shaped t he general public's views of these developments. The metaphors used in both cases reflect public discourse about general social life.

I. METAPHORS

Much has been written about what metaphors are and how they work. [3] Lakoff and Johnson (1980) have offered the view that metaphors are an expression of a culture's basic ideas; they determine how we see the world which we experience, as well as how we act in that world. Parts II and III of this paper present two case examples in this vein which demonstrate that metaphors "are necessary, and not just nice" (Ortony, 1975).

How Does a Metaphor Mean?

> "When I use a word," Humpty Dumpty said, "it means just what I choose it to mean—neither more nor less."
>
> —Lewis Carroll, *Alice in Wonderland*

What exactly a metaphor is, and how it works, has long been the subject of debate in philosophy, linguistics, psychology, and literary theory (see Black, 1962, or Ortony, 1979, for a review). [4] Metaphor has traditionally been treated as a figure of speech or literary device reflecting imprecise thinking or added on to non-metaphorical speech for decoration. Long contrasted with literal language and considered the inferior of the two (being less precise, less scientific, appealing to the emotions, and so forth), metaphors were thought to be replaceable by literal figures alone. Newer developments treat metaphor more as a way of seeing and/or learning, and as such, as an elemental part of language and thought, rather than as decoration which can be eliminated. From this point of view metaphors as literary devices constitute a subset of the more general human cognitive activity. As Lakoff and Johnson (1987, p. 79) write,

> Metaphor is not a harmless exercise in naming. It is one of the principal means by which we understand our experience and reason on the basis of that understanding. To the extent that we act on our reasoning, metaphor plays a role in the creation of reality.

It is this approach that constitutes the backdrop for this article.

Following Black (1962, 1979) and Lakoff and Johnson (1980), let us define metaphor as the juxtaposition of two superficially unlike elements in a single context, where the separately understood meanings of both interact to create a new perception of each, and especially of the focus of the metaphor. [5] Subjected to analysis, the surface unlikeness yields elements which both metaphoric vehicle and focus share. Some simple examples might be, "The grass is always greener in the other person's yard"; or, "green with envy"; or "the greenhorn fresh off the boat." In each of these examples, what we might take to be our common sense notion of green-ness is brought into three different settings, illuminating both the concept of green (the vehicle) and its focus in new ways.

When we consider the link between perception and action, metaphors which initially appear to be merely descriptive may acquire a prescriptive aspect. No

longer are we only presenting new insights into a situation; we are also suggesting the possibility of action in response to the situation described by the metaphor. In talking about the economic situation, for example, we might say:

> Inflation has *pinned* us *to the wall*.

> Our biggest *enemy* right now is inflation.

> Inflation has *robbed* me of my savings (Lakoff and Johnson, 1980, p. 33).

"Inflation," itself a metaphor which depicts the state of the economy as blown up or swollen, is here presented as a street fighter, an enemy seeking to destroy, a robber. Putting monetary swelling in such linguistic company suggests not only the possibility, but, indeed, the very necessity (given the societal values of the metaphor's American context) of response: one does not turn the other cheek to a fighter; rather, one searches for vulnerable places and plans a counterattack. These metaphors preclude the possibility that inflation might be immune to planning and policy. If, for example, inflation were part of an inevitable cycle, the best defense would not stave it off, nor the best offense rid us of it.

Some of the attributes of metaphors are illustrated in this example. Metaphors direct vision, thinking, and action. While they give new insight into and understanding of some things, they can blind us to other aspects of the situation. By highlighting some aspects and obscuring others, they organize perceptions of reality and suggest appropriate actions in light of those perceptions.

In the same way, technological metaphors may suggest perceptions and courses of action for policy-makers and others to follow. As Lakoff and Johnson (1980, p. 158) note, rather than the veracity of the metaphor,

> The more important questions are those of appropriate action. In most cases, what is at issue . . . [are] the perceptions and inferences that follow from it and the actions that are sanctioned by it. . . . We draw inferences, set goals, make commitments, and execute plans, all on the basis of how we in part structure our experience, consciously and unconsciously, by means of metaphor.

Moreover, the knowledge that links metaphoric perception with action is learned and known tacitly (Polanyi, 1966), without being made explicit to ourselves or to others. It is their conventionality, and the tacit knowledge mutually shared and communicated in their use, that mask the power of metaphors to shape action, since we are not in the habit of making explicit the implications for action which are embedded in the metaphors we use.

In this way, metaphors may give expression to some prior, unarticulated understanding of a situation. In a culture that values governmental planning and policy-making, for example, it would not be unusual to create metaphors for the economy which suggest action rather than passive acceptance. Metaphors, in other words, can be models *of* a situation as well as models *for* it (to borrow Geertz's [1973, p. 99] phrase).

