Being Human in Postwar American Thought and Culture: A History from the Cybernetic Perspective

by

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Abstract

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In the late 1940s and early 1950s, cybernetics offered the idea that man and machine could be understood using the same functionalist analysis. In the form that mathematician Norbert Wiener popularized it, cybernetics was also deeply conflicted by the implications of this common analysis, and fought to preserve the idea that true thinking was a uniquely human capacity. During a period when many scientists were re-examining the role science ought to play in the postwar age, the cybernetics conferences sponsored by the Josiah Macy, Jr. Foundation were a forum for discussing the nature and role of science. Cybernetics is particularly well suited to cultural history, since it resonated with an American cultural mood that included Cold War anxieties, and worries that communism indicated that human beings could degenerate into unthinking, perfectly obedient robots. The Macy conferences as well as Norbert Wiener's published books emphasizing the dangers of the nuclear and machine age – urgent problems to which cybernetics might provide solutions – attracted a reasonable amount of attention from the popular press. The idea of the individual was also widely perceived to be under threat, ostensibly due to the mindless conformity of postwar life. This thesis explores the ways in which cybernetics understood, affected, and reflected the conceptions of human beings and machines dominant in postwar American thought and culture. Reading cybernetics in light of the cultural preoccupations of the period shows that far from being the prophetic movement historians have often thought, it was very much rooted in its time. Other historians have argued that cybernetics was the foundation of a new era in American thought and culture, bringing about a period that N. Katherine Hayles calls posthuman. The thesis concludes with a critical examination of posthumanism and its relationship to cybernetics.

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Acknowledgments

" 'At this rate,' he meditated gloomily, 'I'll have crossed out all four installments before I've got even one written.' "

Dawn Powell, *The Wicked Pavillion*

This has been a long haul. I'm grateful for this space in which to indulge myself.

I worked on this thesis in three different cities over a four and a half year period. I want to thank all those café owners who didn't seem to mind when, desperate for a different set of walls and some background noise, I lingered for two hours over a measly cup of coffee. Innumerable Second Cups and Starbucks, of course, but also the new Bridgehead Coffeehouse around the corner from my current apartment in Ottawa, Café l'Ange, where the kind owner showed too much interest in what I was writing for me to screw up the courage to return, Futures Bakery in Toronto, which was only too happy to indulge my graduate student pretensions, the Connecticut Muffin in Brooklyn Heights for their generous supply of electrical outlets and comfortable seating, and above all, Tillie's of Brooklyn, kitty-corner from the unbelievably expensive 342-square foot apartment I shared with my husband and our neurotic cat. Tillie's attracts other lonely thesis writers and has beautiful big windows looking out onto DeKalb Street and its fascinating variety of pedestrians. The staff play good music and freely criticize the commercially successful careers of New York City television actors. And my undying gratitude to every one of these establishments for being air-conditioned, because my apartments were not.

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Introduction

In one respect, Wiener's book resembles the Kinsey Report: the public response to it is at least as significant as the content of the book itself. [1]

What you are holding is not a history of cybernetics. Rather, it is a history of the meaning of being human in American thought and culture in the period following World War II, and the ways in which cybernetics affected and reflected this. Cybernetics, or the study of communication in machines and living things, reached a high-water mark in influence in the early 1950s. This was coincident with a number of meetings held by a diverse group of scientists who wanted to share their ideas and apply recent work in engineering and mathematics to the social sciences. Ten meetings took place between 1942 and 1952. All but one were held at the Beekman Hotel in New York City, and they came to be known by the name of their sponsor, the Josiah Macy, Jr. Foundation. The participants in the Macy conferences included some of the mathematicians and engineers who were the architects of the modern computer, as well as physiologists and psychologists who wanted to understand human thought. It was a gathering-place for those who studied the mind and those whose ambition was a machine that could think. These topics attracted significant popular attention, and would have done so even if the conferences had never taken place and popular books on cybernetics had never seen the light of day. But the Macy conferences and the popular books on cybernetics fuelled the growing public interest in man-machine relations, an interest which resonated strongly with the broader culture of Cold War tensions, factory automation, the growing role of

[1] Pierre de Latil, *Thinking by Machine: A Study of Cybernetics,* Y. M. Golla, trans. (Boston: Houghton Mifflin, 1957) 16-17, paraphrasing "Machines that Think," *Business Week* (19 February 1949).

computers, and an overall concern with the meaning of being human. The mathematician who coined the term cybernetics, Norbert Wiener, quickly became synonymous with these concerns in the public mind, thanks to his popular books, articles, and speeches.

