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“We Defend Every Place”: Building the Cold War World

This book is about computers, as machines and as metaphors, in the politics and culture of Cold War America.

As machines, computers controlled vast systems of military technology central to the globalist aims and apocalyptic terms of Cold War foreign policy. First air defenses, then strategic early warning and nuclear response, and later the sophisticated tactical systems of the electronic battlefield grew from the control and communications capacities of information machines. As metaphors, such systems constituted a dome of global technological oversight, a *closed world*, within which every event was interpreted as part of a titanic struggle between the superpowers. Inaugurated in the Truman Doctrine of “containment,” elaborated in Rand Corporation theories of nuclear strategy, tested under fire in the jungles of Vietnam, and resurrected in the impenetrable “peace shield” of Ronald Reagan’s Strategic Defense Initiative, the key theme of closed-world discourse was global surveillance and control through high-technology military power. Computers made the closed world work simultaneously as technology, as political system, and as ideological mirage.

Both the engineering and the politics of closed-world discourse centered around problems of *human-machine integration*: building weapons, systems, and strategies whose human and machine components could function as a seamless web, even on the global scales and in the vastly compressed time frames of superpower nuclear war. As symbol-manipulating logic machines, computers would automate or assist tasks of perception, reasoning, and control in integrated systems. Such goals, first accomplished in World War II–era anti-aircraft weapons, helped form both cybernetics, the grand theory of information and control in biological and mechanical systems, and artificial intelligence (AI), software that simulated complex symbolic thought. At the same time, computers inspired new psychological theories built around concepts of “information processing.” Cybernetics, AI, and cognitive psychology relied crucially upon the computer as metaphors and models for minds conceived as problem-solving, self-controlling, symbol-processing systems. The word “cyborg,” or cybernetic organism, captures the strategic blurring of boundaries inherent in this metaphor. *Cyborg discourse*, by constructing both human minds and artificial intelligences as information machines, helped to integrate people into complex technological systems.

The cyborg figure defined not only a practical problem and a psychological theory but a set of *subject positions.* Cyborg minds -- understood as machines subject to disassembly, engineering, and reconstruction -- generated a variety of new perspectives, self-interpretations, and social roles. These identities were most

thoroughly explored in science fiction, where cyborg figures ranged from the disembodied, panoptic AIs of *Colossus: The Forbin Project* and *2001: A Space Odyssey* to the mechanical robots of *Star Wars* and the engineered biological androids of *Blade Runner.* But in a world increasingly structured by and theorized in terms of information processing devices, cyborg subjectivity was not only fictional but real.[1] Cyborgs were subjective devices nested inside the larger technological systems of the closed world. Hence this book also probes subjectivity and political identity in a real world of cyborgs by exploring the dramatic worlds of science fiction in books and film.

In exploring these ideas, I will develop three major theses. First, I will argue that the historical trajectory of computer development cannot be separated from the elaboration of American grand strategy[2] in the Cold War. Computers made much of that strategy possible, but strategic issues also shaped computer technology -- even at the level of design. Second, I will link the rise of cognitivism, in both psychology and artificial intelligence, to social networks and computer projects formed for World War II and the Cold War. Here again the grand strategy of the postwar era influenced the form and content of major research programs, culminating in an abstract theory of intelligence as heuristic information processing and in a new interdiscipline, "cognitive science." Finally, I will suggest that cyborg discourse functioned as the psychological/subjective counterpart of closed-world politics. Cyborg discourse yielded up new possibilities for experience, identity, and political action within a total Cold War controlled by global information and control systems. Where closed-world discourse defined the architectures of a political narrative and a technological system, cyborg discourse molded culture and subjectivity for the information age. Cyborgs, with minds and selves reconstituted as information processors, found flexibility, freedom, and even love inside the closed virtual spaces of the information society.

This chapter sets the stage for the book's argument with three short scenes from the closed world. The scenes are drawn from across the Cold War's historical span; each illustrates one of the book's major divisions. My goal is to enact the book's themes and their interplay here, at the outset, before proceeding to more detailed analysis. Like most dramas and all history, our first scene begins *in medias res* — in the middle of the story — in the night skies over Southeast Asia, riven by the sounds and furies of a terrible war.

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[1] Donna J. Haraway, "A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s," *Socialist Review*, Vol. 15, No. 2 (1985), 65–107; Haraway, "The Promises of Monsters," in Lawrence Grossberg, Cary Nelson, and Paula A. Treichler, eds., *Cultural Studies* (New York: Routledge and Kegan Paul, 1992), 295–337.

[2] The term "grand strategy," borrowed from political science and roughly equivalent in my usage to "geopolitics," refers to a nation's long-term, integrated political goals and the military means deployed to attain them.

Scene 1: Operation Igloo White

In 1968 the largest building in Southeast Asia was the Infiltration Surveillance Center (ISC) at Nakhom Phanom in Thailand, the command center of U.S. Air Force Operation Igloo White. Inside the ISC vigilant technicians pored over banks of video displays, controlled by IBM 360/65 computers and connected to thousands of sensors strewn across the Ho Chi Minh Trail in southern Laos.

The sensors -- shaped like twigs, jungle plants, and animal droppings -- were designed to detect all kinds of human activity, such as the noises of truck engines, body heat, motion, even the scent of human urine. When they picked up a signal, it appeared on the ISC's display terminals hundreds of miles away as a moving white "worm" superimposed on a map grid. As soon as the ISC computers could calculate the worm's direction and rate of motion, coordinates were radioed to Phantom F-4 jets patrolling the night sky. The planes' navigation systems and computers automatically guided them to the "box," or map grid square, to be attacked. The ISC central computers were also able to control the release of bombs: the pilot might do no more than sit and watch as the invisible jungle below suddenly exploded into flames. In most cases no American ever actually saw the target at all.

The "worm" would then disappear from the screen at the ISC. This entire process normally took no more than five minutes.

Operation Igloo White ran from 1967 to 1972 at a cost ranging near $1 billion a year. Visiting reporters were dazzled by the high-tech, white-gloves-only scene inside the windowless center, where young soldiers sat at their displays in air-conditioned comfort, faces lit weirdly by the dim electric glow, directing the destruction of men and equipment as if playing a video game. As one technician put it: "We wired the Ho Chi Minh Trail like a drugstore pinball machine, and we plug it in every night."

Official claims for Igloo White's success were extraordinary: the destruction of over 35,000 North Vietnamese and Pathet Lao trucks, each carrying some 10,000 pounds of supplies destined for the communist insurgency in South Vietnam. Had these figures been accurate, a conservative estimate would still have put the cost of interdiction in the neighborhood of $100,000 for each truck destroyed -- the truck and the supplies inside it usually being worth a maximum of a few thousand dollars.

But the official estimates, like so many other official versions of the Vietnam War, existed mainly in the never-never land of military public relations. In 1971 a Senate subcommittee report pointed out that the figure for "truck kills claimed by the Air Force [in Igloo White] last year greatly exceeds the number of trucks believed by the Embassy to be in all of North Vietnam." Daytime reconnaissance flights rarely located the supposedly destroyed vehicles. The Vietcong were

supposed to have "dragged" the trucks' carcasses into the jungle during the night, but in many cases this idea was pure delusion. The guerrillas had simply learned to confuse the American sensors with tape-recorded truck noises, bags of urine, and other decoys, provoking the release of countless tons of bombs onto empty jungle corridors which they then traversed at their leisure. Traffic over the Ho Chi Minh Trail continued, harassed but far from "interdicted."

The antiseptic efficiency of the ISC was belied by the 13,000 civilian refugees created by American operations along the Ho Chi Minh Trail[3] -- as well as by the loss of an estimated 300–400 American aircraft involved in Igloo White operations. In the end, despite more than four years of intensive computer-controlled bombardment of their heavy-equipment supply lines, the communists were able to field a major tank and artillery offensive *inside* South Vietnam in 1972. Nevertheless, Igloo White was counted, officially, as an important success that had managed to destroy up to 90 percent of the equipment sent down the Ho Chi Minh Trail.[4]

Operation Igloo White's centralized, computerized, automated method of "interdiction" resembled a microcosmic version of the whole United States approach to the Vietnam War. Under Robert McNamara, the Department of Defense completed a process of centralization begun by President Truman, making the service secretaries responsible to the Secretary of Defense in practice as well as in principle. McNamara achieved this goal by seizing control of the military budget. Wielding financial power like a bludgeon, he forced the services to coordinate their purchasing and therefore to coordinate their planning as well.

To control the budget, McNamara introduced a cost-accounting technique known as the Planning Programming Budgeting System (PPBS), which was built on the highly quantitative tools of systems analysis. The PPBS was therefore a natural application for the computer, at the time still a very expensive, fascinating novelty that could generate authoritative-sounding simulations and ream after ream of cost-benefit calculations. Gregory Palmer notes that while it often served more as a heuristic or ideal, "in its pristine form, PPBS was a closed system, rationally ordered to produce carefully defined outputs."[5] Lyndon Johnson regarded the PPBS as so successful that in 1965 he ordered all federal agencies to adopt it.

As the United States became more and more deeply involved in Vietnam, the McNamara Defense Department's administrative centralization and rationalization

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[3] Because of its source, this Air Force estimate must be regarded as conservative. This figure amounts to more than 5 percent of the estimated total population of the region.

[4] The discussion of Igloo White is based on Paul Dickson, *The Electronic Battlefield* (Bloomington: Indiana University Press, 1976), 83–97; George L. Weiss, "Battle for Control of the Ho Chi Minh Trail," *Armed Forces Journal* (February 15, 1972), 19–22; "You Can't Run Wars with a Computer," *Business Week* (June 5, 1971), 122; and James Gibson, *The Perfect War: Technowar in Vietnam* (New York: Atlantic Monthly Press, 1987), 396–399.

[5] Gregory Palmer, *The McNamara Strategy and the Vietnam War: Program Budgeting in the Pentagon, 1960–68,* (Westport, CT: Greenwood Press, 1978), 7.

was extended to a strategic and sometimes even a tactical centralization within the White House and the Office of the Secretary of Defense (OSD). After President Johnson ordered U.S. bombing of North Vietnam in 1965, McNamara and his assistants ran the air war in Southeast Asia from the Pentagon, integrating information and target lists prepared by military agencies all over the world. The OSD literally micromanaged the bombing campaign, specifying the exact targets to be attacked, weather conditions under which missions must be canceled or flown, and even the precise qualifications of individual pilots.[6] Even Johnson himself sometimes took part in targeting decisions.

As Martin van Creveld points out in his masterful study of command in war, the availability of new technologies and techniques of management was a large part of the reason for this entirely novel situation.

> During the two decades after 1945, several factors . . . caused the American armed forces to undergo an unprecedented process of centralization. In the first place, there was the revolutionary explosion of electronic communication and automatic data processing equipment, which made effective worldwide command and control from Washington a practical technological proposition. Second, there was the preoccupation during the 1950s with the need for fail-proof positive control systems to prevent an accidental outbreak of nuclear war, a preoccupation that led first to the establishment of the Worldwide Military Command and Control System (WWMCCS) in 1962 and then to its progressive extension from the Strategic Air Command, for which it had originally been designed, down to the conventional forces. New administrative techniques, such as cost-benefit analysis with its inherent emphasis on the pooling of resources and the careful meshing of each part with every other, further contributed to the trend toward central management, as did the appearance on the market of the data processing hardware needed to make it possible.[7]

The elements of this list of factors are worth close attention. High-technology communications and computing equipment, nuclear weapons and Cold War nuclear anxiety, quantitatively oriented, "scientific" administrative techniques, and the global objectives of U.S. military power combined to drive forward the centralization of command and control at the highest levels. At the same time, this drive created serious -- and in the case of Vietnam, finally fatal -- impediments both to effective action and to accurate understanding of what was going on in the field. Van Creveld calls these disruptions the "information pathologies" of that war.

