The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision

Peter Galison

1. The Enemy

"I . . . hope you can find some corner of activity in which I may be of use during the emergency," the mathematician and physicist Norbert Wiener wrote the czar of American war research, Vannevar Bush, on 20 September 1940. Britain was under unrelenting aerial attack, and a Nazi invasion seemed imminent. Wiener scrambled across the disciplinary map to throw his weight behind a technological defense. He suggested procedures to improve Bush's computational device, the so-called differential analyzer, in ways that would facilitate faster design of war materiel from airplane wings to ballistic shells. More concretely, he reiterated a previous proposal that the Allies loft air-bursting containers of liquified ethylene, propane, or acetylene gases to engulf a wide volume of the sky in a pro-

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longed detonation.[1] That repelling the onslaught of bombers had pushed all scientific questions aside is hardly surprising. For the German Air Force had dubbed 13 August 1940 "The Day of the Eagle," and with it the Battle of Britain had begun with an assault of almost 1500 aircraft flown against British air stations and aircraft factories. During the following two weeks over a thousand Londoners had died under the rain of bombs, and September was worse. On 7 September alone, 448 civilians perished; on 15 September the Germans pitched 230 bombers and 700 fighters against London, Southampton, Bristol, Cardiff, Liverpool, and Manchester.[2]

Over the next few years, Wiener's attention focused increasingly on the problem of destroying enemy airplanes. His early efforts at computation and antiaircraft fire coalesced in a remarkably ambitious calculating device that he called the "antiaircraft (AA) predictor," designed to characterize an enemy pilot's zigzagging flight, anticipate his future position, and launch an antiaircraft shell to down his plane. But Wiener's electronic manipulation did not stop with halting Nazi air attacks. In the course of characterizing the enemy pilot's actions and designing a machine to forecast his future moves, Wiener's ambitions rose beyond the pilot, even beyond the World War. Step by step, Wiener came to see the predictor as a prototype not only of the mind of an inaccessible Axis opponent but of the Allied antiaircraft gunner as well, and then even more widely to include the vast array of human proprioceptive and electrophysiological feedback systems. The model then expanded to become a new science known after the war as "cybernetics," a science that would embrace intentionality, learning, and much else within the human mind. Finally, the AA predictor, along with its associated engineering notions of feedback systems and black boxes, became, for Wiener, the model for a cybernetic understanding of the universe itself. This paper is an exploration of that expansion. In it, I will be backtracking from the widest ontologi-

1. Norbert Wiener, letter to Vannevar Bush, 20 Sep. 1940, box 2, folder 58, Norbert Wiener Papers, collection MC-22, Institute Archives and Special Collections, Massachusetts Institute of Technology Archives, Cambridge, Mass. (hereafter abbreviated NWP).

2. Martin Gilbert, *The Second World War: A Complete History* (New York, 1989), pp. 117–25.

Peter Galison is the Mallinckrodt Professor of Physics and History of Science at Harvard University. His work focuses on the history, philosophy, and cultural location of twentieth-century physics. His books include *How Experiments End* (1987), *Image and Logic: The Material Culture of Modern Physics* (forthcoming), *Big Science: The Growth of Large-Scale Research,* edited with Bruce Hevly (1992), and *The Disunity of Science: Boundaries, Contexts, and Power,* edited with David Stump (forthcoming).

cal claims of cybernetics into a collocation of vacuum tubes, resistors, and condensers designed to replicate the intentions of a hidden enemy pilot.

Enemies were not all alike. In the killing frenzy of World War II, one version of the Enemy Other (not Wiener's) was barely human; to the Americans, British, and Australians, the Japanese soldiers were often thought of as lice, ants, or vermin to be eradicated. As General Sir Thomas Blamey told a unit in Port Moresby in 1942: "Beneath the thin veneer of a few generations of civilization [the Japanese soldier] is a subhuman beast, who has brought warfare back to the primeval, who fights by the jungle rule of tooth and claw, who must be beaten by the jungle rule of tooth and claw. . . . Kill him or he will kill you." A year later, Blamey insisted on the Buna battlefield that "fighting Japs is not like fighting normal human beings. . . . The Jap is a little barbarian. . . . We are not dealing with humans as we know them. We are dealing with something primitive. Our troops have the right view of the Japs. They regard them as vermin."[3] These monstrous, racialized images of hate certainly presented one version of the World War II enemy, but it was by no means the only one.