The popular attention stemmed from a widespread but often unexamined belief that man and machine were profound opposites. If we study this belief in the context of the literature on cybernetics and man-machine relations aimed at a general audience, however, we learn that popular conceptions of man and machine were much more ambiguous than they might at first appear. The brain-washing scare of the 1950s, for example, unabashedly treated man as a potential machine. Successful brainwashing was supposed to exploit a human being's mechanistic tendencies, leaving its victim without a mind to call his own. Conversely, reporters spoke of the cybernetic automata and robots in terms usually reserved for pets or infants, partly because they were so much smaller than the huge and uncuddly computers, but also because they evinced a curiosity irresistibly reminiscent of babies and familiar animals.

News features on automata reflected the optimism cybernetics could inspire. But optimism was not wholly characteristic of the popular understanding of cybernetics, nor was it characteristic of the cybernetic movement itself. Cybernetics reflected in miniature the ambiguity of these new machines in American thought and culture, and their contradictory implications for human dignity. Computers, or 'electronic brains,' did not arouse the indulgent baby-talk that the automata did, although they were constructed on similar principles. The automata served to entertain or to model, and did little to affect daily life. Computers, on the other hand, posed obvious threats – unemployment, nuclear destruction by the push of a button, and humanity's obsolescence. The computer also propelled the image of man as a robot – mechanical and impervious to any appeal. Robots were linked to communism in the American imagination, since communism was feared partly because it seemed to punish individual thought and treat its subjects as machines. The fear of the human being becoming a machine, therefore, was at least as strong an impulse in the American imagination as the fear of a thinking machine run amok. Similarly, during the public debate over automation in the 1950s, both sides stressed the importance of preventing the human being from being treated like a machine, and continually returned to the idea that human beings had to be free to develop their minds in order to attain the fullest possible humanity.

This came at a time when many Americans feared that human individuality was in danger of extinction. Books like *The Lonely Crowd* (1950) and *The Organization Man* (1956) contributed to the widespread concern that American postwar culture placed too great an emphasis on conformity rather than on the individualistic virtues that were presumed to have built the nation. The postwar rebellion against conformity among intellectuals and artists served to strengthen the conviction that to be fully human, one had to develop one's mind. And other cultural developments supported the centrality of mind. The meteoric success of psychology had substituted a secular mind for the older notion of the soul.[2] Newspapers and magazines carried frequent accounts of the regimentation and the atrocities of the Nazis throughout the late 1940s and early 50s.

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[2] Ian Hacking has argued that it was specifically the sciences of memory that secularized the soul: "But we have learned how to replace the soul with knowledge, with science. Hence spiritual battles are fought, not on the explicit ground of the soul, but on the terrain of memory, where we suppose there is such a thing as knowledge to be had." *Rewriting the Soul: Multiple Personality and the Sciences of Memory* (Princeton: Princeton Univ. Press, 1995) 5.

They also published increasingly severe warnings of the unyielding strictness of communism, which seemed a clear example of how easily human beings could become machines. Cybernetics frequently stood guard against the potential mechanization of the human being – a fascinating stance, since it also believed the mind to be a kind of machine. The public generally overlooked the contradiction, likely because cybernetics was the double beneficiary of postwar attitudes to physical science. Physical science was at once prestigious and contemptible, thanks to the spectacular power of the atomic bomb, and its brutal effects. Cybernetics was a physical science, and therefore held the key to nature's secrets. Unlike atomic science, however, it was not directed to military ends, and in comparison appeared to be the very embodiment of research directed to the improvement of the human condition. In some popular writing, including Wiener's, cybernetics was even offered as a way to resolve international tensions through its precise understanding of the human mind.

These conceptions of humanity and human potential were very different from those dominant before the war. Anson Rabinbach has documented the idea of the human being as a site of energy conservation and conversion in the late nineteenth and early twentieth centuries in his book *The Human Motor* (1990). The idea of the labouring body is familiar to most readers from the work of the engineer Frederick Winslow Taylor, father of scientific management, whose efforts to pin down the most economical use of physical energy in his time-and-motion studies are a frequent reference point in cultural histories. In contrast, the major figures in the 1950s automation debates were not very concerned with the effects the factory line had on the labouring body, since machines appeared to be about to eliminate hard physical work, and legislation had taken care of many of its risks. The debate about the dehumanizing effects of factory production shifted from physical to mental conditions. Sociologists and engineers alike questioned the mindlessness of the production line. Some believed computers would wipe out the few opportunities labourers had to exercise their judgment. Some believed that computers would encourage labourers to enter the professional classes – even when physical work was eliminated, someone would have to look after the computers. Others hoped that complete automation would free those workers to develop their minds more fully during their bountiful leisure time.