Metaphors are not commonly understood according to the literal meanings of their words. To talk of "housing decay," for example, is not to mean literally that the wood is rotting or that the bricks are decomposing. The decay metaphor is understood through tacit analysis of its meaning in a particular context of reference (in this case, the deterioration of a typically lower-class neighborhood).

On the other hand, metaphorical meaning presupposes an understanding of its literal sense in some context. If we did not know the ordinary meaning of "decay," we could not apply it sensibly to deteriorating houses. For metaphors to be understood as part of public discourse, rather than private musings, their literal meanings must be part of a shared context—"a set of standard beliefs . . . ([or] current platitudes) that are the common possession of the members of some speech community" (Black, 1962, p. 40) or, we might add, thought community.

When the interpretive context changes, the meaning of the metaphor may change as well. In this way, metaphors entertain the possibility of multiple meanings. In the Arabic of some Middle Eastern countries, for example, green connotes maturity, ripeness; in which case, calling someone a "greenhorn" would not carry its American English connotations of new, bumbling, unknowing, and our other green metaphors would acquire new meanings or become altogether senseless.

This approach to the analysis of metaphors suggests that we cannot eliminate them as though they were mere decorative additions. We also must be

cautious against the thought that in discovering the meaning(s) of the metaphor, we will be able to get down to the root of the problem and thereby eliminate the hidden source which directs action. If metaphor is indeed a figure of thought, reflecting thought as well as shaping it, attempts to eliminate the metaphor may not eliminate the thought. In finding another expression of that thought, we may, as D. F. Miller (1985) notes, be simply substituting one metaphor for another. In ferreting out one metaphor, we might only discover that it stands on the shoulders of another, much as inflation, the enemy, rests on an older convention of a misshapen, bloated economy. What we may discover in analyzing technological metaphors are ways in which language both shapes and reflects our thinking and our action, rather than that we are getting to the final core of an issue. [6]

II. A CENTURY OF ORGANIZATIONAL STUDIES

> *ecology* n. 2. The relationship between organisms and their environment [Greek *oikos*, house + logy]
> — *American Heritage Dictionary*, 1975

The interdisciplinary academic field of organizational studies (also known as organizational theory and/or organizational behavior, its two major and contending components) traces its origins to Max Weber's writings in the early 1900s. Weber's descriptions of the bureaucratic forms of organization he saw around him became the touchstone for both schools of thought in which they are still currently applied: management (i.e., the "private" or "profit" sector) and public administration (i.e., the "public" or "non-profit" sector). Looking at organizations in their societal context, we may see a technology for harnessing and regulating human labor and other resources in the production of goods and services. Organizations and organizing are at once tools of production, processes of harnessing labor, and a technique of domination and control (see Ferguson, 1984, on the latter). Tracing developments in organizational studies over the last 100 years, we find an ecology of metaphors, each shaping thought about organizations, interacting with its predecessors, seeking homeostasis or fighting for domination, in relationship with its societal value environment. [7]

Machine: Human labor is individualistic and even chaotic. We bring order out of chaos (in our *imitatio Dei*) by creating bureaucracies, as the Pharaoh did in constructing the pyramids, Moses in setting up tribal courts of hearings and

judgment, Weber in enumerating the criteria for the arrangements he saw around him (Gerth and Mills, 1946), and Taylor (1967[1911]) in setting down the "principles of scientific management." Taylor's depiction of the universal principles and laws of management draws on the imagery of the machine as simple lever: the pressure of money produces human efficiency, the pressure of human labor produces products. [8] The engineer is the scientific manager. Weber depicts an arrangement of parts which regulate ("oil") themselves through lines of authority and responsibility, all under the control of the chief authority. The "mechanization" of society in the 1800s-1900s extended to views of organizations, and the machine metaphor is evident in subsequent theories which focus on organizations' structural design. Management is the "hands on" control of the labor force, from the Italian *maneggiare*, to handle a horse. And the organizational structure "manages" the unregulated whims of monarchs and popes.

Family: But in the late 1930s, in part under the spreading influence of Freudian ideas about the psyche, humans were once again perceived as chaotic, behaving according to the social psychological rules of the "informal organization" rather than conforming to the written rules and regulations of the bureaucratic machine. The Hawthorne experiments (Roethlisberger and Dickson 1966[1939]) discovered that social interaction is a determining factor in the efficient regulation of the workplace. Humans are seen to be controlled by interpersonal roles and group norms, rather than by Weberian rules of organizational structures. We see this new emphasis in the title of an essay and later book which became exceedingly influential in the development of the human relations school of management thought: "the *human* side of enterprise" (McGregor, 1957, emphasis added). The organization is now seen as a "family"; and yet, although the family image invoked by human relations theorists is a happy, peaceful, conflict-free one, it is a patriarchal family—still a metaphor of control, where the control is vested in the father figure, the CEO.