Another and distinct Allied vision held the enemy to be not the racialized version of a dreaded opponent but rather the more anonymous target of air raids. This enemy's humanity was compromised not by being subhuman, vicious, abnormal, or primitive but by occupying physical and moral distance. Viewed from afar, from the icy heights of thirty thousand feet, a city in Germany looked small, and individual people appeared to be invisible, partially shorn of their likeness to the bomber. After opening a spate of airmen's letters, one British censor from the Air Ministry reported on 21 June 1942: "[The letters] illustrate the effect of airmen's remoteness from their attacks on human beings. Expressions of satisfaction that the Germans are having to undergo the punishment they have hitherto meted out to others are found in almost all letters, but there is an absence of vindictiveness or fanaticism in the phrases used."[4]

3. Quoted in John W. Dower, *War without Mercy: Race and Power in the Pacific War* (New York, 1986), pp. 53 and 71.

4. Quoted in Max Hastings, *Bomber Command* (New York, 1979), p. 146. Other recent literature on the moral, political, and military aspects of bombing civilians includes Michael Sherry, *The Rise of American Air Power: The Creation of Armageddon* (New Haven, Conn., 1987), which argues that the slide towards civilian bombing led inexorably to the use of atomic weapons against civilian targets, and Conrad C. Crane, *Bombs, Cities, and Civilians: American Airpower Strategy in World War II* (Lawrence, Kan., 1993), especially pp. 53–59, which tracks aviators' attitudes in the field as differing according to their specific tasks: piloting, navigating, or bombing. Distancing, however, had to be maintained, often under immense stress. One pilot (who was killed in November 1944) wrote shortly before his death: "The whole idea was to blow up just as much Germany tomorrow as possible. From way up high, it wouldn't mean a thing to me. I wouldn't know if any women or little kids got in the way." Such remarks were followed in the very next sentence by doubts: "I'd thought about it before, but that night it was close. The more I thought of it, the uglier it seemed" (Bert Stiles, *Serenade to the Big Bird* [1947; New York, 1952], p. 21).

To get at the future behavior of the bomber-organism, Wiener and Bigelow made a tour that summer (1942) of the various installations charged with precisely measuring the flight of a plane. At Princeton and Tufts, they consulted on errors in tracking procedures; at Langley Field, experts offered them data on the regularities and irregularities of airplane motion; at the Aberdeen Proving Ground, at the Frankford Arsenal in Philadelphia, and at the Foxboro Instrument Company, additional information came pouring their way. But it was at the Anti-Aircraft Board at Camp Davis, North Carolina, that the two prognosticators received their most precious documents: tracking data on two test flights—the so-called flights 303 and 304—at one-second intervals.[39] These two trajectories through the sky were crucial because they gave, for the first time, realistic data that could be used as input to, and a test on the output of, the prognosticating machine.

Over the next five months, Wiener worked to reproduce these data—to little avail. By December 1942, it was all too clear that, however clever the general statistical analysis had been, it was barely able to compete with two simpler, geometrical prediction machines designed by Hendrik Bode. The first simply extrapolated the future from the derivative of the plane's trajectory, calculated at a fixed initial point. The second Bode method continuously recomputed its prediction on the basis of a trajectory derivative computed ten seconds back from the plane's current position. In December 1942 and January 1943, Wiener compiled the following chart for Weaver:[40]

Track	(1) Bode	(2) 10 Sec. Bode	(3) Statistical
303	6 hits	22 hits	23 hits
304	35 hits	55 hits	49 hits

Bode, from Bell Laboratories, had developed a geometrical fire-control predictor that had the virtue of being based on already-existing technology and the vice of not taking into account the random fluctuations and irregular trajectories of the bombers.

Quite clearly, Wiener's own method (statistical) was barely better than the ten-second Bode method for track 303 and inferior to the ten-second Bode for track 304. In light of this manifest inadequacy, Wiener

(1933; New York, 1961), pp. 234–86; and Woodworth and Mary R. Sheehan, *Contemporary Schools of Psychology*, 3rd ed. (New York, 1964), pp. 111–213.