The shift in emphasis from body to mind is also apparent in comparisons of the automata and robots from before and after the war. Early twentieth-century automata shared the characteristics of the automata of earlier centuries. René Descartes famously asked how he could know that the men he saw crossing the square were men and not automata, and his question retained its vividness for the succeeding three centuries. Automata mimicked essentially physical qualities, and they looked like their real-life counterparts. They began to change around the time of World War II. The robot mascots for the 1939 World's Fair in New York looked roughly like a man and a dog, but there was an obvious artificiality to their craftsmanship. Their unpainted metal and angularity emphasized their manufacture, manufacture that was a symbol of the future that the fair celebrated. In the scientific workshops, however, automata bore only passing resemblance to their namesake rats and tortoises. More and more, they were designed to illuminate mental processes rather than mimic physical processes – puzzle-solving, or navigation around obstacles. Their craftsmanship was judged by the sophistication of their thinking, rather than their physical mimicry. This was especially true of the chess-playing computers. There was no need to make these computers look like human players, since the source of their uncanniness lay in their ability to beat good human players. On the one hand, they were obviously not human. But the introspection and anxiety they inspired could only be the result of a belief that thinking had to be uniquely human, a conviction that became firmer with each new example of a thinking machine.

Wiener, who was the public face of cybernetics, was excited about the potential of these mechanical creatures. At the same time, he was deeply worried about the increasing mechanization of society and the threat that automation posed to a uniquely human capacity for thought. "The modern industrial revolution," he wrote, " is...bound to devalue the human brain, at least in its simpler and more routine decisions." He warned,

> Whether we entrust our decisions to machines of metal or to those machines of flesh and blood which are bureaus and vast laboratories and armies and corporations, we shall never receive the right answers to our questions unless we ask the right questions....The hour is very late, and the choice of good or evil knocks at our door.[3]

Yet Wiener, too, was sure that scientists and engineers could apply their knowledge of machines to understanding the human mind. In the form that Wiener popularized it, cybernetics was paradoxical – an effort to secure human dignity based on our capacity for thought, constantly undermined by the conviction that the mind could be duplicated in mechanical form.

The cybernetic analysis treated human beings and machines as functionally identical, a kind of Cartesian fantastication that to some contemporary observers has come true. These observers have concluded that human dignity and even humanity are

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[3] Norbert Wiener, *Cybernetics* (Cambridge: MIT Press, 1948) 27, 185-6.

ideas which are not worth rescuing. Scholars of the changing intellectual landscape, they argue that we are no longer human, but posthuman. Posthumanism is allied with the other big post-ism of contemporary scholarship, postmodernism, and is moved by a similarly restless discontent with the perceived self-satisfaction of most intellectual history. 'What's so great about humanism, or even being human?' they cry, and deploy dialectics to prove humanism's oppressiveness. Posthumanism, they believe, offers a fresh start, a chance at a mature understanding of history and society. But as if they had been injured once too often, they approach even this new possibility of liberation cynically, which still cannot save them from becoming mired in many of the problems they lay at humanism's door. Posthumanism is a highly unsettled term. There is far more at stake in the debate over what it means to be human than a cultural coming-of-age story, as Wiener recognized nearly sixty years ago.

Approach

Traditional history of science and technology has tended to focus (reasonably enough) on the science and technology. Even when it explores cultural background (in old-fashioned terms, 'externalist' accounts), the goal is generally to explain the effect of culture on technoscientific developments. Culture tends to play a secondary role. In this dissertation, I have given equal weight to scientific ideas and to mainstream thought in order to illuminate some of the connections between them. It is a contribution to what has been called "the new cultural history of science," or the cultural history of ideas.[4] It is emphatically not a defence of the notion that science is inevitably in culture's thrall.

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[4] Robert Howard, *New York Times Book Review* (December 16, 1990) 7.

Cybernetics is a special case, and is particularly receptive to a methodology that attempts to connect science and mainstream culture. Since it never developed into an independent scientific field, cybernetics existed mainly in the form of ideas that were shared at the Macy conferences and in publications aimed at a general audience. It was much more diffuse than the majority of scientific endeavours, which is why I frequently refer to it as the cybernetics movement.[5] Although it would be unwise to make pronouncements about the overall relationship of science and culture, the influences of culture on cybernetics (and vice-versa) are especially apparent, since it relied at least as much on ideas of what constituted communication, learning, and thought as it did on scientific modelling and experiment. It can therefore provide insight into the American *mentalité* in the mid-twentieth century. This is a history of how things seemed to those who worried about man, machine, and the meaning of being human.