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[6] Martin Van Creveld, *Command in War* (Cambridge, MA: Harvard University Press, 1985), 244.
[7] Ibid., 236.

In Operation Igloo White we see how these techno-strategic developments were played out on a regional scale: centralized, remote-controlled operations based on advanced computing and communications gear; an abstract representation of events (sensors, maps, grids, "worms") justified in terms of statistics; and a wide gap between an official discourse of overwhelming success and the pessimistic assessments of independent observers, including American soldiers on the ground. Like McNamara's PPBS, Igloo White was a "a closed system, rationally ordered to produce carefully defined outputs." These "outputs" were not only military but rhetorical in character.

From start to finish the Cold War was constructed around the "outputs" of closed systems like Igloo White and the PPBS. Its major strategic metaphor, "containment," postulated an American-led policing of closed Communist borders. Its major military weapon, the atomic bomb, became the cultural representative of apocalypse, an all-or-nothing, world-consuming flame whose ultimate horizon encircled all conflict and restructured its meaning. Cold War military forces took on the character of systems, increasingly integrated through centralized control as the speed and scale of nuclear war erased the space of human decision-making and forced reliance on automated, pre-programmed plans. The official language of the Cold War, produced by think tanks such as the Rand Corporation, framed global politics in the terms of game-theoretic calculation and cost-benefit analysis.

None of this -- metaphors, weapons, strategy, systems, languages -- sprang into being fully formed. We must therefore ask: How and why did global military control come to seem a "practical technological proposition," as van Creveld puts it? How did tradition-bound military services, oriented toward leadership based on battlefield experience, become transformed into managers of automated systems embodying pre-programmed plans based on abstract strategies? What held the official strategic discourse of the Vietnam era together, in the face of what could have been construed as glaring evidence of failure? What enabled the fantasy of global control through high-technology armed forces to persist throughout the Cold War, at the highest levels of government, as exemplified in President Reagan's Strategic Defense Initiative?

This book locates a key part of the answer to these questions at the intersections of politics, culture, and computer technology, in the ways computers and the political imagination reciprocally extended, restricted, and otherwise transformed each other. Like other elements of the post–World War II high-technology arsenal, such as the atomic bomb, the long-range jet bomber, and the intercontinental ballistic missile, computers served not only as military devices and tools of policy analysis but as icons and metaphors in the cultural construction of the Cold War. As H. Bruce Franklin has put it, "American weapons and American culture cannot be understood in isolation from each other. Just as the weapons have

emerged from the culture, so too have the weapons caused profound metamorphoses in the culture."[8]

I use the phrase "closed-world discourse" to describe the language, technologies, and practices that together supported the visions of centrally controlled, automated global power at the heart of American Cold War politics. Computers helped create and sustain this discourse in two ways. First, they allowed the practical construction of central real-time military control systems on a gigantic scale. Second, they facilitated the metaphorical understanding of world politics as a sort of system subject to technological management. Closed-world discourse, through metaphors, techniques, and fictions as well as equipment and salient experiences, linked the globalist, hegemonic aims of post–World War II American foreign policy with a high-technology military strategy, an ideology of apocalyptic struggle, and a language of integrated systems.

The Postwar World as a Closed System

In early 1947, because of a fiscal crisis, Great Britain withdrew its support from anticommunist forces in Greece and Turkey. To take up the slack, President Truman drove through a military aid package by "scaring hell out of the American people" in a major speech before Congress.[9] In it he pictured communism as global terrorism with implacable expansionist tendencies. The speech implied that the United States would henceforth support anticommunist forces anywhere in the world.

In June, the administration announced the European Recovery Plan or "Marshall Plan," an aid package of unprecedented proportions designed to help reconstruct European industrial capitalism as well as to correct a huge U.S. export surplus, to create a common market within Europe, and to integrate Germany into the European economy. That same year the term "Cold War" came into common use to describe the overt, but militarily restrained, conflict between East and West. East-West relations remained essentially frozen for the next six years -- and the Truman Doctrine of "containment" became the essential U.S. policy toward communism for more than four decades.

Containment, with its image of an enclosed space surrounded and sealed by American power, was the central metaphor of closed-world discourse. Though multifaceted and frequently paradoxical, the many articulations of this metaphor usually involved (a) globalism, (b) a many-dimensional program with ideological,

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[8] H. Bruce Franklin, *War Stars: The Superweapon and the American Imagination* (New York: Oxford University Press, 1988), 7.

[9] This was Senator Arthur Vandenberg's advice to Truman for how to push a costly foreign aid bill through the Republican-controlled Congress.

political, religious, and economic dimensions, and (c) far-reaching military commitments that entailed equally far-reaching domestic policies. The rhetoric of American moral leadership that underlay the idea of containment can be traced back to the colonial vision of a City on a Hill, while the idea of an American sphere of influence dates to the Monroe Doctrine.[10] Closed-world political discourse differed from its predecessors, however, in its genuinely global character, in the systematic, deliberate restructuring of *American* civil society that it entailed, and in its focus on the development of technological means to project military force across the globe.

The language of global closure emerged early in the Truman administration as a reflection of perceived Soviet globalist intentions. Truman's young special counsel Clark Clifford, in an influential secret 1946 report, wrote that the Soviets saw conflict with the West as inevitable and sought "wherever possible to weaken the military position and influence of the United States abroad." "A direct threat to American security," Clifford concluded, "is implicit in Soviet foreign policy."[11] With the Monroe Doctrine in the background, American policy soon progressed to a globalism of its own.

Then Undersecretary of State Dean Acheson was one of the principal architects of containment. In pushing the aid package for Greece and Turkey that became the occasion for the Truman Doctrine, Acheson used the analogy of "rotten apples in a barrel" whose "infection" would spread throughout the world if unchecked. The ambiguity of Acheson's container metaphor is instructive. Was the United States the lone active agent in the scene, reaching in from outside the barrel to remove the bad apple? Or was the United States inside the barrel as well, one of the apples to whom "infection" might spread if nothing were done? Such ambiguities ruled the political culture of the Cold War era. That culture saw communism both as an external enemy to be contained or destroyed by overt economic manipulation, covert political intervention, and military force, and as an internal danger to be contained by government and civil surveillance, infiltration, public denunciation, and blacklisting.

The military dimension of closed-world discourse followed from the United States' role as the new hegemonic power within what historians such as Fernand Braudel and Immanuel Wallerstein have called the "capitalist world-system."[12] World-systems theory holds that the intrinsic logic of capitalism drives it to seek international economic integration: the elimination of trade barriers of all sorts (economic, political, social, and military) to foster free-market exchange. Capitalism, as a purely economic force, knows no geography. (Nation-states, on the other hand,

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[10] See Loren Baritz, *Backfire* (New York: Ballantine, 1985), Chapter 1.

[11] The Clifford Report, reprinted in Arthur Krock, *Memoirs: 60 Years on the Firing Line* (New York: Funk & Wagnall's, 1968), 422–482.

[12] Major works of these historians include Fernand Braudel, *Civilization and Capitalism, Fifteenth to Eighteenth Centuries,* trans. Sian Reynolds (New York: Harper & Row, 1981–84); Immanuel Wallerstein, *The Modern World-System* (New York: Academic Press, 1974); Wallerstein, *The Politics of the World-Economy* (New York: Cambridge University Press, 1984).

tend to pursue policies of economic autarky, seeking to maximize their own well-being within a geographical territory or trading bloc by establishing a balance of power.) Those politico-economic units that succeed in remaining outside the capitalist world-system are either part of the "external world" (self-sufficient empires), or are unconnected to large-scale economic systems (subsistence communities). According to this theory, when a single hegemonic power emerges within the world-system, its structural position leads it to attempt to force other nations to abandon autarky in favor of free trade and free capital flows.[13]

The United States, as the only combatant nation to emerge unscathed from World War II, became the hegemon of the postwar period. The USSR became the predominant organizing force of the "external world" outside capitalist markets. Thus the world-system formed one kind of closed world, while the Soviet Union and its satellites formed another. The Cold War struggle occurred at the margins of the two, and that struggle constituted the third closed world: the system formed from the always interlocking traffic of their actions.

Both the military and the economic logic of containment had an ambiguous character. American goals were simultaneously

- to enclose the Soviet Union (seeing it as a closed society, an empire),
- to enclose the capitalist nations (seeing capitalism as a closed system, shielding it from the supposedly penetrating force of communist politico-economic doctrines), and ultimately
- to extend the capitalist world-system to enclose the entire world by penetrating and exploding the closed Soviet sphere.

In an ideologically laden metaphor, this last goal was normally spoken of as "opening up" the world to the free market.

So the world of the Truman Doctrine and McCarthyism was closed in a triple sense. On one reading the closed world was the repressive, secretive communist society, surrounded by (contained within) the open space of capitalism and democracy. This was the direct intent of the containment metaphor. But on another reading, the closed world was the capitalist world-system, threatened with invasion. It required defenses, a kind of *self*-containment, to maintain its integrity. In the third and largest sense, the global stage as a whole was a closed world, within which the struggle between freedom and slavery, light and darkness, good and evil was being constantly joined in every location -- within the American government, its society, and its armed forces as well as abroad. Each side of the struggle had, in effect, a national headquarters, but the struggle as a whole went on everywhere and perpetually.

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[13] Thomas J. McCormick, *America's Half-Century: United States Foreign Policy in the Cold War* (Baltimore: Johns Hopkins University Press, 1989), 5.

Under the Truman Doctrine and the Marshall Plan, the world had become a system to be both protected and manipulated by the United States. Within the quasi-religious American mythos, no ideological space remained for other conflicts. Truman's construction of the bilateral world in his 1947 speech presented Congress with a simple binary decision: democracy or Stalinist communism, freedom or slavery, good or evil.[14] Bilateralism created a systematic vision of the world by making all third-world conflicts parts of a coherent whole, surrogates for the real life-or-death struggle between the Free World and its communist enemies.

The Truman administration gradually articulated a "defensive perimeter" that ran southward along the Iron Curtain, then eastward across Greece, Turkey, Israel, and Iran to southern Asia. From America's Pacific coast the line stretched along the Aleutian chain to Japan, Taiwan, South Korea, the Philippines, and Vietnam. This "perimeter" essentially enclosed the Soviet Union within a circle of forward air bases and politico-military alliances. By 1950, with the U.S. entry into the Korean War, the administration had defined American interests in totally global terms. In a memo to Congress defending the President's right to commit troops on his own authority, Acheson argued that "the basic interest of the United States is international peace and security. The United States has, throughout its history, . . . acted to prevent violent and unlawful acts in other states from depriving the United States and its nationals of the benefits of such peace and security." The North Korean invasion of South Korea constituted exactly such a disruption. Summing the terms of his equation, Acheson concluded that the North Korean action represented a "threat to the peace and security of the United States and to the security of United States forces in the Pacific."[15]

Under such a definition of national security, the U.S. umbrella covered the globe. When the incorrigible General Douglas MacArthur wanted to roll back the Chinese as well as the North Koreans, Truman was forced to relieve him of the Korean command. But in the ensuing Senate investigation, MacArthur became a national hero for declaring the struggle against communism a "global proposition." "You can't let one-half of the world slide into slavery and just confine yourself to defending the other," the general told the senators. "What I advocate is that *we defend every place,* and I say we have the capacity to do it. If you say we haven't, you admit defeat."[16]

Truman repudiated MacArthur, exposing the difference between the rhetoric of Cold War and the limits of political will. But MacArthur's strong words merely

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[14] See Walter LaFeber, *The American Age: United States Foreign Policy at Home and Abroad Since 1750* (New York: W.W. Norton, 1989), 454 and passim.