39. See Wiener, "Statistical Method Of Prediction in Fire Control," Final Report on Section D-2, Project no. 6, submitted to Weaver, Section D-2 NDRC, 1 Dec. 1942, Record Group 227, OSRD, Contractors' Reports, Division 7, NDCrc-83, OSRD Report No. 1863, MIT, NA-LC.

40. See Wiener, letter to Weaver, 15 Jan. 1943, Record Group 227, OSRD, Contractors' Reports, Division 7, NDCrc-83, enclosure with OSRD Report No. 1863, MIT, NA-LOC. See also Wiener, "Final Report," 1 Dec. 1942, NA-LC.

judged the only hope for the method to lie in a vastly increased statistical base involving the calculation of tens, if not hundreds, of tracks. Since this would tie up the computing facilities of the country, and because the likelihood of improvement struck him as "too distant to be significant in the present war," Wiener hesitated to recommend further research until after the end of the war.[41] What went wrong? Wiener speculated:

> To what extent the negative result of this investigation is due to bad tracking, to what extent to the restriction of the useable past [flight path] to 10 seconds, and to what extent to the fact that the enemy plane has a very considerable chance to change its flight pattern, whether voluntary or involuntary, in the twenty seconds of projectile flight, is not yet fully clear.[42]

It may have been "not yet fully clear," but Wiener was "convinced" that it was the enemy's capacity to maneuver rather than anything else that would save him from inevitable destruction at the mechanical hands of the predictor. Failure came hard, for Wiener was frustrated by the predictor's weakness: "I still wish that I had been able to produce something to kill a few of the enemy instead merely of showing how not to try to kill them."[43]

3. *From AA Predictor to Human Nature*

What Wiener was willing to do, even in the worst days of war, was to turn to psychological and philosophical implications of the predictor. In their 1943 article "Behavior, Purpose and Teleology," Wiener and Bigelow collaborated with the cardiologist Arturo Rosenblueth, then visiting Harvard Medical School, to present a new, behaviorist description of the very concept of purpose. Aside from the pure satisfaction of classification, the authors were pleased to single out the class of predictive behavior because "it suggests the possibility of systematizing increasingly more complex tests of the behavior of organisms."[44] Of particular importance, they contended that their classification rehabilitated "purpose" and "teleology" by bringing them under the aegis of a "uniform behavioristic analysis" that was equally applicable to living organisms and machines.

Where Darwin had assiduously tracked the similarities between human and animal in order to blur the boundary between them, Wiener's

41. Wiener, letter to Weaver, 15 Jan. 1943.

42. Wiener, "Statistical Method of Prediction in Fire Control," p. 7.

43. Wiener, letter to Weaver, 28 Jan. 1943, box 2, folder 64, NWP.

44. Arturo Rosenblueth, Julian Bigelow, and Wiener, "Behavior, Purpose and Teleology," *Philosophy of Science* 10 (Jan. 1943): 22; rpt. *Norbert Wiener*, 4:184.

efforts were devoted to effacing the distinction between human and machine. Darwin's dog suffered remorse; Wiener's AA predictor had foresight. Indeed, over the course of the war, Wiener reported in 1945, men had grown ever more accustomed to attributing animation to servomechanical systems:

> The semi-humorous superstition of the gremlin among the aviators was probably due, as much as anything else, to the habit of dealing with a machine with a large number of built-in feedbacks which might be interpreted as friendly or hostile. For example the wings of an airplane are deliberately built in such a manner as to stabilize the plane, and this stabilization, which is of the nature of a feedback . . . may easily be felt as a personality to be antagonized when the plane is forced into unusual maneuvers.[45]

Our consciousness of will in another person, Wiener argued, is just that sense of encountering a self-maintaining mechanism aiding or opposing our actions. By providing such a self-stabilizing resistance, the airplane acts as if it had purpose, in short, as if it were inhabited by a gremlin.