That said, it is difficult to find smoking guns. Twentieth-century scientists frequently kept things like departmental memos and speaking invitations, which contributed to the mounting ephemera in the archives, but diary-keeping and lengthy letter-writing were no longer fashionable pastimes. The Norbert Wiener Archive at the Massachusetts Institute of Technology is a striking example of this. Carbon copy paper ensured that his responses to invitations made it into the archive, but by the time he was involved in the Macy conferences, he was likely too busy to write the personal letters that occupied his time while still a student. The Warren S. McCulloch Papers at the American

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[5] David Mindell's recent book might be seen as the complement to this, since it deals with the material history that inspired cybernetics. I am primarily interested in ideas, which sometimes found material instantiations. *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Baltimore: Johns Hopkins, 2002).

Philosophical Library in Philadelphia show a similar pattern. Another problem is that the collected papers of twentieth-century scientists are often highly redundant when it comes to answering questions about what they were thinking. The archives generally contain rough draughts of work that was later published, and therefore add little to a good library collection. These draughts sometimes show subtle changes from their published forms, of course, but rarely do the basic ideas deviate from what was eventually published. Many of the cyberneticians were in their peak career years while the Macy conferences were taking place, and rejection notices from journals and publishing houses seem to have been extremely unusual. In any case, neither journalists nor the public were reading the private papers of scientists – they were reading their popular books and the media accounts of scientific work. In order to develop an account of the themes common to cybernetics and mainstream culture, I have used primary source material that might under other circumstances be considered secondary sources. Contemporary commentary on society and cybernetics is crucial to understanding the ideas of being human dominant in the 1940s and 50s.

Wiener published two well-received general books on cybernetics, and newspapers, magazines, and middlebrow periodicals like *The Atlantic* and *Scientific American* frequently published pieces that touched on the concerns shared by cybernetics. Cultural observers from various fields produced books that attempted to understand the social and technological changes that had taken place after the war.[6] As for the cyberneticians themselves, transcripts were produced for the final five conferences (unfortunately, there is no usable record of the first five).[7] This is a valuable and unusual record of scientific conversation. The conferences generally followed a pattern of a short presentation, followed by lively and unrestrained discussion. The objections and counter-objections of the cyberneticians resonate strongly with the fears and dreams expressed in the documentation of more mainstream culture, and careful comparison of the themes arising from all these sources produces an understanding of man-machine relations, and more importantly, the idea of being human, in postwar American thought.

This approach is quite different from the way other historians have treated cybernetics. There are three major histories of cybernetics in the 1940s and 1950s – N. Katherine Hayles's *How We Became Posthuman* (1999), Jean-Pierre Dupuy's *The Mechanization of the Mind* (published in French in 1994), and Steve Heims's *The Cybernetics Group* (1991). Heims uses the transcripts of the Macy conferences as the basis for a series of biographical accounts of the scientists involved and their interactions with one another. Dupuy aims to pick up where Heims leaves off, and argues that the cyberneticians were pioneers in the development of a scientific account of mind. Hayles is a professor of English, and her book traces themes common to cybernetics and major works of science fiction. In addition to these, there are smaller works dealing with the history of cybernetics: Peter Galison's paper "The Ontology of the Enemy," (1994),

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[6] To illustrate a point, I have sometimes used such books that were published in the 1960s or even the 1970s. Experience has taught me to point out explicitly: these are being used as primary sources, not secondary sources.

[7] Margaret Mead took notes on the first five conferences. These still exist as part of her papers held by the Library of Congress. Unfortunately, they are in her personal shorthand, which has so far remained undecipherable.

Evelyn Fox Keller's essay "The Body of a New Machine" (1995), and Andrew Pickering's "Cyborg History and the World War II Regime" (1995) are the most detailed of these.[8] In the face of such a wealth of analysis, it would be pointless to produce another history of cybernetics and the Macy conferences from the perspective of straightforward history of science. But a work connecting cybernetics to broader cultural preoccupations has not been written until now.

Superficially, this approach appears to have the most in common with Hayles's book, which galls me not a little. There are two fundamental distinctions between this thesis and *How We Became Posthuman*, no matter that I agree with Hayles that it is important to study science in light of other cultural endeavours. First, posthumanism cannot offer the liberation she hopes for, nor is its connection to cybernetics straightforward. This is the subject of my final chapter. Second, I have largely avoided fictional accounts (novels and films), except where they serve to illustrate fears and hopes that were also covered in media accounts (newspapers and magazines). Occasionally, when a film or a novel contained a particularly sharp example of our beliefs about humans and machines, I have mentioned it, but only when the technology portrayed in the fictional account actually existed. Depictions of imaginary technology are not only overwhelmingly great in number (Hayles had to severely limit the novels she examines), but they muddy the question of how mainstream culture responded to the actual science. Fiction often imagined the worst possible scenarios, usually machines enslaving humanity in some way. There is a more subtle but ultimately more interesting strain of

[8] Other historians, like Donna Haraway and Lily Kay, have dealt with cybernetics in passing, and I mention their work where it is relevant in the body of this thesis.

history to be found in the thoughts people had about actual or imminent technology (or, in the case of brainwashing, techniques they believed to exist).