[15] Dean Acheson, "Authority of the President to Repel the Attack in Korea," *Department of State Bulletin* (July 31, 1950), 173–178.

[16] General Douglas MacArthur, *Hearings Before the Committee on Armed Services and the Committee on Foreign Relations of the United States Senate, 82nd Congress, 1st session* to "Conduct an Inquiry into the Military Situation in the Far East and the Facts Surrounding the Relief of General of the Army Douglas MacArthur from his Assignments in the Area" (1951), 68, 81–83. Italics added.

carried Acheson's doctrine to its logical conclusion. Acheson, in the MacArthur hearings, explained that Korea itself mattered very little. Rather, American security now depended not only upon strategic might but also upon ideological power. To demonstrate the free world's strength, the United States must now actively repel communist aggression anywhere in the world.[17] But John Foster Dulles, Eisenhower's secretary of state, would prefer MacArthur's language to Acheson's: "a policy which aims only at containing Russia is, in itself, an unsound policy. . . . It is only by keeping alive the hope of liberation, by taking advantage of whatever opportunity arises, that we will end this terrible peril which dominates the world."[18] Dulles threatened "massive retaliation" -- implying nuclear force -- in response to communist aggression anywhere in the world.

National Security Council Resolution 68 (NSC-68), probably the most important document of the Cold War, was also the most forthright expression of what James Chace and Caleb Carr have called the "universalization of threats to American security."[19]

> The implacable purpose of the slave state to eliminate the challenge of freedom has placed the two great powers at opposite poles. . . . The assault on free institutions is world-wide now, and in the context of the present polarization of power a defeat of free institutions anywhere is a defeat everywhere. . . . [It is no longer] an adequate objective merely to seek to check the Kremlin design, for the absence of order among nations is becoming less and less tolerable. This fact imposes on us, in our own interests, the responsibility of world leadership. . . . [T]he cold war is in fact a real war in which the survival of the free world is at stake.[20]

In these and similar words the architects of closed-world discourse articulated a new language along with their political strategy and military posture, intimately linking metaphors, beliefs, and ideologies to practices, policies, and technologies of the Cold War in the dark and all-encompassing theater of apocalypse.

Characterizing the Closed World

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[17] James Chace and Caleb Carr, *America Invulnerable: The Quest for Absolute Security from 1812 to Star Wars* (New York: Summit Books, 1988), 251–252 and passim.

[18] John Foster Dulles, *Hearings Before the Committee on Foreign Relations, United States Senate, 83rd Congress, 1st session* on "The Nomination of John Foster Dulles" (1953), 5–6.

[19] Chace and Carr, *America Invulnerable*, 248.

[20] NSC-68, as cited in Chace and Carr, *America Invulnerable*, 248.

A "closed world" is a radically bounded scene of conflict, an inescapably self-referential space where every thought, word, and action is ultimately directed back toward a central struggle. It is a world radically divided against itself. Turned inexorably inward, without frontiers or escape, a closed world threatens to annihilate itself, to implode.[21]

The term descends from the literary criticism of Sherman Hawkins, who uses it to define one of the major dramatic spaces in Shakespearean plays. Closed-world plays are marked by a unity of place, such as a walled city or the interior of a castle or house. Action within this space centers around attempts to invade and / or escape its boundaries. Its archetype is the siege, with the *Iliad* as originary model; war, either literal or figurative, is its driving force. Notably, the closed world includes not just the sealed, claustrophobic spaces metaphorically marking its closure, but the entire surrounding field in which the drama takes place. The dividing conflict which drives social action in the closed world finds parallels in the inward psychological division of characters, such as Hamlet, torn between the power and the impotence of rationality and between the necessity and the choking restriction of social convention. In tragedy this leads to self-destruction (e.g., Hamlet or Romeo) and in comedy to exorcism of these forces (e.g., the punishment of Malvolio).[22]

The alternative to the closed world is not an open world but what Northrop Frye called the "green world."[23] The green world is an unbounded natural setting such as a forest, meadow, or glade. Action moves in an uninhibited flow between natural, urban, and other locations and centers around magical, natural forces -- mystical powers, animals, or natural cataclysms (e.g., *A Midsummer Night's Dream*). Green-world drama thematizes the restoration of community and cosmic order through the transcendence of rationality, authority, convention, and technology. Its archetypal form is the quest, in which characters struggle to integrate (rather than overcome) the world's complexity and multiplicity. The green world is indeed an "open" space where the limits of law and rationality are surpassed, but that does not mean that it has anarchic. Rather, the opposition is between a human-centered, inner, psychological logic and a magical, natural, transcendent one.[24]

The "closed world" of this book is political and ideological rather than literary. But since historiography always involves a dramatic reconstitution of a disorderly past, it has much in common with its literary cousins.[25] Postwar

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[21] Sherman Hawkins, personal communication.

[22] Sherman Hawkins, "The Two Worlds of Shakespearean Comedy," in J. Leeds Barroll, ed., *Shakespeare Studies,* Vol. III (Cincinnati: The Center for Shakespeare Studies, 1968), 62–80.

[23] See Northrop Frye, *The Anatomy of Criticism* (Princeton, NJ: Princeton University Press, 1957), pp. 182ff; Frye, *A Natural Perspective: The Development of Shakespearean Comedy and Romance* (New York: Columbia University Press, 1965).

[24] We will return to this opposition in chapter 10. However, since I want to focus on the *structure* of the very particular closed world of the Cold War, the closed world / green world contrast will not play a central role in this book.

[25] See Hayden White, *Metahistory* (Baltimore: Johns Hopkins University Press, 1973).

American politics, as well as those of divided Europe, were in fact dominated by the same unity of place that characterizes closed-world drama. The stage was the globe as a whole, truly a world divided against itself as never before. The action was one of attempts to contain, invade, or explode a closed communist world symbolized by phrases like "the Iron Curtain" and physically instantiated by the Berlin Wall. At the same time the globe itself was seen as a closed whole, a single scene in which the capitalist/communist struggle was the only activity and from which the only escape was the technological utopia of space travel. The United States reconceived itself -- building upon the political heritage of Manifest Destiny and the religious iconography of the City on a Hill[26] -- as the manager, either directly or by proxy, of the entire global political, economic, and military scene.

In the closed world of the Cold War, all military conflict took place beneath the black shadow of nuclear arms. It was war in a military world where mutual and total annihilation, even the end of all human life, was the overarching possibility within which all other conflicts were articulated. Paradoxically, ultimate weapons also produced ultimate limits to military power. After 1949, nuclear weapons could deliver only the hollowest and most Pyrrhic of "victories." Against the contradictions and the terror of nuclear arms, war itself became as much an imaginary field as a practical reality.

Inside the closed horizon of nuclear politics, simulations became more real than the reality itself, as the nuclear standoff evolved into an entirely abstract war of position. Simulations -- computer models, war games, statistical analyses, discourses of nuclear strategy -- had, in an important sense, more political significance and more cultural impact than the weapons that could not be used. In the absence of direct experience, nuclear weapons in effect forced military planners to adopt simulation techniques based on assumptions, calculations, and hypothetical "rules of engagement." The object for each nuclear power was to maintain a winning *scenario* -- a theatrical or simulated win, a psychological and political effect -- rather than actually to fight such a war. *Actual* outcomes no longer mattered, since the consequences had become too enormous to be comprehended and too dangerous to be tested. The world of nuclear arms became by its very grossness and scale a closed world, a lens through which every other political struggle must be seen. For those who contemplated its strategy, nuclear war could only be understood as a many-leveled game.

The Cold War's portent as an economic and material fact could not be grasped apart from its metaphorical and cultural dimensions. Weapons of war were also understood to be focal elements of the economy, of national politics, and of scientific research. Computers were a primary example of this inseparability of weapon from tool, tool from metaphor, and metaphor from political action. They were a key factor in the massive increases in the speed and scale of warfare through their implementations in systems designed for air defense, military command-and-

[26] See Baritz, *Backfire*.

control, data analysis, and satellite surveillance and, from the early 1960s, as components of self-guided and "smart" weapons such as guided missiles, cruise missiles, and advanced jet aircraft. But computers were also of immense symbolic and practical importance in the ideological worlds of the Cold War and the Vietnam War, for which they represented a potential for total oversight, exacting standards of control, and technical-rational solutions to a myriad of complex problems.

"Closed-world discourse" thus names a language, a worldview, and a set of practices characterized in a general way by the following features and elements.

- *Techniques* drawn from engineering and mathematics for modeling aspects of the world as closed systems.
- *Technologies,* especially the computer, that make systems analysis and central control practical on a very large scale.
- *Practices of mathematical and computer simulation* of systems, such as manufacturing processes and nuclear strategy, in business, government, and the military.
- *Experiences* of grand-scale politics as rule-governed and manipulable, for example by means of the power of nuclear weapons or of Keynesian economic intervention.
- *Fictions, fantasies, and ideologies*, including such visions as global mastery through air power and nuclear weapons, global danger from an expansionist "evil empire," and centralized, instantaneous, automated command and control.
- A *language* of systems, gaming, and abstract communication and information that relied on formalisms to the detriment of experiential and situated knowledge. This language involved a number of key *metaphors*, for example that war is a game and that command is control.

In the last part of this chapter we will examine in detail the concept of discourse, which links these heterogeneous elements. Then, in chapters 2-4 (and again in chapter 9), we will explore how computers were pressed into service as material and metaphorical supports for closed-world discourse, and thus for America's role in post–World War II geopolitics. First, however, let us scan another scene from the closed world: the roots of cyborg discourse in Alan Turing's universal machines.

Scene 2: Turing's Machines

In 1950 Alan Turing, the British mathematician who invented the theory of universal digital computation, devised an "imitation game" in which a computer is programmed to simulate human thought processes. A person attempts to discern the difference between the computer and a "real" person by interrogating them both through a terminal. This game became known as the Turing test for machine intelligence. The questions of whether it is the right test, whether a computer will ever pass it, and exactly what it would mean for one to do so have served as the foci of long and intense debates in artificial intelligence and philosophy of mind.[27]

The possibility that machines could carry out mental operations had occurred to Turing from the moment of his first major mathematical discovery, in 1935–36 (published as "On Computable Numbers, with an application to the *Entscheidungsproblem*" in 1937), if not before. Turing had considered the relationship between the infinite set of "configurations" of a simple imaginary computing machine -- known today as the "universal Turing machine," of which all possible digital computers are more or less incomplete instances -- and the mental states of human beings. A human "computer" performing the operations of a Turing machine by hand would necessarily, on Turing's view, proceed through a sequence of discrete mental states directly analogous to the states of the machine. "The operation actually performed is determined . . . by the state of mind of the [human] computer and the observed symbols. In particular, they determine the state of mind of the computer after the operation is carried out. . . . We may now construct a machine to do the work of this computer."[28]

Elsewhere in his 1937 paper Turing made clear that the essential move in this analogy was to reduce each "state of mind" of the (human) computer to a single unit. This could be done by translating any complex operation into a series of definite steps. This, of course, is the basic principle of operation of the digital computer. Any mechanical computer would necessarily perform each step in the course of performing the operation; ergo, the steps would functionally define discrete mental states. The mechanical computer might then be said to have a kind of mind, or alternatively, the human computer could be defined as a machine. In 1937 Turing left this point hanging. His central, and successful, aim was to construct

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[27] Alan Turing, "Computing Machinery and Intelligence," *Mind*, Vol. 59 (1950), 433–460. For a recent version of this debate, see Paul M. Churchland and Patricia Smith Churchland, "Could a Machine Think?," *Scientific American*, Vol. 256, No. 1 (1990), 32–37, and John R. Searle, "Is the Brain's Mind a Computer Program?," *Scientific American*, Vol. 256, No. 1 (1990), 26–31.