Within the rubric of "purposeful behavior," then, Wiener and his collaborators Bigelow and Rosenblueth allowed for those acts that do not involve feedback while the process is underway (such as a frog that shoots its tongue out towards a fly) and those (such as a self-guided missile or torpedo) that gather information and use that information to correct themselves en route. But beyond any particular features of humans or machines lay Wiener's deep-seated commitment to a behaviorist vision of both. His was not a claim that no criteria differentiated humans and machines. Quite obviously there was no machine that could (as yet) write a Sanskrit-Mandarin dictionary; and, similarly, no living organism rolled on wheels. But it was the behaviorist impulse to focus on broad classes of actions, and to do so on the basis of the input and output he knew so well from communication technology, that led Wiener to his blurring of the man-machine boundary. *Black boxes,* as Wiener used the term, meant a unit designed to perform a function before one knew how it functioned; *white boxes* designated that one also specified the inner mechanism. In this

45. Wiener, "Operationalism—Old and New" (1945), box 11, folder 570, NWP, pp. 14–15. In particular, the wings of an airplane rise from the fuselage upward towards the wingtips (this rise is known as the dihedral). When the plane banks (while maintaining direction), the plane side-slips towards the lower wing. Since the lower wing is now positioned more nearly parallel to the ground, the lower wing encounters the relative wind strongly while the upper wing, now tilted more nearly perpendicular to the ground, encounters the relative wind more weakly. This raises the lower wing, righting the airplane. See, for example, the popular 1944 flight instruction book by Wolfgang Langewiesche, *Stick and Rudder: An Explanation of the Art of Flying* (1944; New York, 1972), especially the subsection "What the Airplane Wants to Do," pp. 125–27, which addresses the dihedral.

what I thought all the functions of the brain are, putting them in positivistic reaction terms of the organism, terms which could be translated into in-put, out-put and adjustment of a mysterious box with binding posts and knobs on it." His conclusion: "That's about what a person is, really."[62] W. Ross Ashby writing from England had similar panegyrics for Wiener's black-box program:

> When I consider how the psychologists have been trying to solve exactly this problem for decades (if not for centuries), the black box being the brain, and when I think how little attention they have given to the principles involved, my opinion of psychologists falls to a new low. The trouble with the psychologist is that he is too proud to learn to walk before he tries to run. So today he lies on his back, foolishly waving his legs, and pretending to be a ballet-dancer, when in reality he hasn't yet learned how to crawl.For this reason I regard it as highly complimentary when I say that your study of the "black box" problem is a first step towards a scientific psychology![63]

Wiener, unlike Boring, thought he could actually make the hardware that would put the specific black-speckled boxes on the table. Such a radical position necessarily left unsatisfied those like Taylor who could not abide the elimination of inner states of human intention, desire, pleasure, and pain in favor of purely observable manifestations. But with the power of wartime materiel and the glittering promise of future industrial riches, it was clearly not Taylor's view that prevailed.

4. *The Philosophy of Nature and the Delivery of Cannon Fire*

If humans do not differ from machines from the "scientific standpoint," it is because the scientific standpoint of the 1940s was one of men-machines at war. The man-airplane-radar-predictor-artillery system is a closed one in which it appeared possible to replace men by machines and machines by men. To an antiaircraft operator, the enemy really does act like an autocorrelated servomechanism. What is astonishing is the globalization of this technological *aperçu* into a new age for humanity and a general philosophy of human action. In 1947, as Wiener reflected on the events of the war, he divided the thoughts of the ages into three epochs. A first era was characterized by the clockmakers, surveyors, and planetary astronomers. Their science was one of prediction by laws and their economy that of the merchant. Boats sailed across seas based on the clocks and astronomical calculation of longitude; this was, as Wiener put it, the

62. Boring, letter to Wiener, 8 Feb. 1945, box 2, folder 67, NWP.

63. W. Ross Ashby, letter to Wiener, 6 Feb. 1951, box 3, folder 134, NWP. Ashby went on to write a well-known text, *An Introduction to Cybernetics* (London, 1956).