Cell/Cyber: World War II saw the development of "systems," in radar, in inertial guidance, and in operations research. After the war, much of the rest of the non-military world was "systematized." Parallel in the scope of its colonization of general life to the earlier "scientization" of society in the late 1800s-early 1900s (e.g., the creation of the First Church of Christ, Scientist; Fanny Farmer's Boston School of Scientific Cooking; even Scientific Methods of Tree Trimming), we find: stereo systems; transportation systems; the nervous system; judicial systems; "the"

System, in the late 1960s; even toilet bowl cleanser systems in the 1990s. The
systems metaphor, extended also to organizations, draws on two sources: the
"cybernetic" device, which in organizational parlance applies Norbert Wiener's
"helmsman" to the organization which takes in information collected from its
surroundings and corrects its goal-oriented actions; and the biological "cell" taking
in inputs from its environment and processing outputs through its semi-permeable
membrane, protected by buffers which absorb danger and facilitate adaptation to
change. Control is achieved through cybernetic feedback (error detection and
correction) and organismic homeostasis through adaptation; organizational systems
do not include theories of mutation or cell division. [9] It is a view of evolution as a
theory of control in the face of random events.

The organization-as-system is a more sophisticated, complex machine,
internally more differentiated than the earlier model and responding to variety in its
environment, unlike the simpler earlier machine. The human factor is noticeably
absent in systems theories of organizations, although human relations theories have
absorbed systems thinking. The latest development is importation of family theory,
which itself now sees the family as a system and the individual member as one of
the system's interdependent parts, rather than as a separate unit.

Game/Contest: The 1970s, especially in the aftermath of the Vietnam War
and in the U.S. of Watergate and the Kennedy and King assassinations, saw
resurgent interest in human factors and a new set of organizational theories based on
the notion that power, influence, interests, and, hence, conflict are normal parts of
human life. This is in marked contrast to the earlier human relations theory's image
of the happy family, where conflict was seen as abnormal and dysfunctional. These
political theories (e.g., Pfeffer, 1981) draw on a life-as-war metaphor, although the
notion of war is more of its moral equivalent—a chess game or other contest.

The political view introduces an element of unpredictability. This metaphor
expresses the research finding that power does not always correspond with its
structural allocation in the form of organizational authority. Control, then, is less
certain, more subject to negotiation (part of the metaphor). This may explain why
there is no small amount of discomfort among organizational theorists with this
perspective. The irony of political *science* is that it promises a scientific study of
power in organizations, implying that power may be controlled. But attention to the
uses of power have largely diverted attention from the allocation and experience of

powerlessness in organizations (Kanter, 1977), where the absence or withholding of power becomes a mechanism for control. This has recently led to attention to "empowerment" of the workforce; but as the concept is being used in practice, it is yet another means of controlling the workforce.

Tribe: The latest development in organizational studies is inclusion of the cultural aspects of organizational life, and here the struggle over control within the academy is paramount. Since the view of organizations as cultures burst onto the scene in the early 1980s, this struggle has been playing out between two schools of thought. The first seems to see organizations as tribes with their own chiefs whose responsibility it is to create new symbols, rituals, ceremonies, and so forth, in order to control organizational members (see, e.g., Deal and Kennedy, 1982). It is a set of writings explicitly and implicitly concerned with the seeming hegemony of Japanese industry as the source of American economic and industrial problems.

The second school is the one that has been most active in explicating the metaphoric nature of theorizing. Its theorists have stepped outside of the functionalism or positivism that had driven organizational studies into a phenomenological, interpretive, or postmodernist stance in which they attend to the meanings made by organizational members, including the possibility of multiple meanings beyond managerial control. While the debates among other theorists writing from the various metaphoric perspectives appear to be battles over the appropriate paradigm for the field (and some talk about it in this way, calling for the field to move beyond its pre-paradigmatic state, in Kuhn's terminology, and to agree on key variables), the second school of organizational culture writers see themselves as part of a philosophical debate over ontological and epistemological assumptions. It is difficult to capture in their writings a metaphoric root, unless it is their concern with the problem of human meaning.

The battle of control is being waged here in theoretical terms. The "tribes" group has created a metaphor of control, through the person of the chieftain. The second group of theorists portrays the first group as apologists for management's need to control (e.g., Kunda, 1992). Seeing organizations as cultures, under the prospect that management cannot control them, is an even more unsettling theoretical premise—one largely unspoken by the tribes group—than was the image of the chief executive out of control under the political perspective.