Hayles sees cybernetics as one of the forces behind the era of postmodernity. Most other historians who have examined cybernetics agree – Galison, Fox-Keller, and Pickering all believe that cybernetics and similar scientific efforts marked the beginning of a new age. In some ways, this is true, but historical tipping-points are fiendishly tricky to identify. Intellectual and cultural milieux do not change overnight, and cybernetics had as much in common with pre-war modernity as it did with the changes that took place following the war. In its simultaneous efforts both to defend the uniqueness of the human mind and to replicate it in the scientific workshop, cybernetics was a highly ambiguous movement – yet unconsciously so. This unconscious ambiguity is emblematic of high modernity. Where the postmoderns accept the contradictions between progress and tradition (and usually gleefully exploit them), twentieth-century moderns often hoped to resolve them – or, in the case of cybernetics and man-machine thinking in general in the 1940s and 50s, did not recognize how intractable they were. It is important to remember that ambiguous attitudes toward the thinking machine have largely become historical artifacts. Aspects of the older metaphorical use of the unstoppable machine survive – 'the American war machine' is a fine current example – but the thinking machine has largely become a tool that we are confident we control.[9] The four decades following World War

[9] Sherry Turkle's work is significant in this regard. Her book *The Second Self* (1984) documented children's belief in an animating spirit behind the computer. Her book *Life on the Screen: Identity in the Age of the Internet* (1995) revealed a culture that was much more secure in viewing the computer without any sense of rivalry.

II may have been the thinking machine's last truly dangerous role in American thought and culture. This thesis deals mainly with the first of these decades.

This ambiguity, combined with the effort to understand popular conceptions of man and machine, made Wiener the only possible choice for a protagonist. Wiener's popular books demonstrate the same kind of ambiguity and contradiction that existed in mainstream culture. Other cyberneticians were much less disturbed by the possibility that the mind might be a kind of machine – Warren S. McCulloch eagerly welcomed it. McCulloch's role in this history is a fundamental difference between this thesis and Dupuy's book. Dupuy picks McCulloch for his central figure, a choice that makes sense given that Dupuy analyzes the role that cybernetics played in the intellectual foundations of contemporary cognitive science. But for an exploration of the effects of cybernetics outside of science and a comparison of cybernetics with broader culture, Wiener's your man.

Roadmap and nota bene

This thesis is arranged in five chapters. The first explores the development of the idea of the human being as a thinking and communicating device in cybernetics, beginning with the role of noise in the culture of high modernity, moving through a critique of the major histories of cybernetics, and finishing with an overview of the concepts that are fundamental to this new understanding of the intellectual history of cybernetics. Chapter 2 deals with the relationship between cybernetics and Cold War culture, presents an original take on the origins of the idea of pure science, describes the open atmosphere of the Macy conferences, and concludes with an examination of the brain-washing scare that shook the United States in the 1950s. (Surprisingly, historians of science have until now neglected brainwashing – it is perhaps the clearest demonstration of a mechanist conception of humanity in twentieth-century American culture.) Chapter 3 deals with cybernetics and the automation debates in the 1950s, the ambiguous role of the machine in American thought, and ideas of how human beings were to achieve their fullest possible potential through their minds. Wiener wrote and spoke extensively on factory automation, and this chapter presents a fresh view of his work. Chapter 4 examines the automata that the cyberneticians built, which have been given short shrift in the history of science. It also looks at chess-playing machines, and analyzes what the cyberneticians and cultural observers thought these various thinking machines might mean. The final chapter is less historical. It takes up the question of posthumanism posed by other historians of cybernetics. It questions whether cybernetics can fairly be called posthumanist, and sketches out the problems inherent in a posthumanist analysis.

Nota bene: I have tended to use the term 'man-machine relations,' and have usually used the masculine pronoun for the examples of human behaviour proffered by the people I have studied. This was deliberate. At the time, these thinkers were indeed thinking of men, even if these were highly abstract men. Women rarely figured in their examples. This also indicates that it was particular kinds of machines that social observers had in mind: first the steam engine rather than the telephone, and later the computer rather than the automobile, let alone the automatic washing machine. They imagined a masculine world, which heightened the drama of the meeting of human and machine. It relied on and also evoked the countless mythic encounters of man and machine. Most historians nowdays are careful to avoid this kind of exclusion – Galison, for example, prefers the expression 'human-machine relations,' and when forced into specificity, uses quotation marks to show his awareness of the problem: 'man.' I hope that my deliberate and obvious use of the masculine terms will take the contemporary reader slightly by surprise, and make her (or him) that much more aware that this particular corner of twentieth-century culture was undeniably masculine.