"engineering of the mercantilist" (*C*, p. 38). As the seventeenth and eighteenth centuries drew to a close, Wiener asserted, a new day dawned in which clocks gave way to the steam engine as the symbol and real center of technological work. Huygens and Newton ceded their place to Rumford, Carnot, and Joule, and it was the manufacturer not the trader who embodied the new culture. Finally, for Wiener, the present age, ushered in by the vast array of electromechanical devices of the war, was the age of information and control. If these developments reached back to Kelvin and Gauss, they found their real form (and interpreters) only in the laboratories and factories of radar and its associated systems. This age, our age, was that of the servomechanism.

As Wiener argued, each age engendered its own simulacrum of humanity—clockmakers of the eighteenth century made their pirouetting mechanical figures, steam engineers of the nineteenth glorified their engines as versions of the body. Our age? We make computers to calculate differential equations, open doors with photocells, and, not surprisingly, "the present automaton . . . points guns to the place at which a radar beam picks up an airplane" (*C*, p. 40). In a sweeping totalization Wiener had, within two years of the end of the war, elevated his AA predictor to the symbol for a new age of man. Whether or not we accept Wiener's techno-periodization of the history of humanity, there seems little doubt that he and many of his contemporaries saw themselves as standing at a historical and philosophical watershed in which the Manichean sciences would undergird the cybernetic age.

To a certain extent, Wiener's hopes and fears for cybernetic technologies were in place before Hiroshima and Nagasaki, but they were multiplied one hundredfold by the August 1945 nuclear bombing of Japan. In the weeks following the atomic blasts, Wiener was too distracted even to respond to a letter from his friend and collaborator, the philosopher Giorgio de Santillana. Finally, in October 1945, Wiener put pen to paper:

> Ever since the atomic bomb fell I have been recovering from an acute attack of conscience as one of the scientists who has been doing war work and who has seen his war work a[s] part of a larger body which is being used in a way of which I do not approve and over which I have absolutely no control. I think the omens for a third world war are black and I have no intention of letting my services be used in such a conflict. I have seriously considered the possibility of giving up my scientific productive effort because I know no way to publish without letting my inventions go to the wrong hands.[64]

In short, almost telegraphic prose, Wiener reported to de Santillana on the full range of his cybernetic work, ranging from wave filters and pre-

64. Wiener, letter to Giorgio de Santillana, 16 Oct. 1945, box 2, folder 69, NWP.

and enthusiastically led by Wiener, von Neumann, McCulloch, and de Nó, the group's intense discussions brought systems, information theory, and feedback mechanisms onto the center stage of sociology, psychology, and anthropology.[67] Northrop later acknowledged the impact of servomechanical theory as "of revolutionary significance for natural science, moral as well as natural philosophy, and for one's theory of the normative factor in law, politics, religion, and the social sciences."[68] To Bateson, the new vocabulary of communication theory and cybernetics presented a turning point in his work; his biographer David Lipset called it a "theoretical conversion" in which his older terms, such as *schismogenesis,* were reworked into the language of the purposeful machine: "regenerative feedback."[69]

While reaching out to the social sciences, Wiener also wanted to raise the Manichean sciences to a more abstract philosophy. At least since the early 1930s, Wiener had held a deep interest in Leibnizian philosophy. He extolled Leibniz's philosophically open mind (as opposed to the Newtonians' dogmatism), he celebrated Leibniz's commitment to relativity, to the quantum mechanical-like identity of indiscernibles, even to the idea of monadic self-containment (by analogy to certain higher-dimensional theories of the electron).[70] But in the years after the war, Wiener saw more in Leibniz. He extracted an overarching philosophical umbrella that covered and combined cybernetics *and* operations research.

Both cybernetics and operations research, he told the Operations Research Society in 1953, were grounded in a modern parallel to Leibnizian monads. Leibniz's own conception of monads are, Wiener assures us, far too anthropomorphic. It was a world picture in which "monads [were] quasi-souls whose activity was confined to the mirroring of the universe of the monads themselves." Cybernetics provided "a similar world-picture": nodes of communication interact by the exchange of orders or commands. According to the cyberneticist, the world is nothing

67. On the Macy meetings, see Gregory Bateson, memo to [invitees], 19 June 1946, box 2, folder 71, NWP; McCulloch, memo to the members of the "Macy Conference on Feedback Mechanisms, 17–19 Oct. 1946," n. d., box 2, folder 71, NWP; "Conference on Feedback Mechanisms and Circular Causal Systems in Biology and the Social Sciences," n. d., box 2, folder 71, NWP. Heims has a good discussion of the tenor of these meetings in *John von Neumann and Norbert Wiener,* pp. 201–7 and a wide-ranging study of the impact of cybernetics on the social sciences in *Constructing a Social Science for Postwar America: The Cybernetics Group, 1946–1953* (Cambridge, Mass., 1993).