Given that the field has a strong managerial bias, and that management is the control of human resources, it is not surprising to find metaphors of control shaping thought in the field. But it is not only labor here, as a mode of production, that is a technology. Organizations themselves are technologies, the servo-mechanisms of industrial and post-industrial society. Is it possible that our ecology of organizational metaphors itself lies within a metaphorical environment of societal control on a broader conceptual plane? In other words, this set of control-oriented metaphors, each striving to correct the failings of its predecessor, not only provides a set of guidelines for actions that will harness an uncontrollable, individualistic, chaotic workforce. It signals that the problem of control underlies this history of theorizing about organizations, that the metaphors are giving voice to this tacitly known concern, and that the various corrective attempts continue not to address, explicitly, societal concern about control.

III. RECOMBINANT DNA, HARVARD UNIVERSITY, AND CAMBRIDGE, MASSACHUSETTS

> Many of us would feel a lot happier if they picked a special form of life
> with which to conduct such experiments, not [E. coli] from human beings,
> so the experiment could be controlled if anything goes wrong.
> —George Wald

The events surrounding the initial development of recombinant DNA research, the scientists' call for a moratorium, and citizen participation in research regulation created a public drama of the Frankenstein of popular perception—that is, the harmful monster escaped from the lab—versus the responsible scientist. In many respects, Frankenstein-the-monster won: not only was the image of the responsible scientist called into question by the reported behavior of actual scientists, but their putative responsibility was further undermined, at least in events in Cambridge, Massachusetts, by the actions of their organizational employer, the university, returning us in interesting ways to the organizational metaphors just discussed. Unlike those metaphors, which are discovered in analyzing academic writing, the metaphors in this case are part of public discourse—the pronouncements of scientists, politicians, university administrators, and lay citizens as they discussed the issues raised by rDNA research. [10]

Frankenstein genes: promises vs. dangers: By the early 1970s scientists

had discovered restriction enzymes which allowed them to cut DNA at a specific site and link it to other DNA, enabling them to recombine genetic material from different species. Members of the community of biologists engaged in these research developments expressed concern first at the June 1973 Gordon Research Conference on Nucleic Acids, in a subsequent letter to the president of the National Academy of Sciences, in the pages of *Science* after it published that letter, and presumably in labs, department meetings, and hallways. The discussions became public outside of the scientific community when university campuses—at Ann Arbor, Michigan, on March 3-4, 1976, followed by Harvard on May 28 and later by others—held public hearings to discuss the safety issues involved in pursuing the research.

The initial debate was framed as a matter of "promises" versus "dangers"; the promises were presented as if they were certain (e.g., applications in food and nutrition, medicine, waste disposal), by contrast with dangers that were "unknown." And yet, the image of the "unknown danger" was clear: "an organism which might *inadvertently escape* into the environment and produce *human cancer . . .*" (Report of the House of Representatives, Subcommittee on Science, Research, and Technology, December 1976, p. 19; emphasis added). This is the fear that captured most of the public's attention, overriding those who saw a moral issue in humans creating new species (Jeremy Rifkin's *Who Shall Play God?* notwithstanding) and compounding the metaphor of the uncontrolled Frankenstein with the metaphor of cancer as illness out of control (as Susan Sontag illustrated, in those pre-AIDS days).[11] Mary Shelley's monster was first invoked at Harvard in an April 21, 1976, public meeting called by the Biological Sciences Executive Committee. As reported later, the meeting considered such questions as:

> Do experiments in genetic engineering carry with them the risk of inadvertently creating a "Frankenstein" bacterium that might pose a significant hazard to humans?
>
> Ought Harvard biochemists to abstain from such experiments, or does a new proposed "containment" laboratory reduce these risks to a minimum?

"Inadvertent" escape, however, is yet another variation on Shelley's story and suggests the ultimate fear of loss of control. The image of uncontrolled and

uncontrollable escape was metaphorically reinforced in Cambridge when it was revealed that the site for the planned top-level security lab, an old brick building on a tree-lined, residential street on the outskirts of Harvard property, was infested with pharaoh ants which had resisted all extermination attempts. [12] It was strengthened yet again by the information that recombining organisms was within the capability of the average high school lab—the vision of anarchic youth creating the biological equivalent of the atomic bomb (also public knowledge by then to the diligent student combing scientific journals). All of the era's worst fears met in the rDNA lab: the irresponsible scientist, the irresponsible teenager, the escaping gene, and cancer. Were the new organism's escape "advertent," it would be a criminal act subject to the laws of the state. This line of thinking reflects an awareness of the absence of laws regulating such research; creating some— initiating control measures—is the metaphorically logical next step.