Chapter 1: Order Wrenched from Disorder

The evolution of noise

Listen to this:

> And now let us imagine how into this world, built on mere appearance and moderation and artificially dammed up, there penetrated in tones even more bewitching and alluring, the ecstatic sound of the Dionysian festival; how in all these strains all of nature's *excess* in pleasure, grief, and knowledge became audible, even in piercing shrieks; and let us ask ourselves what the psalmodizing artist of Apollo, with his phantom harp-sound, could mean in the face of this demonic folk-song![1]

So wrote Freidrich Nietzsche in 1872, proving once again modernity's prophet. By the early twentieth century, prominent composers were rejecting classical definitions of key and meter, experimenting with unusual rhythms, and scattering their music with enough accidentals that key signatures were reduced almost to suggestions. The Italian futurist Luigi Russolo demanded even more radical changes, calling for sounds that combined "the noises of trams, explosions of motors, trains, and shouting crowds." These concerts never went beyond a minority taste – his attempt to combine the new instruments with the old in a Paris concert held in 1921 was ill-received.[2] Most Parisians, like urban dwellers elsewhere, preferred that the industrialized world of modernity be silenced as much as possible. However, noise was impossible to escape, and it became the subject of a variety of investigations.

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[1] Neitzsche, *The Birth of Tragedy*, in Walter Kaufmann, trans. *The Birth of Tragedy and the Case of Wagner* (New York: Vintage Books, 1967) 46.

[2] Luigi Russolo, "The Art of Noise," in Richard Kostelanetz and Joseph Darby, *Classic Essays on Twentieth Century Music* (New York: Schirmer Books, 1996) 37.

Historian Stephen Kern, who has chronicled the relationship between noise and modernity, cites William Dean Howells's disgust with the desecration wrought by urban noise in progressive-era New York City:

> People are born and married, and live and die, in the midst of an uproar so frantic you would think they would go mad of it....Imagine...a wife bending over the pillow of her husband to catch the last faint whisper of farewell, as a train of five or six cars goes roaring by the open window! What horror! What profanation![3]

The city government was worried, too. In 1930, the New York City Noise Abatement Commission prepared a questionnaire to determine the sources of urban noise. Although it was printed in all the metropolitan newspapers, the commission collected only a little more than 11,000 noise complaints, an indication to one contemporary observer "that either that the majority of the citizens were not that interested, or that noise did not affect them seriously."[4] Perhaps the citizenry merely believed that little could be done to quiet the city. In any case, the lack of response did little to allay the Commission's fears. In their report to the Commissioner of Health, they compared the physiological and psychological effects of noise to shell-shock. They wondered whether it was possible to achieve "noiseless progress," despite a list of nearly thirty sources of urban noise, including subways, construction, car horns, delivery vehicles, newsboys, and noisy parties.[5] All these unwanted sounds led not only led to hearing loss, sleep loss, and

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[3] William Dean Howells, *Through the Eye of the Needle* (New York, 1907). Cited in Stephen Kern, *The Culture of Time and Space* (Cambridge: Harvard University Press, 1983) 126.

[4] Norman William McLachlan, *Noise: A Comprehensive Survey from Every Point of View* (London: Oxford University Press, H. Milford, 1935) 124.

[5] New York City Noise Abatement Commission, *City Noise: Report to Shirley W. Wynne, Commissioner of Health* (New York, 1930) 106, 27.

consequent fatigue, warned the commission, but to psychophysical disorders such as neurasthenia and psychasthenia – in short, they were a grave threat to the smooth functioning of society and the efficiency of the worker.[6] Others were less alarmed, but insisted on the need to quiet noisy living conditions as much as possible, since "the noise seems to act as a catalytic agent or accessory factor, thereby inducing or accentuating a nervous state....so the effect of noise must be regarded seriously."[7]

Some of the sources of noise in the modern urban soundscape had only recently become common. The radio, the telephone, and the telegraph brought with them a bevy of engineers devoted to perfecting the new communications technologies. By the early decades of the twentieth century, entire research departments were organized around the effort to improve communication by eliminating electronic disturbance, which was also known as noise. It was called noise for the simple reason that it interfered with the intelligibility of the signal, in the same way that literal noise hampered conversation. The telephone converted the human voice into an electronic signal, and any electronic noise interfering with it became literal noise on the line. Literal and metaphorical noise overlapped considerably during World War II, as scientists redoubled their efforts to minimize the two kinds of noise. Electronic noise caused precious information to be lost. Literal noise made gunners deaf, interfered with pilots' perception, and rendered messages unintelligible by the inescapable din. Communication between aircraft carriers and fighter planes was poor, for example, partly because of the equipment's limited capacity to maintain signal integrity, but also because the noise of engines and gunfire overwhelmed the puny human voice. Even within sight of the safety of the hangar, the