68. F. S. C. Northrop, "Ideological Man in His Relation to Scientifically Known Natural Man," in *Ideological Differences and World Order: Studies in the Philosophy and Science of the World's Cultures,* ed. Northrop (New Haven, Conn., 1949), p. 414.

69. David Lipset, *Gregory Bateson: The Legacy of a Scientist* (Englewood Cliffs, N. J., 1980), p. 182. See also Heims, "Gregory Bateson and the Mathematicians: From Interdisciplinary Interaction to Societal Functions," *Journal of the History of the Behavioral Sciences* 13 (Apr. 1977): 141–59.

70. See Wiener, "Back to Leibniz! Physics Reoccupies an Abandoned Position," *Technology Review* 34 (Feb. 1932): 201–3, 222, 224.

more than the mutual internal relations of these incoming and outgoing messages—ultimately cybernetics carries, on Wiener's own account, a "quasi-solipsistic" vision of the universe. Taken in its epistemological function, cybernetics can be either observational (purely incoming messages) or experimental (incoming and outgoing messages). At the same time, Wiener wanted to make plain that while epistemology may well capture the knowledge-gathering function of the science, cybernetics will not rest there: "messages may be sent for the purpose of exploring the universe, but they may also be sent with the intention of *controlling* the universe." Precisely because Wiener wanted to accentuate the dual aspect of information, he distinguished between messages that could be sent "in the indicative and the imperative mood."[71]

As the windowless monads suggest, and as Wiener's own proclamation of quasi-solipsism made explicit, the cybernetic philosophy was premised on the opacity of the Other. We are truly, in this view of the world, like black boxes with inputs and outputs and no access to our or anyone else's inner life. This same opacity prevails in von Neumann's game theory, where the opponent acts according to certain universal maximization principles but where the thought process that eventuates in any given move is hidden from us. Although in his later life Wiener came to reject von Neumann's game theory as containing an inadequate psychological basis,[72] in the years directly after the war, he sympathized with the project, even identifying it as being of the same "spirit" as cybernetics.[73]

The impact of the Manichean sciences not only on computation and automata theory but also on the social sciences should not be underestimated. For Mead, Northrop, and Bateson, the impact of Wiener's models of feedback and homeostasis became essential components of their analyses. Even *Time* saluted Wiener in 1950 as one of the leaders of the new "computermen" who were blurring the boundaries between the wet sciences of the brain, psychological properties, and the machine (caricatured in fig. 5). Given such adulation, it is perhaps not too surprising to find many social scientists identifying themselves with the new sciences emerging from the war. The social scientists' fascination with systems in the 1940s and 1950s may have roots in older turn-of-the-century networks of telephony and power. Recent fascination with information-based feedback systems, however, tracks its roots more proximately—to the radar and tracking systems of World War II.

71. Wiener, "Delivered to the Operations Research Society," 23 Nov. 1953, box 12, folder 738, NWP, pp. 2, 3.

72. See Heims, *John von Neumann and Norbert Wiener,* pp. 305–10.

73. "[Morgenstern's] very important joint book on games with Dr. von Neumann . . . represents a most interesting study of social organization from the point of view of methods closely related to, although distinct from, the subject matter of cybernetics" (*C,* pp. 18–19).

postmodernism and the "trivial" cybernetic vision (presumably of Wiener) is unsustainable.[76]

From this continuity between cybernetic and Lyotardian postmodernist social relations, two things might follow. We could conclude that Wiener and his allies were postmodernists *avant la lettre*. Or, as I incline to believe, it might be the other way around: we track Lyotard's postmodernist and game-theoretical worldview back deep into the heart of the Manichean sciences. As we study the development of postwar science, then, it seems to me of utmost importance not to seize uncritically the central metaphors of operational analysis, game theory, and cybernetics and make them our own while claiming all the while a new "postmodern" periodization.