Public involvement in research regulation reframed the debate: the "certain promise versus unknown, inadvertent danger" frame shifted to a "rights" frame—the right of scientists to academic freedom versus the right of the public to protection from harm. Academic freedom calls into play the question of the freedom of universities, especially private ones, to pursue their own interests without public interference (returning us to our organizational metaphors). The public's right to protection from harm caused by irresponsible scientists becomes also the public's right to protection from harmful organizations, although the latter is mostly expressed metaphorically rather than explicitly, an example of knowledge known and shared tacitly through the metaphors which give it voice.

Harvard and M.I.T.: institutions out of control? Cambridge, Massachusetts, is home to two world-class institutions of higher learning, one a school of liberal arts and professions, the other a technological institute. Their organizational cultures are different; their styles of operation are different; and their relationships with their host community are different. MIT has traditionally educated the sons (its student body has been predominantly male) of Cambridge and working class Somerville at whose edges it lies. Engineering has often been seen as the first step of the upwardly mobile, the blue collar ticket into the professional class. Harvard, by contrast, educates the sons (traditionally) of the economic, political, and social elites of the U.S. and the world. While MIT has been seen as part of the community, Harvard is perceived as an elite institution. Harvard has long suffered poor town-gown relations, by contrast with MIT which has, with a few notable exceptions,

been on excellent terms with Cambridge. These relations were played out organizationally in the rDNA developments as well.

In 1975, when the voluntarily-assumed moratorium on rDNA research was underway, Harvard and MIT were both engaged in P1 and P2 levels of research. (Labs are rated from lowest security rating P1 to highest P4; the moratorium was on P3 and P4 levels of research.) MIT was holding off on P3 level research pending NIH guidelines, in compliance with the moratorium. But a professor at Harvard applied on behalf of the biology department for federal funds to build a P3 lab.

His proposal was approved in October 1976. Late in the month, a Harvard vice-president told Cambridge Mayor Alfred E. Vellucci that the university would proceed to build the lab as soon as it received City Council's approval. The same message was given to the council on November 1. After discussion that evening, the council tabled its vote until the following week's meeting. On November 3, in a routine procedure, Harvard asked the city manager for a building permit for the lab.

Council members were furious. One said, "Once again, Harvard is not dealing in good faith. . . . What Harvard is doing is backing us into a corner." The mayor, who two days earlier had thanked the university for its "close cooperation" with the City Council, retracted that praise, saying: "Harvard scientists just walk in, walk out and say 'The hell with the City Council.' Since we're all in the middle of the ballroom dancing, we should have at least finished the dance."

The Associate Dean of Harvard's Faculty of Arts and Sciences told a newspaper reporter that the public normally has no role in Harvard's decision-making process. In terms of the organizational metaphors discussed earlier, Harvard acted out the machine metaphor of a self-contained entity with all the rights of a 19th-century corporation of limited liability. Its actions were not those of an interdependent part of a societal system that perceives the effect of those actions on the community which is also part of that system. The machine metaphor led them to proceed according to corporate rights and to ignore the terms of debate between academic rights and public rights. The image of the irresponsible organization beyond public control exacerbated the public's fear of the irresponsible, uncontrollable scientist.

Internally, as well, Harvard behaved in keeping with the early machine

metaphor of organizational life. The Committee to Regulate Hazardous Biological Agents in the College of Arts and Sciences, established in August 1975, reported to the dean on May 3, 1976. The letter begins by stating what issues the committee had not considered:

> We do not address the general moral and ethical problems which some people have raised, . . . we do not plan facilities or advocate research programs. . . . No other committees or individuals have been designated to deal with these other issues and with the question of how, when a complex technology touches the public interest, the public voice is to be heard. These are important matters with which we cannot deal while at the same time coping with the technical questions of safety and safety regulation.

The chairman of the committee later told a newspaper reporter, "I find it difficult to impose a level of hazard on society. . . . A more representative group has to be formed. . . . The public must decide what level of hazard they find acceptable." The Associate Dean of Arts and Sciences added, "You can't address a national issue in a university." In other words, the committee reverted to its lines of authority and responsibility, rather than engaging the human relations, systems, or political metaphors of organizational life. Both the committee chair and the dean present a picture of the university and society as separate entities. By invoking the machine metaphor, they projected a view of an organization in control of itself, but independent of the city. Had they enacted a systems metaphor of interdependent parts, or a family or chess game metaphor of partnership of some kind, they would not have left the city feeling abandoned on the dance floor and out of control of an institution seemingly responsible only to itself.