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[6] Ibid., 110.

exhausted pilots of long-range bombers were in danger because of noise: "airplanes returning from long flights were crashing short or to one side of the landing fields for no other reason than the stultifying reaction of engine roar upon the pilot's perception."[8] The relentlessness of literal noise made the electronic metaphor that much more effective – it was vital to eliminate it.

Before and during the war, literal noise was a powerful symbol of the merciless speed of modernity. But intellectual history does not always follow the most obvious route. Thanks to the sciences of communication that arose during the 1940s and 1950s, it was metaphorical noise that was fundamental to the conception of the human being that dominated the popular and scientific imagination in the post-war period. The scientific study of communication was initially classified, like all wartime research, but versions of it were published by the late 1940s. Claude Shannon's "The Mathematical Theory of Information," which set precise definitions of messages and communication, was published in 1948. In the same year, mathematician Norbert Wiener produced a small volume called *Cybernetics, or Communication and Control in the Animal and the Machine*. Wiener coined the term cybernetics to refer to a new field of scientific inquiry which was to have broader research interests than Shannon's information theory. "We have decided to call the entire field of control and communication theory, whether in the machine or in the animal," he wrote, "by the name *cybernetics*."[9] Shannon and Wiener

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[7] McLachlan, 130.

[8] *Business Week* (19 January 1946), 54.

[9] Norbert Wiener, *Cybernetics* (Cambridge : MIT Press, 1948) 11; Claude Shannon, "The Mathematical Theory of Communication." *Bell System Technical Journal* 27 (July and October 1948): 379-423 and 623-656. See also William Aspray, "The Scientific Conceptualization of Information: A Survey," *Annals of the History of Computing* 7 (April 1985): 117-140; W.V. Slack, "Claude Shannon and Communication

recognized that if communication was a matter of transmitting signals, not simply conversation, then far more than the telephone and the telegraph could be conceived in terms of information transmitted through discrete channels. Information was the pattern to be discerned in the chaos, the inverse of entropy. Three cyberneticians would later write, "If noise is defined as random activity, then information can be considered as order wrenched from disorder, as improbable structure in contrast to the greater probability of randomness."[10] The particular contribution of cybernetics was the recognition that problems in physiology, sociology, and psychology could also be conceived in terms of information, communication, and self-regulation through feedback control. These ideas made the organism into a communicative device. More importantly for the course of intellectual and cultural history, they made the human being into a communicative device. It was an idea that exercised a powerful hold on the American imagination during the postwar era, and fit neatly with a broader intellectual movement that found our humanity in our unique capacity for thought. This reconception of the human being is a rich and largely unexplored topic, with parallels in fields far beyond engineering and mathematics.

The cyberneticians believed that they could design machines with the capacity to learn. Weiner began *Cybernetics* with the suggestion that feedback devices, properly arranged, could be used to make an engineer's white box (a device with known workings)

Theory," *MD Computing* 14 (July/August 1997): 262-264.

[10] Heinz von Foerster, ed. *Cybernetics: Circular, Causal, and Feedback Mechanisms in Biological and Social Systems* 8 (New York: Macy Foundation, 1952) xiii. Only the transcripts of the last five of the ten conferences on cybernetics were published. There is no useful record of the first five – see Steve Heims, *The Cybernetics Group* (Cambridge: MIT Press, 1991) 18, 74. The transaction volumes were published the year following each conference. Hereafter, *Transactions* and the volume number.

into the functional duplicate of a connected black box (a device with unknown workings). The white box, Wiener believed, would then have assumed "a structure based on past experience," which meant that it had demonstrated the capacity to learn. Conclusions like these struck many outside of cybernetics as outrageous, as we shall see, but the cyberneticians had come to them through the examination of living things. Neuropsychiatrist Warren McCulloch and mathematician Walter Pitts, prominent figures within the cybernetics movement, published a paper in 1943 showing that the neural activity of the brain could be represented with symbolic logic, and Wiener consistently argued that the conditioned reflex was evidence of unconsious learning, since it demonstrated that information was stored "in the permeability of the synapses."[11] The new emphasis on feedback of information and the idea that the capacity to store, communicate, and act on information demonstrated the rudiments of thought may have had some basis in biology, but the inspiration was clearly mechanical. When applied to the human being, reconceived as a thinking or communicating device, the effects rippled far beyond cybernetics. The machine had long been the opposite of the mind – ingenious automata might occasionally fool even the most obdurate skeptics, but this was generally due to their physical resemblence. In any case, a machine could no more think than a parrot could talk. Cybernetics, by making thinking into the storage and communication of information, rendered the problem of distinction moot, only to run into a broader cultural belief that thinking was a uniquely human characteristic. This belief had been growing stronger in the interwar years, as the old industrial economy – which had highlighted the physical capacity of the human body – began its slow decline. The cybernetic automata