Donna Haraway invoked cybernetics in a more subtle, yet still conflicted *post*modern way. In "The Biological Enterprise: Sex, Mind, and Profit from Human Engineering to Sociobiology" (1979), she used the term *cybernetics* to characterize post–World War II biological sciences in terms, and with a periodization, that Wiener would have recognized. Before the war (according to Haraway) biological discourse had been organized around the organism viewed through the categories of medicine and the clinic. These included intelligence testing, human relations, physiology, and racial hygiene. After the war, the new sciences of information- and control-dominated systems reshaped biology, including sociobiology. This new, more cybernetic biology emphasized communication and feedback. For Haraway, E. O. Wilson's work typified the latter set of developments with his stress on information transfer among insects, including efficiency, noise, and capacity.[77] In her view, cybernetics, although often used to sanction the status quo, is ultimately far more open to a new and more liberating vision of the biological sciences than the psychobiological and organic functionalist theories that preceded it. The cybernetic biological view (sociobiology) is, in Haraway's view, *less* open to racism or sexism because in cybernetics the organic body is depicted as an engineering entity, always modifiable, and never defined essentially.[78]

Haraway opened "A Cyborg Manifesto" (1985) with a partial, ambivalent continuation of these Wienerian themes: "A cyborg is a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction."[79] I say the continuation is partial and

76. Ibid., p. 16.

77. See Donna J. Haraway, "The Biological Enterprise: Sex, Mind, and Profit from Human Engineering to Sociobiology," *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York, 1991), pp. 44–45.

78. See ibid., p. 67.

79. Haraway, "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century," *Simians, Cyborgs, and Women,* p. 149.

ambivalent because the cultural meaning she struggled to ascribe to the communication and information technologies is utterly different from the cultural meanings that emerged from cybernetics.[80] Haraway alluded to the "cyborg orgy" that she saw "coded by C^3I, command-control-communication-intelligence, an $84 billion item in 1984's US defence budget." Just this cyborg root in military feedback systems is, she allowed, the "main trouble" with cyborgs: "But illegitimate offspring are often exceedingly unfaithful to their origins. Their fathers, after all, are inessential."[81] Can the cybernetic vision be so easily detached from its military historical origins and present location? After all, the very notion of a cyborg issued from an Air Force contractor's extension of Wiener's ideas.[82] I would argue that the associations of cybernetics (and the cyborg) with weapons, oppositional tactics, and the black-box conception of human nature do not so simply melt away.

For the classic cyberneticists (exemplified by Wiener, Rosenblueth, McCulloch, and their colleagues), the blurred boundary between human and machine opened an infinity of possibilities; Haraway, like Wiener, stressed the possibility that machines could be open-ended, nondedicated in their function, and able to reproduce, learn, and interconnect with the human. But Wiener, unlike Haraway, saw power and control as absolutely central to the very definition of cybernetics, for better or worse. Indeed, by the end of his life, as if to push this theme to its theological *Endstation,* Wiener had come to see the human-machine relation as a model, if not an incarnation of the bond between God and "man." The paradoxes of religion ("Can God create a rock too great for him to move?") reemerged as questions about the cyberneticist and his offspring ("Can a human create an entity that can beat him at chess?"). On the last lines of the last page of his last book, Wiener put it this way: "Since I have insisted upon discussing creative activity under one heading, and in not parceling it out into separate pieces belonging to God, to man, and to the machine, I do not consider that I have taken more than an author's normal liberty in

80. On "cultural meaning," see Peter Galison, "The Cultural Meaning of *Aufbau,*" in *Scientific Philosophy: Origins and Developments,* ed. Friedrich Stadler (Dordrecht, 1993), pp. 75–93.

81. Haraway, "A Cyborg Manifesto," pp. 150–51.

82. The term *cyborg* itself was, as Matthew Price has shown, first used by Air Force contractors, in 1960, in the context of speculative research on biochemical means for extending the capability of astronauts. One line of inquiry was the search for drugs that would alter osmotic pressures within the body to allow unprotected "walks" in space. See Matthew Price, "'Man Must First Conceive'—A Critical Philology of the Cyborg," unpublished manuscript. This links rather closely on the one hand with Wiener (whom the Air Force contractors cite) and on the other with the bionic implants required by the space pilot in the science fiction representations of cyborgs cited by Haraway in "A Cyborg Manifesto," p. 179.

calling this book

GOD AND GOLEM, Inc."[83]

We who make cyborgs are, in the end, like gods.