[28] Alan Turing, "On Computable Numbers, with an application to the *Entscheidungsproblem*," *Proceedings of the London Mathematical Society*, Vol. 42 (1937), 251.

a mathematical proof that almost *any* problem that could be precisely formulated could be solved by a sufficiently powerful Turing machine.[29]

A less grand objective, namely automatic calculation, led George Stibitz of Bell Laboratories, Howard Aiken of Harvard University, John Atanasoff of Iowa State University, and others to start developing prototypes of electronic and electro-mechanical automatic digital calculators independently in the late 1930s. Their work, however, was generally ignored, like Charles Babbage's prescient nineteenth-century design for an Analytical Engine, an enormous symbol-manipulating machine with many of the features essential to a true digital computer, including a memory, programmability, conditional loop capability, and a central processing unit.[30] It was not until the war, with its urgent demands for advanced technology, that the Turing machine's revolutionary implications were carried into practice.

In 1939 Turing began working with a team of scientists at the Government Code and Cypher School (GCCS) in Bletchley Park, near London. Early in the war, British intelligence had received working copies of sophisticated German cipher machines called "Enigma" and "Fish" used to encode secret messages. The machines themselves were only part of the cryptological problem, however, since their codes required keys that were frequently changed. Manual methods could not uncover the keys fast enough to make intercepted messages useful. Turing's group at Bletchley Park was charged with developing computational devices to automate and speed up the decrypting process. One of these machines, the 1943 "Colossus," was a true electronic digital computer. One version had 2400 vacuum tubes, was programmable (though it could not store programs internally, the critical advance that created modern computers), and was in some ways more advanced than the far larger American ENIAC. Because the Colossus remained a military secret after the war, the ENIAC has often mistakenly been designated the first electronic digital computer, even though it was not fully operational until 1946 and even though the ENIAC research team was aware, at least in general terms, of Turing's wartime work.[31]

The Colossus and other devices Turing helped invent successfully decoded many thousands of German command messages. German confidence in the Enigma and British secrecy about Turing's "Ultra" project were so high that the Germans

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[29] Ibid. The requirement of "sufficient power" refers essentially to the size of the computer's memory. It should be noted that this is only a principle or potential, since solving many problems would require time and computer memory on a scale completely beyond practical possibility. Interestingly, while Turing is often remembered for the problems his machine *can* solve, the mathematically significant point of his paper consists in a proof that there exist some mathematical problems that cannot even in principle be formulated as algorithms (fixed procedures) and therefore *cannot* be solved by a Turing machine.

[30] Similarly, the first general-purpose, program-controlled digital calculator was constructed by Konrad Zuse in Germany in 1941 and used by the German war industry. Though they were discovered by the Allies after the war, Zuse's machines were never followed up and had little influence on the main stream of computer development.

[31] Among others, Herman Goldstine, one of the ENIAC's designers, makes this claim.

never traced the source of their security leaks to the Allies' code-breaking activities. Without this intelligence, Allied forces might have suffered even greater defeats in the first years of the war. The protection of trans-Atlantic shipping from the dreaded U-boats, for example, relied heavily on the work of Turing's decryption group. Churchill placed the GCCS work among his top priorities and personally ordered that the group's requests for personnel and equipment be instantly and fully satisfied.[32] "I won't say that what Turing did made us win the war, but I daresay we might have lost it without him," Turing's wartime statistical clerk I. J. Good said afterwards.[33]

By 1950 Turing had worked for a decade at designing, building, and operating digital computers. As his research progressed, Turing elaborated his belief in the possibility of machine intelligence. In a famous prediction, he wrote that within fifty years it would be possible "to program computers . . . to play the imitation game so well that an average interrogator will not have more than 70 percent chance of making the right identification after five minutes of questioning." In 1991, forty-one years after Turing's prediction, computers fooled five of ten judges in a limited version of the Turing test restricted to a single area of knowledge such as wine-tasting or romantic love.[34]

But another of Turing's 1950 predictions has received far less attention, though it was in many ways more important and more profound. He wrote:

> The original question, 'Can machines think?' I believe to be too meaningless to deserve discussion. Nevertheless I believe that 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.[35]

This prediction -- not those that herald the actual existence of thinking machines -- is the second major theme of this book. For Turing was clearly right on this score, and far sooner than he thought. Even in his own day computers we would now think of as almost pathetically primitive were known in the popular press as "giant brains."[36] By the late 1980s phrases like "expert systems," "artificial intelligence," and "smart" and even "brilliant weapons" were part of the everyday

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[32] See Andrew Hodges, *Alan Turing: The Enigma* (New York: Simon and Schuster, 1983), Chapters 4 and 5.

[33] I. J. Good, interviewed in Pamela McCorduck, *Machines Who Think* (New York: W. H. Freeman, 1979), 53.

[34] John Markoff, "Can Machines Think? Humans Match Wits," *New York Times* (November 9, 1991), 1, 10.

[35] Turing, "Computing Machinery and Intelligence," 442.

[36] The ubiquity of phrases such as "electronic brain" and "giant brain" in 1950s press accounts of computing must be experienced to be fully appreciated.

vernacular of the business and defense communities and the popular press. Prominent philosophers argued for the naturalness of the "intentional stance" (the attribution of purposes, goals, and reasoning processes) in describing some of the actions of computers.[37] Within certain subcultures, such as computer hackers and child programmers, highly articulated descriptions of the computer as a self with thoughts, desires, and goals, and of the human self as a kind of computer or program, were commonplace.[38]

Cyborgs

In tandem with closed-world politics, new conceptions of psychological processes -- "cognitive" psychology and artificial intelligence -- began their rise to scientific ascendancy during the Cold War. Wartime work on integrating humans into combat machines helped produce "cybernetic" theories of information and communication that applied equally to the machines and their human components. New theories of brain function were tightly linked with concepts of digital logic stemming from Turing's ideas. By 1956 the concept of "artificial intelligence" had been invented and laboratory research on computerized minds begun.

In psychology the new view, then still unnamed, opposed behaviorism's emphasis on external observables and simple conditioning with complex internal-process models based on metaphors of computers and information processing. It reached maturity in the middle 1960s with the publication of Ulric Neisser's *Cognitive Psychology*.[39] By the late 1970s cognitive psychology had been integrated with artificial intelligence, linguistics, and neuropsychology to form a new interdiscipline known as "cognitive science." Successful inheritor of the failed ambitions of cybernetics, cognitive science views problems of thinking, reasoning, and perception as general issues of symbolic processing, transcending distinctions between humans and computers, humans and animals, and living and nonliving systems.

This new and powerful conception of psychology evolved in a reciprocal relationship with a changing culture of subjectivity for which computers became, in Sherry Turkle's words, a "second self." As she has shown, the analogy between computers and minds can simultaneously decenter, fragment, and reunify the self by reformulating self-understanding around concepts of information processing and

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[37] Daniel C. Dennett, *Brainstorms: Philosophical Essays on Mind and Psychology* (Montgomery VT: Bradford Books, 1978); John Haugeland, *Artificial Intelligence: The Very Idea* (Cambridge, MA: MIT Press, 1985).

[38] Sherry Turkle, *The Second Self: Computers and the Human Spirit* (New York: Simon and Schuster, 1984).

[39] Ulric Neisser, *Cognitive Psychology* (New York: Appleton-Century-Crofts, 1967).

modular mental programs, or by constituting an ideal form for thinking toward which people should strive. Interactive relationships with information machines provided an experiential grounding for this reconstituted self and its values. At the same time they helped establish the sense of a vast and complex world inside the machine. Mid-1980s cyberpunk science fiction named the world within the computer "cyberspace."[40] With the emergence of global computer networks and "virtual reality" technologies for creating and inhabiting elaborate simulated spaces, in the 1980s cyberspace became a reality. It held, and holds, an irresistible attraction for many of the millions who spend much of their daily lives "logged in."[41]

World War II–era weapons systems in which humans served as fully integrated technological components were a major source of the ideas and equipment from which cognitivism and AI arose. These were the first exemplars of a new type of device able to mediate or augment human sensory or communications processes and perform some decision or calculation functions on their own, almost always with electronics and computers. American military forces began to integrate their human and technological components on a gigantic scale through their C3I (command, control, communications, and intelligence) systems. The smooth functioning of such machines, their tightly constrained time scales, and the requirement of continuous, 24-hour preparedness demanded that all components react predictably, that they follow orders and transmit information exactly as specified. In such highly integrated systems, the limited, slow, error-prone characteristics of human perception and decision-making had to be taken into account. This required a theory of human psychology commensurable with the theory of machines.

Contemporary high-technology armed forces employ a second generation of computerized weapon systems that take computer-assisted control to its logical conclusion in fully automatic and, potentially, autonomous weapons. Automatic weapons are self-controlled devices that use internal sensory capacities to track their targets, usually under microprocessor or other computer control. Examples include cruise missiles, torpedoes, and "killer satellites." Autonomous weapons, by contrast, would be self-controlled not only in tracking targets but in identifying them and making the decision to attack. These would include any launch-on-warning nuclear defense system, the autonomous tanks funded by the Defense Advanced Research Projects Agency's 1983 Strategic Computing Initiative, and the space-based nuclear defense system envisioned by the Strategic Defense Initiative.

The word I will use to describe these and similar technologies, ranging from artificially augmented human bodies and human-machine systems to artificial intelligences, both real and hypothetical, is "cyborg." Cyborg figures -- blends of

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[40] The term "cyberspace" was coined by William Gibson in his novel *Neuromancer* (New York: Ace Books, 1984).

[41] See Michael Benedikt, ed., *Cyberspace: First Steps* (Cambridge, MA: MIT Press, 1991); Michael L. Dertouzos et al., "Communications, Computers, and Networks: How to Work, Play and Thrive in Cyberspace," *Scientific American*, Vol. 265, No. 3 (1991), special issue.

organism and machine -- pervade modern culture, from the person with a pacemaker or artificial hip to AI-controlled automated factories to fictional robots and androids. Though multiply determined, these figures received their first and fullest articulation on the high-technology battlefield.

Turing thus predicted the emergence of a language of intelligent machines that I will call "cyborg discourse." This discourse is primarily concerned with the psychological and cultural changes in self-imagining brought on by the computer metaphor. Typically, cyborg discourse focuses on the psychological, metaphorical, and philosophical aspects of computer use, rather than on their political, social, and material dimension. It is both an account and an expression of the view that the computer is an "object to think with," in Turkle's phrase. Research in artificial intelligence, parallel distributed processing, cognitive psychology, and philosophy of mind forms a part of this discourse. So do social phenomena such as hacker communities and cultural expressions such as cyberpunk science fiction. While closed-world discourse is built around the computer's capacities as a tool of analysis and control, cyborg discourse focuses on the computer's mind-like character, its generation of self-understanding through metaphor.

Cyborg discourse is the field of techniques, language, and practice in which minds are constructed as natural-technical objects (in Donna Haraway's phrase) through the metaphor of computing.[42] It includes the following elements.

- *Techniques* of automation and integration of humans into mechanical and electronic systems, especially computerized systems.
- The computer as a *technology* with linguistic, interactive, and heuristic problem-solving capacities.
- *Practices* of computer use. Cyborg discourse became increasingly prominent as computers spread out of scientific and military centers into business, industry, and, in the 1980s, the home.
- *Experiences* of intimacy with computers and of connection to other people through computers, particularly in coherent communities focused on computers, such as hackers. Turkle's phrase "second self" captures the subjective depth of such experiences.
- *Fictions* and *fantasies* about cyborgs, robots, and intelligent machines, increasingly prominent in science fiction and popular culture. Scientific theories of artificial intelligence and cognitive psychology also formed cores

[42] Donna J. Haraway, "The High Cost of Information in Post–World War II Evolutionary Biology," *Philosophical Forum*, Vol. XIII (1981–82), 244–278.

for *ideologies* of human minds as manipulable machines, projecting their future integration with computers.