Rights: organizational vs. public: "Are we going to raise the potential crisis of ruining the entire ecological system just so that some scientists can get into their work faster?" asked Harvard Professor Richard N. Goldstein. The initial call for a research moratorium had been hailed by the public as a significant development within the scientific community. Such debate was seen as "unprecedented" (perhaps by comparison with the secrecy of the Manhattan Project): the scientific community deliberating on the safety of its own research, expressing doubts about possible outcomes, calling voluntarily—without public or governmental pressure—for a moratorium. It is as though the Dr. Frankenstein of Shelley's novel had called for a town meeting and engaged his responsibility, rather

than holing up in his room and then fleeing. As the House of Representatives Subcommittee on Science, Research and Technology Report noted, "Although there were strong feelings . . . about the imposition of 'regulations,' there also was a very strong feeling about the *social obligations of the investigators*" (emphasis added).

The University of Michigan committee charged with developing rDNA research policies recommended "that adherence of researchers to guiding principles can best be monitored by a local committee of faculty peers." This invokes the image of the responsible scientist, an image strengthened by scientists' voluntary call for a moratorium on the research. This was counterposed against the image of the irresponsible scientist, more the Dr. Frankenstein of Shelley's novel than the mad scientist of Hollywood movies (a distinction that Winner, 1977, chapter 8, makes wonderfully clear).

As more became known about rDNA techniques—in September 1977, the inventor of recombinant techniques, Dr. Stanley Cohen, announced that he had found such recombination occurring in nature—many scientists who had initially opposed the research changed their minds about the potential hazards and argued on behalf of peer review rather than governmental regulation. Harvard's vice-president noted that the fact that a university scientist opposed to the research could publicly criticize its policies "makes the collegiate institution the most appropriate place for recombinant DNA research. . . .We should trust people to be responsible and ethical without undue interference."

On the other side of the coin, a November 3, 1977, *New York Times* editorial noted three instances in which university scientists contravened federal regulations, one of them an rDNA experiment. Two other infractions of rDNA guidelines also made the news: researchers at the University of California in San Francisco attributed it to "innocent error," confusion over NIH rules, and lack of communication; while Harvard Medical School's investigative committee claimed the problem resulted from misunderstandings of the guidelines, communications failures, and administrative lapses. The *Times* editorial concluded that such infractions would be "the surest way to lose that argument [that] . . . the scientific community can be trusted to police itself."

Against the image of the irresponsible scientist were the lay heroes of the Cambridge Experimentation Review Board (CERB), who had educated themselves

sufficiently about the matters involved in rDNA research to make informed public policy on behalf of the city. In creating the CERB, the city manager decided "to create a committee of Cambridge citizens who could approach the subject *in an unbiased manner and insure that the public safety is at all times the foremost consideration*," rather than to constitute a committee of scientists who might *"have a self interest in the experimentation*" (emphasis added). One CERB member told a reporter, "We have to *open up the universities* so that the public can gain knowledge about the science that is . . . encroaching upon our lives" (emphasis added). And Mayor Vellucci declared his intention to have "a team of scientists who are opposed to this thing" evaluate the CERB report.

The initial science and technology frame of promises and dangers focused on the individual scientist. The possible safeguards appealed to were also scientists, but in groups, associations or organizations: peers, professional societies, the university. Shifting attention from the potentially irresponsible scientist to the potentially irresponsible organization shifted the locus of the possible safeguard—to the community of responsible lay citizens. It is less a legal than an organizational frame and, moreover, one that suggests a hierarchy of moral authority to invoke in the face of control issues. Like the child's game of paper, stone, scissors, the scientist can overcome the lone citizen, but the community of citizens outweighs the university.

IV. CONCLUSION: ECOLOGIES OF METAPHORS

Analysis of the metaphors of public discourse on rDNA research reveals the compounding of images of uncontrollable process, irresponsible scientist, and uncontrollable organization. The Frankenstein metaphor suggests the possibility of control: build a top-level security lab to contain the newly designed gene. But this suggests that the organism *wants* to escape; and we can plan and design for intentional acts. Inadvertent escape does not fit the metaphor. In that case, the only entity that can be controlled are the scientists—hence, a moratorium among peers and NIH guidelines—and the organizations employing them—hence, local, state, and federal regulations. But human error and willfulness cannot be controlled; organizations cannot eliminate the human element from their "machines"; and the public comes to distrust both human scientists and "inhuman" bureaucracies. [13]

The Frankenstein metaphor suggests the possibility of control, if only the

Doctor will be responsible. The metaphors of organizational studies suggest an ongoing—and failing—battle for control of an essentially uncontrollable human enterprise. Both stories suggest not only that control is a theme in modern life, but that the battle for control is what we play out over and over. Even after 100 years of exploring the nature of organizations, the dominant metaphor is still the organization as machine—the tool under (or escaping from) human control, itself a tool *for* human control. Both cases share a sense of the need to exercise control over a world out of control. Both are, on the surface, "hero" stories. In the first, the scientific manager, the "humane" manager (drawing on McGregor's [1964] Theory Y form of Maslowian incentive use), the systems oriented manager, or the culture-creating manager makes the organizational tool work. The public drama of rDNA regulation ended with the public as victorious hero—claiming human responsibility, exercising human judgment, but *in support of* rDNA research done by responsible scientists and controlled universities. The moral here seems to be not about yielding control, but about abdicating judgment.