Haraway, by contrast, took the variability, the unfixed nature, of the cyborg as grounds for the *partiality,* not the *omnipotence,* of what is human. As she put it, we are ourselves already in so many respects cyborgs—through our reproductive technologies, our psychopharmacologies, our prostheses (mechanical and computational)—that we can no longer put any stock in essentialist definitions of the classic dichotomies of mind and body, animal and human, organism and machine, public and private, nature and culture, men and women, primitive and civilized.[84] I understand her project to resonate with the more critical branch of postmodern theory: a refusal to espouse a nostalgia for a "natural" or "feminine" world that preexisted technology and a concomitant move to use (rather than simply shun) the built world of technology and science. Postmodernism holds cybernetics in an uneasy embrace. As a postmodernist challenge to a fixed human, racial, or gendered nature, the cyborg presents an alternative, a way out. But (as Wiener and Lyotard attest in different ways) the successes of cybernetics in blurring the human and nonhuman have been most striking in the agonistic field, if not the battlefield itself; the choice between fighting Augustinian and Manichean enemies, as Wiener pointed out, is merely one of tactics. In choosing the cyborg to lead the flight from modernism, one risks reducing the picture of human capacities to one of tactical moves and countermoves in a metaphorical extension of automatic airwar.

Whether we accept or reject the ontology of the Manichean sciences, in discussing the technologies of cybernetics we find ourselves in the grip of a powerful set of cultural meanings. By this, I do not mean that feedback systems were born (so to speak) with a full complement of symbolic associations. As with any set of artifacts, it is possible to trace back fragments of servomechanisms, game theory, and operational reasoning long before 1940. One can cite, as Wiener often did, fragments by James Clerk Maxwell, Leibniz, and many others who attended to issues of self-regulation, interconnection, and communication. Wiener, for example, knew perfectly well that the nineteenth century had a well-developed theory of the steam-engine governor, and by the 1920s electrical analogues in the form of voltage regulators were legion.

As Otto Mayr has so exhaustively demonstrated, pre–twentieth century feedback devices were culturally located quite differently from sys-

83. Wiener, *God and Golem, Inc.: A Comment on Certain Points where Cybernetics Impinges on Religion* (Cambridge, Mass., 1964), p. 95.

84. See Haraway, "A Cyborg Manifesto," p. 163.

disputants on one side."[90] Differing from Hobbes (Wiener did not believe that people were fundamentally selfish), he nonetheless saw morality as a conflict not resolved in the distant past but as continuing into the here and now. Such a relentless struggle continued in the cybernetic weltanschauung, though it took a new, scientific, and more subtle form, embracing not only morality but our relation with the world itself. Wiener queries whether the world is an active (Manichean) opponent or merely a passive (Augustinian) antagonist, the only difference being that the "Manichean devil" used tricks, craftiness, and dissimulation against us, while the "Augustinian devil" did not change methods: "The difference between these two sorts of demons will make itself apparent in the tactics to be used against them" (*HU,* p. 35). To Wiener, the essential and unrelieved reality of the world was that the individual lived in isolation, struggling (searching for tactics) to create order out of chaos. Science itself, as it faced nature, was such a battle: "The scientist," he declared late in life, "is always working to discover the order and organization of the universe, and is thus playing a game against the arch enemy, disorganization. Is this devil Manichean or Augustinian? Is it a contrary force opposed to order or is it the very absence of order itself?" (*HU,* p. 35). Cybernetics, that science-as-steersman, made an angel of control and a devil of disorder.

But perhaps disorganization, noise, and uncontrollability are not the greatest disasters to befall us. Perhaps our calamities are built largely from our efforts at superorganization, silence, and control.

90. Wiener, "The Highest Good," *The Journal of Philosophy, Psychology, and Social Methods* 11 (Sep. 1914); rpt. *Norbert Wiener,* 4:49.