- *Languages* of formal representation of thought processes, such as computer languages, formal semantics, and theories of human information processing.

- *Metaphors* building on the computer's formal and mechanical features: the brain as a set of digital switches, the mind as a set of programs.

Like closed-world discourse, cyborg discourse as an analytical construct offers a vantage point that cuts across the divisions between the intellectual history of cognitive science and the engineering-economic history of computers. Cyborg discourse is also political, though the politics in question are more often socio-cultural than governmental.

The nature of this political structure is revealed most tellingly when the two discourses are articulated simultaneously. This happens almost anywhere that artificial intelligence experts, Defense Department planners, or communities of computer users discuss their visions of the future. But it occurs most explicitly and directly in near-future science-fiction novels and films.

Scene 3: Cyborgs in the Closed World

The closed world of computer-controlled global hegemony and the image of the computer as a cyborg, a mind-like artifact, come together powerfully in *The Terminator* (1984), a relatively low-budget science-fiction / horror film directed and co-written by James Cameron.

The Terminator opens in Los Angeles in the year 2029 A.D. amidst the rubble and smoke of a nightmarish post-holocaust world. We later learn that an all-out nuclear exchange has been initiated by the "Skynet computer built for SAC-NORAD by Cyberdyne Systems. New, powerful, hooked into everything, trusted to run it all. They say it got smart. A new order of intelligence. Then it saw all people as a threat, not just the ones on the other side. It decided our fate in a microsecond: extermination." The few remaining human beings eke out a miserable existence in grimy underground bunkers, crawling out at night to do battle with the robot killing machines that are now the masters of the planet. Their one major asset in this battle is a savvy leader who seems to have special insight into the enemy, a man named John Connor.

To finish off the human resistance, the machines send a cyborg (a combination of machine and organism) back in time to the pre-holocaust present (not insignificantly, 1984). The Terminator's mission is to find and kill Sarah Connor, mother-to-be of John Connor. But the resistance learns of this gambit and is also able to send a soldier, Kyle Reese, back in time to warn and protect Ms. Connor.

The relevant Sarah Connor turns out to be the third person of the same name listed in the Los Angeles telephone directory. While the Terminator mechanically seeks out and murders the first two, Reese has a chance to find the real target and starts following her. When the cyborg attacks, he blasts it repeatedly with a shotgun at close range, but this only stops it for the few seconds Reese and Connor need to escape.

The basic structure of the plot from this point on is standard horror-movie fare about a helpless woman pursued by an unstoppable monster / man and rescued by a (male) good guy in an ever-escalating orgy of violence. After many narrow escapes and Kyle's eventual death, Sarah finally destroys the Terminator (now reduced to a robotic skeleton) by crushing it in a metal press inside a deserted automated factory.

Arnold Schwarzenegger plays the Terminator with a terrifying mechanical grace. Completely devoid of emotion, within seconds of his appearance on the screen he kills two young men just to take their clothes. His mechanical nature is repeatedly emphasized through a number of devices. He has a seemingly symbiotic relationship with all kinds of machines: for example, he starts cars by merely sticking his fingers into the wiring. When shot, he sometimes falls, but immediately stands up again and keeps on lumbering forward. We see him dissect his own wounded arm and eye with an X-Acto knife, revealing the electro-mechanical substrate beneath his human skin. Perhaps most frightening of all, he is able to perfectly mimic any human voice, enabling him to impersonate a police officer and even Sarah's own mother.

What makes the Terminator so alien is not only his mechanical body but his computerized, programmed mind. At times we see the world through his eyes: the picture becomes graphic and filtered, like a bit-mapped image viewed through infrared goggles. Displays of numbers, flashing diagrams, and command menus appear superimposed on his field of vision. The Terminator speaks and understands human language, and his reasoning abilities, especially with respect to other machines (and weapons), are clearly formidable. But he is also a totally single-minded, mechanical being. Kyle warns Sarah that the Terminator "can't be bargained with. It can't be reasoned with. It doesn't feel pity, or remorse, or fear. And it absolutely will not stop -- *ever* -- until you are dead." The Terminator thus blends images of a perverse, exaggerated masculine ideal -- the ultimate unblinking soldier, the body-builder who treats his body as a machine -- with images of computer control and robotic single-mindedness, complete with an alien subjective reality provided by the Terminator's-eye sequences.

The film is built around the idea of a final, apocalyptic struggle to save humanity from its own creations, first from computer-initiated nuclear holocaust and second from the threat of self-aware, autonomous machines grown beyond the limits of human control. But a strong subtheme provides an unusual and very contemporary twist. Sarah Connor begins the film as a waitress whose major problem in life seems to be trying to get a Friday night date. Resentfully, sometimes angrily ("Come on. Do I look like the mother of the future? I mean, am I tough? Organized? I can't even balance my checkbook"), under the relentless pressure of the Terminator's pursuit, she is educated about the threats the future holds and her role as progenitor of the future savior. She learns to make plastic explosive, bandages Kyle's gunshot wound, and listens carefully as he instructs her in the importance of resistance, strength, and fighting spirit. She proves how far she has come in the film's final moments, when the wounded Reese flags as the cyborg approaches. Sarah, hardened and strong, drags him from the Terminator's path, shouting "*On your feet*, soldier!" in a voice that rings with determination. She, not Kyle, is the one who finally destroys the Terminator, in one of the film's most powerful moments. In the end she is transformed into a tough, purposeful mother-to-be, pregnant by Kyle, packing a gun, driving a jeep, and heading off into the sunset and the oncoming storm as heroically as any cowboy of yore.

The Terminator thus offers a new kind of heroine: a single mother who will be both source and model for a race of soldiers fighting for humanity against machines. When Sarah asks Kyle what the women of the future are like, he replies tersely, "Good fighters," and in a dream-memory we see him and a female partner on a combat mission against the machines. In this portrait women take up arms and emerge as men's allies and equals in an increasingly dangerous, alien, and militarized world. The sub-plot of *The Terminator* is about arming women for a new role as soldiers, outside the more traditional contexts of marriage and male protectorship. The message is also that women are the final defense against the apotheosis of high-technology, militaristic masculinity represented by the Terminator -- not only because they harbor connections to emotion and love, as in more traditional imagery, but because they are a source of strength, toughness, and endurance: "good soldiers."

The social reality of 1984 held extraordinary resonances with *The Terminator*'s themes. Public anxiety about nuclear weapons, revelations of epidemic computer failures in NORAD early warning systems, and the Strategic Defense Initiative created a highly charged context for the theme of computer-initiated nuclear holocaust. News stories about "survivalist" movements abounded. Meanwhile a rising tide of robot-based automation in industry, a new wave of computerization in workplaces based on new personal-computer technology, and the Strategic Computing Initiative's controversial proposals for autonomous weapons matched the film's theme of domination by intelligent machines. (Indeed, one of the film's more effective devices is the constant visual reference to the ubiquity of machines and computers: robots, cars, toy trucks, televisions, telephones, answering machines, Walkmans, personal computers.)

With respect to gender issues, the film took its cue from two social developments. First, the highest rates of divorce and single motherhood in history grounded the film's elevation of a single woman to heroine status. Second, starting in the mid-1970s women had become increasingly important as soldiers. Indeed, women filled 10 to 13 percent of all U.S. military jobs by 1985, and there were serious proposals to increase the ratio to 50 percent in the Air Force (sheer physical strength is not a factor in high-tech jobs like flying jet fighters, and it even seems that women are able to handle higher G-stresses better than men and thus to stay conscious longer during power turns). So it was not much of a stretch for the film to find a model for women of the future in the armed forces.

The iconography of closed-world discourse is reflected in almost every element of this film. The Terminator's terrifying, mechanical single-mindedness and the references to the Skynet "defense network computers" are archetypal closed-world images. The Terminator's mind is inflexible but within its limits extremely clever; the Skynet system is "hooked into everything." The ambiance throughout *The Terminator* is that of closed-world drama. The setting is a grim, usually dark, urban landscape. Almost all of the action occurs in enclosed spaces, and much of it takes place at night. Virtually no natural objects or landscapes appear in the film. Scenes from the world of 2029 A.D. take this imagery to an extreme, with nothing remaining above ground but the rubble and twisted girders of blasted buildings and the charred remains of dead machines. Human dwellings are underground, dirty, furnished with weaponry, canned goods, and the burned-out hulks of television sets, now used as fireplaces. Only two scenes occur in a natural setting: the few hours Sarah and Kyle spend resting in a wooded area (though even here they hide in a semi-enclosed space under a bridge), and the final scene in which Sarah drives off toward the mountains of Mexico in a jeep. Thus, in a pattern we will see repeatedly in closed-world discourse, the green world is the final refuge -- when there is one -- from apocalypse.

Cyborg imagery is also prominent in the film. The Terminator is a liminal figure: a computerized machine that can pass as a man; a living organism whose core is a metallic, manufactured robot; a thinking, reasoning entity with only one purpose.[43] He seems to be alive, but he cannot be killed. He talks, but has no feelings. He can be wounded, but feels no pain. In a flashback (to the future), we learn that the Terminators were created to infiltrate the bunkers of the resistance. Dogs, however, can sense them. Dogs, of course, are marginal figures of another sort, connecting humans with the animal, the natural, and the wild, with the green world.

The Terminator is a military unit, like Kyle Reese, but he is a caricature of the military ideal. He follows his built-in orders unquestioningly, perfectly, and he has no other reason for living. But Kyle, too, has an intense single-mindedness about

[43] See Turkle on computers and "computational objects" as marginal objects in psychological discourse.

him, likewise born of military discipline. He dismisses his gunshot wound with a disdainful "Pain can be controlled." He speaks of an emotionless life in a future world where humans, like the machines they fight, live a permanent garrison lifestyle. The Terminator is the enemy, but he is also the self, the military killing machine that Kyle, too, has become -- and that Sarah herself must become if humanity is to survive. Humans have built subjective, intelligent military machines but are reduced to a militaristic, mechanical, emotionless subjectivity in order to fend off their own products.

The fictional world of *The Terminator* draws our attention to the historical and conceptual ways in which closed-world and cyborg discourses are linked. Just as facts -- about military computing, artificial intelligence, nuclear weapons, and powerful machines -- give credibility to fiction, so do fictions -- visions of centralized remote control, automated war, global oversight, and thinking machines -- give credibility and coherence to the disparate elements that comprise these discourses. We cannot understand their significance without understanding these linkages.

Closed-world discourse helped guide U.S. military policy into an extreme reliance on computers and other high-technology weapons.[44] It also supported many U.S. attempts to manipulate world politics. Cyborg discourse collaborated with closed-world discourse both materially, when artificial intelligence technologies and human/machine integration techniques were used for military purposes, and metaphorically, by creating an interpretation of the inner world of human psychology as a closed and technically manipulable system. Cyborg discourse is the discourse of human automata: of cybernetic organisms for whom the human/machine boundary has been erased. Closed-world discourse represents the form of politics for such beings: a politics of the theorization and control of systems.[45] Thus the third theme of this book is the interactive construction of facts and fictions through the creation of iconographies and political subject positions -- maps of meaning, possible subjectivities, narrative frames -- within the dramatic spaces of the closed world.