It is not just that technological metaphors control our thought processes about the technologies we thought to control (Edge, 1990). This implies that if we could only eliminate our control-oriented metaphors, we would no longer fear technologies out of control. Yet we cannot eliminate metaphors from our thinking. And the theme of control over nature and human activity is a long-standing presence in this thinking, from religious metaphors ("What the devil's got into you?") to technological ones ("He's letting off steam!"), reflecting the history of our explanations of control problems. Even Frankenstein has been updated, extended recently to "Frankenfood" (*Contra Costa [California] Times* 7/15/92). New perceptions lead to new metaphors which further shape new perceptions: ecologies of metaphors are not static, as the history of organizational metaphors shows. Yet the theme of control persists; and thought also shapes our language, including our metaphors.

Thinking about ecologies of metaphors emphasizes the relationship among language, thought, values, beliefs, feelings—in short, the cultural context within which we live. Attention to ecology is itself a metaphor which directs perception, belief, attitude, and action. The causal direction embedded in the notion that belief drives cognition, as Edge suggests, is not exclusive: seeing is believing, and believing is seeing; both describe human processes. The metaphor may be both the model *of* pre-existing thought and a model *for* subsequent action. If we want the

world and our technologies to be under control, we will invoke control metaphors; and they, in turn, will lead us to believe, and act in accordance with the belief, that we can control them—until, that is, we make the metaphors explicit. Like asking the centipede what his 39th leg is doing when his 56th is up, at that point our metaphors are no longer controlling our cognitions and belief. But when we resume our march, it is likely to be under the influence of other controlling metaphors.

This paper itself constitutes the creation of a metaphor and of a metaphoric ecology. By bringing organizational studies and rDNA processes into the same analysis, I have created a context in which we might search beneath apparent surface dissimilarities for common themes, and use the one to illuminate the other (although I have tried to make each case both vehicle and focus). Second, by putting two sets of metaphors into relationship, I have created an ecology in which the organizational metaphors are the environment for the rDNA metaphors, at the point where the latter entail organizational action. And the public's fear of rDNA technology serves as an environment in which to understand managerial attitudes toward organizations as technologies. But is this not also saying that a metaphor is an ecology—a relationship of an entity with its environment? And so we are left with ecologies of metaphors, and metaphors of metaphors, all conveying meaning tacitly—which is to say, beyond conscious human control, so that we may continue to proceed, like the centipede.

NOTES

1. I have "borrowed" the idea of "ecologies of..." from Ed Wachtel, who proposed to use it to look at ecologies of communications technologies. He should be absolved, however, of any responsibility for the particular way in which I have applied that idea.

2. The former concerns metaphor's epistemological role in creating researchers' theoretical categories and concepts: dominant metaphors are seen to underlie the theories of the field and to structure researchers' creation of new knowledge and categories of analysis. We find this concern in sociology (Brown, 1976); in political science (Landau, 1964; Myrdal, 1968; Rayner, 1984; Yanow, 1987a); in organizational studies (Bourgeois and Pinder, 1983; Keeley, 1980; Manning, 1979; Morgan, 1980, 1983, 1986; Pinder and Bourgeois, 1982; Yanow, 1987b); and in technology studies (Edge, 1990), among other fields.

3. The second focus of analysis has been on the ways in which metaphors used in daily life shape public thought about and action towards the subject of the metaphor. Traditionally, most work on metaphors in general social life has been done by anthropologists studying geographically remote societies (e.g., Fernandez, 1972, 1974). Attention to the role of metaphors in directing everyday life in a Western context has been undertaken typically in other disciplines. Political science and policy analysis have been primarily concerned with rhetorical devices in public language (such as social

policies or politicians' speeches) which categorize political events and direct public perception of them and action in their regard (Bosman, 1987; Edelman, 1977; Garrison, 1981; Howe, 1988; D.F. Miller, 1985; E. F. Miller, 1979; Rein and Schon, 1977; Schon, 1979; Stone, 1988; Titus, 1945). Organizational studies has focused on the connection between organizational metaphors and organizational action (Donnellon, Gray, and Bougon, 1986; Krefting and Frost, 1985; Merten and Schwartz, 1982; Pondy, 1983; Smith and Simmons, 1983; Srivastva and Barrett, 1988; Yanow 1992).