Tools, Metaphors, and Discourse

I will argue throughout this book that tools and metaphors are linked through discourse. But what is "discourse"? How does it work? How does it connect technology with theory, ideology, and subjectivity? Before proceeding with more historical investigations, I want to step back in order to develop some conceptual

[44] On the brittleness associated with highly computerized military forces, see Gene I. Rochlin, *The Computer Trap: Dependence and Vulnerability in an Automated Society* (Princeton, NJ: Princeton University Press, forthcoming).

[45] See Haraway, "A Manifesto for Cyborgs" and "The Promises of Monsters."

apparatus. This section explores the nature of computers, the relation between tools and metaphors, and the theory of discourse upon which this book relies. (Readers whose eyes glaze over at the word "theory" should feel free to skip this section, though you might well want to check back later.)

What Are Computers?

Computers are clearly *tools* or machines, technical levers usefully interposed between practical problems and their solutions. But two essential features distinguish computers from all other machines. These are (a) their ability to store and execute programs that carry out conditional branching (that is, programs that are controlled by their own results to an arbitrary level of complexity), and (b) their ability to manipulate any kind of symbolic information at all, including numbers, characters, and images. These features allow the same computer to "be" many different machines: a calculator, a word processor, a control system, or a communication device.

Unlike classical Aristotelian machines, computers do not perform physical work. They can only control other machines that do, such as lathes, printers, or industrial robots. To do this, they transform information -- programs, specifications, input from sensors -- into control signals. Computers have little in common with hammers, cooking utensils, power drills, and the other devices that come to mind most readily in connection with the word "tool." They resemble more closely things like rulers and blueprints, tools whose main function is to connect ideas and concepts to the material world. For the most part, computers are tools for *organizing* rather than performing work, tools for the mind. Computers are really language machines, *information machines*; they are -- to pun on modern jargon -- hyper texts: active, interactive, hyperactive, self-activating language and code.[46]

The computer's extraordinary flexibility and its special nature as an information machine make it attractive as an analogy for other complex processes less well understood. Thus the computer has also become a culturally central *metaphor* for control, for scientific analysis, and for the mind.[47] Sherry Turkle has described MIT students' use of computer jargon to talk about their human relationships: one student said she needed to "debug" herself through psychotherapy and referred to her "default solutions" for dealing with men.[48] The

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[46] See Paul N. Edwards, "Hyper Text and Hypertension: Hypertext, Post-structuralist Critical Theory, and Social Studies of Science," *Social Studies of Science*, Vol. 24, No. 2 (1994), pp. 229-78.
[47] See, for example, Fritz Machlup and Una Mansfield, eds., *The Study of Information: Interdisciplinary Messages* (New York: John Wiley, 1983), and Theodore Roszak, *The Cult of Information* (New York: Pantheon, 1986).
[48] Turkle, *The Second Self*, 16.

distinguished artificial intelligence researcher Marvin Minsky has described minds as miniature societies in which "dumb agents" analogous to small programs compete for resources, develop coalitions and enmities, and behave in sometimes unpredictable ways, in an aggregation producing intelligence as a kind of by-product.[49] Because of the computer's abilities and its complexity, this metaphorical dimension can reach beyond descriptive convenience. The computer can become a simulated world, an electronic landscape within which new experiences and relationships are possible. For heavy users, the computer can become a kind of virtual reality -- a domain of experience and a way of life.

Tools as Metaphors

What is the relation between computers as tools and computers as metaphors?

In *Computer Power and Human Reason,* MIT computer scientist Joseph Weizenbaum compares computers to clocks. Like computers, clocks are machines that do no physical work. Weizenbaum calls clocks and computers "autonomous machines," as opposed to the "prosthetic machines" that extend the human physical ability to alter or move about within the material world. An autonomous machine, "once started, runs by itself on the basis of an internalized model of some aspect of the real world." Weizenbaum points out that autonomous machines and the internalized models they embody have had profound effects on human experience. His meditation on the clock (following Mumford) is worth quoting at length:

> Where the clock was used to reckon time, man's regulation of his daily life was no longer based exclusively on, say, the sun's position over certain rocks or the crowing of a cock, but was now based on the state of an autonomously behaving model of a phenomenon of nature. The various states of this model were given names and thus reified. And the whole collection of them superimposed itself on the existing world and changed it. . . . The clock had created literally a new reality. . . . Mumford [makes] the crucial observation that the clock 'disassociated time from human events and helped create the belief in an independent world of mathematically measurable sequences: the special world of science.' The importance of that effect of the clock on man's perception of the world can hardly be exaggerated.[50]

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[49] Marvin Minsky, *The Society of Mind* (New York: Simon and Schuster, 1986).

[50] Joseph Weizenbaum, *Computer Power and Human Reason: From Judgment to Calculation* (San Francisco: W. H. Freeman, 1976), 23–25.

The clock was a machine whose primary function was metaphorical. The operation of clocks came to stand for and to structure both the physical process and the personal experience of the passage of time, drawing all aspects of time together under the aegis of a universal symbol. The name of the machine remains embedded in our contemporary concept of time, visible whenever someone responds to the question "What time is it?" with the answer "It's three o'clock." The example demonstrates the possibility of a machine's having subtle, profound, and *material* effects *solely through its function within a system of ideas.*

All tools, including clocks and computers, have both practical and metaphorical or symbolic dimensions. This is true for reasons also noted by Weizenbaum: "tools, whatever their primary practical function, are necessarily also pedagogical instruments. They are pregnant symbols in themselves. They symbolize the activities they enable, i.e., their own use. . . . A tool is also a model for its own reproduction and a script for the reenactment of the skill it symbolizes."[51] The experience of using any tool changes the user's awareness of the structure of reality and alters his or her sense of the human possibilities within it. Weizenbaum mentions the tool's effect on an individual's "imaginative reconstruction" of the world. In a technological culture, that effect extends beyond the phenomenology of individual experience to large elements of the society as a whole. In cases such as the clock or the automobile it can help create wholesale changes in culture.

Language is a prominent element in this "imaginative reconstruction." Complex tools like computers and cars evolve complex languages for talking about their functioning, their repair, and their design. Beyond the demands of practical interaction, linguistic metaphors drawn from tools and machines are extremely commonplace. One may speak of "hammering home" a point in an argument, "cutting through" bureaucratic "red tape," "measuring" one's words, having a "magnetic" personality, "steering" someone in the right direction, an argument's being "derailed" or "on track," and so on. Tools and their uses thus form an integral part of human discourse and, through discourse, not only shape material reality directly but also mold the mental models, concepts, and theories that guide that shaping.

Tools shape discourse, but discourse also shapes tools. In fact, I will argue that tools like the computer must be considered elements of discourse, along with language and social practices. Metaphors can be not merely linguistic but experiential and material as well. This is what makes metaphors such as the computer political entities.

Concepts of Discourse

[51] Ibid., 18.

But what is "discourse," and how does it integrate tools, metaphors, politics, and culture? To understand both the meaning of this term and my reasons for using it so much, it will help to consider some related concepts that I might have used in its place: *ideology*, *paradigm*, *worldview*, and *social construction*.

Raymond Williams defines ideology as "the set of ideas which arise from a given set of material interests."[52] Historically, especially in the Marxist tradition, this concept has been important in focusing attention on the relationships between the material conditions of existence (natural resources, human abilities and needs, the current state of technology, etc.) and social systems, shared beliefs, legal codes, and state structures. Analysis of ideology has concentrated on how political and social power emerges from those relationships.

Unfortunately, "ideology" also carries with it a strong secondary sense, that of "illusion, abstract and false thought." This is connected with the frequent intent of analysts who use the term to expose "the ways in which meaning (or signification) serves to sustain relations of domination."[53] This common connotation tends to identify "ideology" with those beliefs and cultural constructions that suppress dissent or revolt by obscuring the true sources of oppression and redirecting the energy of social unrest into channels controlled by a dominant class. Everyday usage often makes "ideology" a pejorative term distinguishing distorted, false, or socially retrograde ideas from true knowledge. Also, there is a long Marxist tradition that regards ideology as a pure *product* of material conditions (e.g., theories of base/superstructure relations) and the acceptance of ideological beliefs as "false consciousness."[54]

Terry Eagleton has recently attempted to rehabilitate the term by rendering it as the subset of discourse that deals with "those power struggles which are somehow central to a whole form of social life."[55] This is an important clarification and a sense I wish to carry forward into my own usage of "discourse." But my purpose is to identify not only politically central struggles but also contests *and collaborations* over issues that have more to do with knowledge and subjectivity than with state politics. Therefore I prefer to reserve the term "ideology" for its narrower sense, with its implications of distortion and false consciousness inherent in beliefs that emerge from particular material conditions. I intend "discourse," by contrast, to be both broader and more neutral with respect to the truth or falsity of belief, emphasizing the constructive and productive elements of the interaction of material conditions with knowledge, politics, and society.

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[52] Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (New York: Oxford University Press, 1976), 143–144.

[53] Terry Eagleton, citing John B. Thompson, in *Ideology: An Introduction* (New York: Verso, 1991). Eagleton's rigorous examination of the term begins with a list of no less than sixteen common definitions.

[54] Among the most sophisticated versions of this position is Gerald Cohen, *Karl Marx's Theory of History: A Defence* (Princeton: Princeton University Press, 1978).

[55] Eagleton, *Ideology*, 8.

A second alternative would be the concept of a "paradigm," as used by Thomas Kuhn and his followers. Kuhn's notion of a scientific paradigm emphasized the development of coherent structures of thought and practice centered around exemplars, or foundational experiments, and basic theoretical concepts. The exemplar(s) implicitly define a set of rules governing the choice and construction of research problems, theories, methods, and instrumentation. Once a paradigm is established, normal scientific practice consists essentially of puzzle solving, or elaborating the paradigmatic theory and working out its experimental consequences. Anomalous results, though almost always present, are simply disregarded until their weight builds to a crisis point, or until a new fundamental theory appears to challenge the established one.

At this point a revolutionary transition occurs, often quite quickly. A new foundational experiment and/or theory redefines or replaces basic terms, and the scientific community re-forms around the new paradigm. The new paradigm is said to be "incommensurable" with the old. This term, whose definition remains disputed, originally seemed to imply that a new paradigm constituted a full-blown, all-encompassing worldview that could not be understood or possibly even perceived by those whose allegiance remained with the old paradigm.[56]

Some of these ideas, too, I wish to preserve in my usage of "discourse." A paradigm has coherence; it is based in concrete practices and frequently in technologies of experimentation, and it may centrally include one or more metaphors. A paradigm, once established, falls into the background of knowledge and appears to be little more than common sense, governing the production of truth (in Michel Foucault's phrase) by constituting the obvious. The concept emphasizes the tremendous inertia acquired by established systems of thought, the embeddedness of theory in language, and the large social and cognitive costs of wholesale transitions. The idea that scientific observations are "theory-laden," in the sense that what scientists see is structured by the paradigm they inhabit, also descends from Kuhn. I would like to preserve most of these notions as connotations of "discourse."

Like "ideology," "paradigm" does not quite fit my purpose here. It has become a term of art in professional history of science, but it has also been popularized to the point of vulgarity, usually in reference to incommensurable gestalts. "Discourse," in my usage, will be neither so hermetic nor so coherent as "paradigm" has often been interpreted to be. Individuals may participate in and be shaped by numerous discourses without being fully determined by any of them. People may have fluent repertoires in alternate, even conflicting, discourses: socially, these discourses may be produced for different purposes in different

[56] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago, 1962); Imre Lakatos and Alan Musgrave, eds., *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press, 1970).

contexts.[57] Finally, the boundaries of discourses are more ragged and more permeable than those of paradigms. The notion of discourse is much more of an analytical construct than the idea of a paradigm. It allows us to discern a certain order, but this order is not *the* order of things, only one suited to a particular purpose, in a particular context.[58] "Paradigm" is a more totalizing term than "discourse," in my usage, will be.

Another alternative might be the old sociology-of-knowledge concept of *Weltanschauung*, or "worldview." This idea captures the contingent nature of discourse and its relative coherence, and it has the advantage of focusing attention on the subjective reality of the experience produced within a socially constructed system of thought.[59] But the term is too phenomenological, emphasizing the subjective dimension of discourse at the expense of its relationships with technology and other material conditions.

Finally, in the last decade a growing literature in the history and sociology of technology has introduced an array of concepts focused around the idea of "social construction," which I take to mean that technologies are always developed by groups engaged in building, simultaneously, their meaning and their physical form. Of these concepts, at least the following bear strong resemblances to those I develop in this book.

Trevor Pinch and Wiebe Bijker's research program in the social construction of technology signals the power of an analysis of technology guided first and foremost by its role in social groups. They describe how social interpretations of problems fix the meaning and physical form of particular technologies.[60] John Law's "heterogeneous engineering" points to the multiplicity of materials and forces that groups draw upon to put together working technologies.[61] The "actor-network

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[57] Imre Lakatos criticized Kuhn's theory for similar reasons, proposing as an alternative that science consists of possibly large numbers of competing "research programs" whose effects are less intellectually dominating. Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes," in Lakatos and Musgrave, eds., *Criticism and the Growth of Knowledge*, 91–196. For an analysis of discourse repertoires based in the sociological tradition, see G. Nigel Gilbert and Michael Mulkay, *Opening Pandora's Box : A Sociological Analysis of Scientists' Discourse* (New York: Cambridge University Press, 1984).

[58] See Donna J. Haraway, *Primate Visions* (London: Routledge Kegan Paul, 1989), especially the introduction.

[59] Karl Mannheim, *Ideology and Utopia: An Introduction to the Sociology of Knowledge*, trans. Louis Wirth and Edward Shils (New York: Harcourt Brace Jovanovich, 1936); Peter L. Berger and Thomas Luckmann, *The Social Construction of Reality* (New York: Anchor Books, 1966).

[60] Trevor Pinch and Wiebe Bijker, "The Social Construction of Facts and Artifacts," in Wiebe Bijker, Thomas P. Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems* (Cambridge, MA: MIT Press, 1987), 17–50.

[61] John Law, "The Heterogeneity of Texts," in Michel Callon, John Law, and Arie Rip, eds., *Mapping the Dynamics of Science and Technology* (London: Macmillan, 1986), 67–83; Law, "Laboratories and Texts," in ibid., 35–50; Law, "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion," in Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*, 111-134. See also the seminal work of Bruno Latour: Latour and Steve Woolgar, *Laboratory Life: The Social*

theory" of Bruno Latour and Michel Callon directs attention to the ways science and technology function as networks of power in which the enrollment of active allies (humans, machines, and other "actants") is a primary mechanism.[62] Bijker's idea of "technological frames" -- much like that of "paradigms" -- refers to the combinations of concepts, theories, goals, and practices used by groups attempting to solve technological problems.[63] Steven Shapin and Simon Schaffer define various "technologies," including the material, the literary, and the social, that seventeenth-century scientists employed to establish a "form of life" and a social space wherein experiments could count as establishing facts.[64] Thomas Hughes has pointed to the role of entrepreneurial "system builders" in creating large technological systems whose scales help them achieve a "momentum" presenting the appearance of a "seamless web" of autonomous technology.[65] Peter Taylor's ideas of "heterogeneous constructionism" and "distributed causality" have significantly expanded the sophistication of the social constructivist program.[66]

These are deep, and deeply important, conceptions of scientific and technological change. However, with the exception of Shapin and Schaffer's Wittgensteinian concept of a "form of life," all of these terms are built to a purpose that is not my own. They help us to understand technological change as a social process, but to do so they focus on the technology itself: innovation, invention, design. As Pinch and Bijker themselves have noted, few studies have managed fully to engage the relationship between the meanings of scientific facts or technological artifacts and their sociopolitical milieu.[67] This is part of my concern in this book, but it is not the whole of it. Instead, my goal is to balance problems in the social construction of technology with their converse, which is to say the technological construction of social worlds. The term "discourse" points strongly to the socio-political dimensions of technology but at the same time, in my usage, directs

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Construction of Scientific Facts (London: Sage, 1979); Latour, "Give Me a Laboratory and I Will Raise the Earth," in Karin Knorr-Cetina and Michael Mulkay, eds., *Science Observed* (London: Sage, 1983), 141–170; and Latour, *Science In Action* (Cambridge, MA: Harvard University Press, 1987).

[62] Michel Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay," in John Law, ed., *Power, Action, and Belief: A New Sociology of Knowledge?* (London: Routledge and Kegan Paul, 1986), 196–233; Callon and Bruno Latour, "Unscrewing the Big Leviathan: How Actors Macro-structure Reality and How Sociologists Help Them to Do So," in Karin D. Knorr-Cetina and Aaron V. Cicourel, eds., *Advances in Social Theory and Methodology* (Boston: Routledge and Kegan Paul, 1981), 277–303.

[63] Wiebe Bijker, "The Social Construction of Bakelite: Toward a Theory of Invention," in Bijker, Hughes, and Pinch, eds., *The Social Construction of Technological Systems*; Bijker and John Law, eds., *Shaping Technology/Building Society: Studies in Sociotechnical Change* (Cambridge, MA: MIT Press, 1992).

[64] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985).

[65] Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore, MD: Johns Hopkins University Press, 1983); Hughes, "The Evolution of Large Technological Systems," in Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*, 51–82.

[66] Peter Taylor, "Building on the Metaphor of Construction in Science Studies: Towards a Stronger Framework for Reconstructing the Heterogeneous Construction of Scientific Activity," manuscript, Department of Science and Technology Studies, Cornell University (1994).

[67] Pinch and Bijker, "The Social Construction of Facts and Artifacts," 46.

attention to the material elements shaping the social and political universe; it is a broad term, in short, for the heterogeneous *media* in which the process of social construction operate.

Having distinguished discourse from these alternatives, let me now develop a positive definition.

Discourse in its narrowest sense refers to the act of conversation (as distinguished from language itself). The analytic use of this term descends from sociological studies of speech in context, sometimes called "discourse analysis." In the larger sense I will employ here, though, discourse goes beyond speech acts to refer to the entire field of *signifying* or *meaningful practices*: those social interactions -- material, institutional, and linguistic -- through which reality is interpreted and constructed for us and with which human knowledge is produced and reproduced. *A* discourse, then, is a way of knowledge, a background of assumptions and agreements about how reality is to be interpreted and expressed, supported by paradigmatic metaphors, techniques, and technologies and potentially embodied in social institutions. This usage emerges from, though it is not identical with, that of French critical theorists such as Roland Barthes, Michel Foucault, and Jacques Derrida. While "discourse," too, has suffered abuse at the hands of those who would make it explain everything (and so explain nothing), I think that it is still fresh and active enough to fill the role I have in mind. To establish this role more precisely, let me briefly sketch its intellectual ancestry.

Wittgenstein: Language-Games and Meaning as Use

My concept of discourse has a great deal in common with the later Wittgenstein's idea of a "language-game." *A* Wittgensteinian language-game is the set of linguistic and nonlinguistic means that constitute some domain of human social practice. *The* language-game, as a whole, consists of "language and the actions into which it is woven," according to the *Philosophical Investigations.*[68]

Wittgenstein sees language in the ordinary sense as part of a wider background of practices, materials, and institutions. His semantic theory emphasizes the primacy of training over explanation in the acquisition of language. Especially as children, people come to understand or acquire the meanings of words as part of patterns of action in their lives. They are taught which words to say in innumerable situations, and the first of these uses have to do with the practical satisfaction of needs and desires. Thus people initially experience language not as representation

[68] Ludwig Wittgenstein, *Philosophical Investigations,* trans. G.E.M. Anscombe (New York: Macmillan, 1958), paragraph 7. All references to this work are to Wittgenstein's paragraph numbers rather than page numbers.

but as action. It is one more thing they can *do,* like reaching for something, crying, or jumping up and down, to get what they want. Once a basic vocabulary is established by training, new language can be learned by explanation. Only at this point can language begin to seem primarily representational. This is the force of Wittgenstein's slogan "meaning is use."[69]

Wittgenstein's most developed example of this phenomenon involves ostensive definition, that is, defining a word by pointing to the object it names. He notes that ostensive definitions are possible only once a "place" in a language-game has been established for the words they define. Thus, pointing to the brake pedal of a car and saying "That's the brake" would only make sense as a definition if the recipient of the explanation already understands automobiles, driving, stopping, starting, and so on. The rest of the context within which "That's the brake" makes sense must be acquired through action -- by driving with other people, watching movies involving cars and drivers, and so on. Furthermore, the act of pointing to something itself has a conventional meaning. Infants must be trained to recognize pointing as part of the process of definition. Not only the word defined by ostension, but the pointing itself and the object indicated by pointing, are components of the language-game in Wittgenstein's view: "it is most natural, and causes least confusion, to reckon the samples among the instruments of the language."[70]

Language-games are profoundly public and conventional in nature. People learn to speak in contexts of action that are themselves to some degree habitual, traditional, and institutionalized. Indeed, a sound can only function as a word by virtue of its use in a community. If I label something with a sound I invent, that sound does not quite count as a word until I employ it in a communicative context. This necessarily involves making it public by teaching someone else how it is to be used, that is, in what pattern of action it has a place. Actions, too, can be apprehended by language only once they become patterned and public, for similar reasons.

> It is not possible that there should have been only one occasion on which someone obeyed a rule. It is not possible that there should have been only one occasion on which a report was made, an order given or understood, and so on. -- To obey a rule, to make a report, to give an order, to play a game of chess, are customs (uses, institutions).
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> To understand a sentence means to understand a language. To understand a language means to be master of a technique.[71]

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[69] On this point see David Bloor, *Wittgenstein: A Social Theory of Knowledge* (New York: Columbia University Press, 1983), especially Chapter 3.
[70] Wittgenstein, *Investigations*, paragraph 16.
[71] Ibid., paragraph 199.

Thus language itself operates as a tool. "Language is an instrument. Its concepts are instruments," Wittgenstein says.[72] He means that words are part of concrete actions, just as actions are part of language.

Wittgenstein's ultimate conclusion is that the process of grounding knowledge comes to an end within language-games -- not in a reality external to the social world.

> But isn't it experience that teaches us to judge like this, that is to say, that it is correct to judge like this? But how does experience teach us, then? We may derive it from experience, but experience does not direct us to derive *anything* from experience. If it is the ground of our judging like this, and not just the cause, still we do not have a ground for seeing this in turn as a ground. No, experience is not the ground for our game of judging. Nor is its outstanding success.
>
> "An empirical proposition can be tested" (we say). But how? and through what? What counts as its test? . . . -- As if giving grounds did not come to an end sometime. But the end is not an ungrounded presupposition: it is an ungrounded way of acting.[73]

Language-games make use of all kinds of things, including experience, evidence, and real objects, but there is no ultimate justification for these uses, since justification is itself an "ungrounded way of acting." What "make" propositions true or false are the public practices of justification, verification, etc., of a particular community, not the properties of objects they "describe." (Description, too, is a language-game, part of a cultural discourse.)