4. The increasing interest in metaphor as a field of analysis may be seen by looking at two bibliographies published since 1970. Shibles (1971) included 3,000 annotated entries on the subject; Van Noppen, DeKnop, and Jongen (1985) cited 4,300 new entries not included in Shibles's work, most of them published between the early 1970s and 1985. Booth (1978) noted that, "1977 produced more titles [concerning metaphor] than the entire history of thought [on the subject] before 1940."

5. The following section is based on Yanow (1992). There is, of course, a long history of concern in philosophy with metaphors and intention. It is not my purpose here to recapitulate that argument, but rather to explore the implications for action of the view that metaphors both reflect prior thought and shape future action, especially in the context of technology studies' concern with the theme of control.

6. This definition is in the tradition of what Black (1962) called the "interaction" approach to metaphor, in which some unnoticed aspect(s) of the focus of the metaphor is highlighted through an interaction between the two parts, leading to a new understanding of the metaphor's focus. He notes two other approaches to metaphor definition: "substitution," in which the metaphor is seen to replace an equivalent literal formulation; and "comparison," in which the metaphor is an abbreviation which can be elaborated on to spell out the comparison being made between its two parts.

7. Edge (1990) noted three attributes of metaphors: their ambiguous associations; their potential to alter feelings and attitudes; and their role in establishing moral and social control. These are related to three of the aspects I include here. There is a difference, however, between saying that metaphors are ambiguous and noting their ability to accommodate multiple meanings due to their contextual specificity. Ambiguity may be an outcome, but it is not the same as ambivalence. If we are ambivalent about technologies, as he argues, that is a property of our feelings toward technology; it is not caused by the potentially-ambiguous nature of metaphors. Second, metaphors not only direct feelings and beliefs, but actions as well. This is their "controlling" element, which is my subject here. Lastly, Edge seems to suggest that not all of us are subject to metaphor's influence, that we can distance ourselves from metaphor. In accepting the position that all thought is metaphoric, and that metaphors not only reflect thought but shape action as well, I suggest that such distancing is not usual, and that in this lies metaphor's power to direct thought and action.

8. It is a recent development within the field of organizational studies to make explicit the metaphors underlying its theoretical arguments. Bolman and Deal (1991), Morgan (1986), and Yanow (1987b) are three examples of such approaches. The metaphors they point to coincide and differ in interesting ways. The organizational literature in which the metaphors mentioned here are found are cited in these three works; I will not note them here extensively. Some of the ideas in this section were originally worked out in collaboration with Scott Cook. I am indebted to him especially for the notion of systems as cells and cybers.

9. A vivid illustration of this is Taylor's example (pp. 40-48), drawn from his consulting work, of the pig iron handler from Bethlehem Steel Company, for whom a wage increase of about 60% was sufficient to increase his daily output nearly 400%. Taylor concludes his story by writing (p. 48):

> There is a science of handling pig iron, and further that this science amounts to so much that the man who is suited to handle pig iron cannot possibly understand it, nor even work in accordance with the laws of this science, without the help of those who are over him.

We have come close to such events conceptually in the last decade, in "mergers and acquisitions" and "hostile takeovers," as well as in the early 1980s and current recession-induced "downsizing" and consequent "outplacement." With the possible exception of "mergers," these activities draw on other metaphors—exchange, war, and Alice in Wonderland-style shrinkage.

10. This section is taken from a set of case studies (Yanow 1985) which drew their data from published newspaper and journal articles, correspondence files, and interviews. All data are from those cases; more specific citation sources are given there.

11. My reference here is to Sontag's *Illness as Metaphor*, originally published in 1978. In 1989 her *AIDS and Its Metaphors* was published. For a single volume containing both, see Sontag (1990).

12. D. F. Miller (1982), in asserting that all thought is metaphoric, proposes that metaphor in general not only includes metaphor proper, but also analogy, translation, exchange, contradiction, synecdoche, and metonymy. In suggesting that the analogy with pharaoh ants was metaphoric thinking, I am following this argument.

13. This latter fear was played out in scientists' and university administrators' fear of a patchwork of local legislation, an aspect of the case which I have not touched on here. This fear eventually led several leading research universities to join forces in hiring and registering a lobbyist in Washington—a higher education first—and it persuaded scientists to abandon their opposition to federal legislation, which they came to see as the lesser evil as compared with the prospect of multiple and conflicting local government policies. (See Yanow, 1985, case C.)

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