Ultimately, for Wittgenstein, language-games are elements of "forms of life," larger, more general, mutually reinforcing patterns of action, language, and logic. In *Leviathan and the Air-Pump*, Shapin and Schaffer offer an extended example. They use Wittgenstein's concept to describe the "experimental life" constructed by Robert Boyle and his colleagues at the Royal Society in the seventeenth century. Boyle and his followers established what (if anything) an experiment proved, what protocols had to be followed for an event to count as an experiment, what sorts of witnesses were necessary to validate the matters of fact demonstrated by experiment, and other fundamental practices and logics of scientific experimentation. To do so they built what Shapin and Schaffer describe as three kinds of *technologies*: material (Boyle's air-pump as a paradigmatic device), social (the laboratory as a limited public space and its membership as valid witnesses), and literary (forms of description of experiments that allowed readers to function as "virtual witnesses"

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[72] Ibid., paragraph 169.

[73] Ludwig Wittgenstein, *On Certainty*, ed. and trans. G.E.M. Anscombe and G.H. von Wright (New York: Harper, 1969), paragraphs 109 and 110.

who could themselves validate an experiment). In short, they constructed the whole form of life, the linked set of language-games and practices, that still underlies science.[74]

Wittgenstein's lessons that language is often if not always a form of action, that meaning is grounded in practice rather than representation, and that the great bulk of human activity occurs within habitual, instinctual, traditional, and institutionalized patterns of action underlie my usage of the term "discourse." These ideas establish a basis for thinking of tools, and the languages and metaphors they generate, together as a single unit of analysis. The tool-like uses of computers and their roles as models, metaphors, and experiences are connected as part of an interrelated set of language-games. We cannot understand their operation as tools in isolation from the way they are taken up in discourse about them, just as we cannot understand discourses *about* computers apart from the devices and the practices that employ them.

Foucault and the Idea of Discourse

The notion of a language-game composed of heterogeneous elements is remarkably similar to Foucault's concept of discourse. But Foucault focuses on a factor Wittgenstein generally ignores: competition among discourses, motivated by power relationships among human groups.

> In a society such as ours, but basically in any society, there are manifold relations of power which permeate, characterize, and constitute the social body, and these relations of power cannot themselves be established, consolidated nor implemented without the production, accumulation, circulation and functioning of a discourse. There can be no possible exercise of power without a certain economy of discourses of truth which operates through and on the basis of this association.[75]

Foucault conceives of discourses as the sites where the objects of knowledge are constructed. In a sense, for Foucault the idea of a discourse replaces the more traditional notions of "institution," "convention," and "tradition." Discourses are the Wittgensteinian *forms of life* institutions and traditions structure for those who inhabit them. A form of life is not -- or is not only -- a form of experience. Discourses create and structure experience, but they are themselves primarily conventional, material, and linguistic, rather than experiential.

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[74] Shapin and Schaffer, *Leviathan and the Air-Pump.*

[75] Michel Foucault, *Power/Knowledge: Selected Interviews and Other Writings 1972–1977,* ed. Colin Gordon (New York: Pantheon, 1980), 93.

In analyzing discourses, Foucault focuses on particularities. He resists reducing discourses to ideologies, or reflections of a "base" in the economy of wealth, seeing instead a multiplicity of "economies" that overlap and vie with each other for dominance. When Foucault describes a discourse as an economy, he means that like the economy of wealth, social institutions constitute self-elaborating and above all productive systems with their own elements and logic. This metaphor of an economy is meant in the almost literal sense of a structure of production and exchange of useful things. Like Wittgenstein, Foucault explicitly differentiates the economy of discourse from "a system of representations."[76] He rejects semiotic or linguistic models because they seem to reduce knowledge to the possession of meaningful symbols, whereas knowledge is for him the result of continuous micro-political struggles.[77]

The economics of discourse is also not a semiotics because the unity of its objects of knowledge is not given by a language or a system of rationality, but created *ad hoc*. Foucault calls sexuality, for example, a "fiction . . . [an] artificial unity [of] anatomical elements, biological functions, conducts, sensations, and pleasures."[78] The sense of a constantly regenerated and changing discourse differentiates Foucault's concept from the more monolithic stability of Wittgenstein's "forms of life." In a sense, Foucault gives a diachronic view of objects Wittgenstein would have characterized synchronically. He describes discourse as "a series of discontinuous segments whose tactical function is neither uniform nor stable."[79] It is a collection of fragments grouped and interconnected around a "support." The support is the object at once studied and invented by the discourse that surrounds it. I will use this concept to describe the role of computers in closed-world and cyborg discourses.

As an example, Foucault asks us to consider the nineteenth-century campaign against children's masturbation. "This campaign entailed . . . using these tenuous pleasures as a prop, constituting them as secrets (that is, forcing them into hiding so as to make possible their discovery), tracing them from their origins to their effects. . . . What was demanded of it was to persevere, to proliferate . . . rather than to disappear for good."[80] The onanistic child thus became a support or artificial center (in a sense not unlike the "exemplars" of Kuhn's paradigms) not only of a theory of

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[76] Michel Foucault, *The History of Sexuality*, trans. Robert Hurley (New York: Vintage, 1980), 68–69.

[77] "The history which bears and determines us has the form of a war rather than that of a language: relations of power, not relations of meaning. History has no 'meaning,' though this is not to say that it is absurd or incoherent. On the contrary, it is intelligible and should be susceptible of analysis down to the smallest detail -- but this in accordance with the intelligibility of struggles, of strategies and tactics. Neither the dialectic, as logic of contradictions, nor semiotics, as the structure of communication, can account for the intrinsic intelligibility of conflicts. 'Dialectic' is a way of evading the always open and hazardous reality of conflict by reducing it to a Hegelian skeleton, and 'semiology' is a way of avoiding its violent, bloody and lethal character by reducing it to the calm Platonic form of language and dialogue." Foucault, *Power/Knowledge,* 114–115.

[78] Foucault, *History of Sexuality,* 154.

[79] Ibid., 100.

[80] Ibid., 42.

sexuality, but of a whole set of nonlinguistic practices as well, such as the architecture of bathrooms, the enforcement of laws, and the production of books and pamphlets. Such figures as the electronic control center (the War Room, for example) and the cyborg soldier are *supports*, in this sense, for closed-world discourse. The figures of the intelligent machine and the Turing test serve this function for cyborg discourse. Cyborg imagery and problems of control overlap and connect both discourses.

The metaphor of a discursive economy also ties the self-elaborating logic of discourse to the reality of social power. Here Foucault's best example is a "mutation" that occurred in Europe, between the seventeenth and the nineteenth centuries, in the way social control was paradigmatically exercised: from *punishment* by force to *discipline* through training and surveillance -- a more subtle but far more pervasive method. For Foucault, Jeremy Bentham's Panopticon, a circular prison constructed so that every inmate is always physically visible to guards in a central tower, was paradigmatic. People who think they are being watched tend to do what they think they are supposed to do, even when they are not. People whose physical actions and emotional responses have been shaped by discipline (soldiers, workers, prisoners) tend to adopt the mindset of the disciplinary institution. Sophisticated, ubiquitous technologies and techniques such as the Panopticon -- and computerized recordkeeping has at least the potential to create immensely wide-ranging and insidious panoptic techniques[81] -- have increased the ability of institutions to control people without touching them, using the subtle pressures of internalized discipline. In this way, argues Foucault, modern power is more productive than repressive in nature.

If power is productive, what does it produce? First, it generates active compliance rather than passive obedience. But also, for Foucault, power produces truth: true knowledge, warranted by a set of techniques and rules for the creation and evaluation of statements as true and false. More simply, power determines what can *count* as true and false. This is the force of Foucault's concept of "power/knowledge": true knowledge is an effect of power relationships, since power sets the norms for acceptable statements and also sets in motion the process of generating and evaluating those statements -- but also itself produces power, since true knowledge enables its possessors to achieve their practical goals. (Thus, in Operation Igloo White, closed-world discourse generated both repressive power -- the surveillance and the bombing itself -- and productive power -- the development of remote sensing techniques, support for the U.S. involvement in Vietnam through the appearance of success, new North Vietnamese tactics, and so on. It also generated specific forms of new knowledge: sensor data and analysis techniques, statistical analyses of Ho Chi Minh Trail traffic, North Vietnamese knowledge of

[81] See Part V, "Social Control and Privacy," in Charles Dunlop and Rob Kling, eds., *Computerization and Controversy* (New York: Academic Press, 1991), 410–522, for a selection of articles on this issue. Also see Shoshana Zuboff, *In the Age of the Smart Machine: The Future of Work and Power* (New York: Basic Books, 1988), especially Chapters 9 and 10.

American tactics, and so on.[82]) In this Foucault goes beyond Wittgenstein, who contents himself with pointing out the conventional character of signification and justification, to try to answer the question of *how* these conventions are themselves produced and enforced.

Finally, the constant exchanges of language and knowledge in which a discourse is enacted actually help to constitute individual subjects and describe and mold the social body. Foucault plays upon the different meanings of "subject," as in the "subjects" of the king, "subjection" to torture or surveillance, and "subjectivity" itself, noting their more than trivial interconnections. Experiences, feelings, habits, and customs may be among the products of discourse. In a sense I will develop in chapter 5, discourses create *subject positions* inhabitable by individuals.[83]

Discourse: Technology as Social Process

A discourse, then, is a self-elaborating "heterogeneous ensemble" that combines techniques and technologies, metaphors, language, practices, and fragments of other discourses around a support or supports. It produces both power and knowledge: individual and institutional behavior, facts, logic, and the authority that reinforces it. It does this in part by continually maintaining and elaborating "supports," developing what amounts to a discursive infrastructure. It also continually expands its own scope, occupying and integrating conceptual space in a kind of discursive imperialism. Like a paradigm, much of the knowledge generated by a discourse comes to form "common sense."

As applied to computers in the postwar world, my concept of discourse accepts neither the billiard-ball imagery of technological "impacts" on society nor the too-frequent conspiracy imagery of technological "choices" as governed by dominant social groups. Instead it views technology as one focus of a *social process* in which impacts, choices, experiences, metaphors, and environments all play a part.[84] This vantage point will allow us to explore the politics of material change and the politics of representation as linked elements of the politics of culture.

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[82] See Gibson, *The Perfect War*. Gibson's analysis of official accounts of Vietnam also uses a Foucaultian framework.

[83] See the chapter on "The Gentle Way in Punishment" in Michel Foucault, *Discipline and Punish: The Birth of the Prison*, trans. Alan Sheridan (New York: Vintage Books, 1977), for a description of such a struggle.

[84] See Merritt Roe Smith's introduction to *Military Enterprise and Technological Change*, ed. Merritt Roe Smith (Cambridge: MIT, 1985), 1–37, and Thomas J. Misa, "How Machines Make History, and How Historians (and Others) Help Them to Do So," *Science, Technology, and Human Values*, Vol. 13, No. 3 & 4 (1988), 308–331.

Objects of knowledge, like other products of human activity, are produced under historically specific conditions from raw materials that are themselves historical products, including practices, objects, symbols, and metaphors. Science and engineering *normally* proceed not so much by the application of well-codified methods to well-defined problems as by what Claude Lévi-Strauss called *bricolage,* or "tinkering."[85] The models, metaphors, research programs, and standards of explanation that make up a scientific paradigm are assembled piece by piece from all kinds of heterogeneous materials. To see science and engineering as tinkering -- as discourse -- is to blur and twist the sharp, neat lines often drawn between them and the knowledges and practices that constitute other human endeavors such as politics, commerce -- or war.

With these conceptual tools ready to hand, we can now explore how computers became a crucial infrastructural technology -- a crucial Foucaultian support -- for Cold War closed-world discourse.

[85] See Claude Lévi-Strauss, *The Raw and the Cooked,* trans. John and Doreen Weightman (New York: Harper, 1969), especially the "Overture," and Paul Feyerabend, *Against Method* (London: New Left Books, 1975).