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[11] *Cybernetics* xi-xii; McCulloch and Pitts, "A Logical Calculus of the Ideas Immanent in Nervous

became fascinating ambiguities, signs of both the resolutely non-human and dangerous usurpers of human privilege.

The human being as a thinking and communicating device was fundamental to the transformation of American culture in the decades following the war. Social scientists and other close observers of the American scene believed they were witnessing the beginning of the "information society," a term which gained wide use by the 1970s. The information society is a society organized around knowledge, facilitated by telecommunications, computers, and what Daniel Bell called "intellectual technology": those techniques, such as game theory, communication theory, and cybernetics, "whose results apply to problems of organized complexity."[12] In the information society, scientific and technical knowledge are the measure of a nation's power. Their prominence represents a profound change in the very notion of technology. "Whereas people of the nineteenth and early twentieth centuries identified technology with the work-performing, energy-transforming machine," a contemporary observer noted, "we are learning to identify technology with other forms of information and control."[13]

Activity,"*Bulletin of Mathematical Biophysics* 5 (1943): 115-133; *Cybernetics* 130.

[12] Daniel Bell, *The Coming of Postindustrial Society* (New York: Basic Books, 1973) 29. James Beninger argues in *The Control Revolution* that the technological changes that led to the information society are much older; they are to be found in the control engineering of engines, mass production and distribution, and mass consumption that developed during the period from the industrial revolution to the early twentieth centuries. Beninger's effort to give the information society a larger context than the postwar period is laudable, but ultimately not very plausible, likely because he wishes to fit the control revolution into a highly ambitious vision of the history of civilization. (Cambridge: Harvard University Press, 1986). For a criticism of conventional thinking about the information society, see Kathleen Woodward, ed. *The Myths of Information: Technology and Postindustrial Culture* (Madison WI: Coda Press, 1980), which includes an essay by Jean-Pierre Dupuy, whose recent history of cybernetics plays an important role in this dissertation.

[13] William Kuhns, *The Postindustrial Prophets: Interpretations of Technology* (New York: Weybright and Talley 1971) 8.

Beginning in the postwar period, the white-collar professionals who organized information for a living increased steadily in numbers and influence. There were obvious material signs of such a change, too, as computers increasingly took over the simpler tasks in record-keeping. The scientists who met in the 1950s to discuss cybernetics were aware that their work was on the cusp of a series of social and technological transitions. In 1950, Wiener – who wrote a number of books for a general audience – published *The Human Use of Human Beings*, which was filled with grave warnings about the decisions society faced.[14]

The Human Use of Human Beings aimed to introduce cybernetics to as wide a readership as possible. However, it was not always clear what kind of science this new field was, for Wiener's writing was often more suggestive than definitive. The vagueness that plagued cybernetics provoked philosopher Kenneth Sayre to state, "There is no recognized philosophic theory or school which could properly be termed cybernetic." He added, "The term 'cybernetics' has not been universally accepted by mathematicians and engineers in this country, who often prefer to speak instead of information theory and the theory of feedback and control." [15] Information theory was restricted to a smaller range of problems, such as minimizing electronic noise, that fell within the established boundaries of engineering. The cybernetic concern with social and philosophical problems meant that for many natural scientists and engineers cybernetics could be, at best, a recreational rather than professional interest. Wiener hoped that it would go much further:

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[14] Norbert Wiener, *The Human Use of Human Beings* (Cambridge: MIT Press, 1950).

[15] Kenneth Sayre, "Philosophy and Cybernetics," in Frederick J. Crosson and Kenneth Sayre, eds. *Philosophy and Cybernetics* (Notre Dame: University of Notre Dame Press, 1967)1, 29, note 1.

> There are fields of scientific work...which have been explored from the different sides of pure mathematics, statistics, electrical engineering, and neurophysiology; in which every single notion receives a separate name from each group, and in which important work has been triplicated or quadruplicated, while still other important work is delayed by the unavailability in one field of results that may already have become classical in the next field. It is these boundary regions of science which offer the richest opportunities to the qualified investigator.

He went on,

> We had dreamed for years of an institution of independent scientists, working together in one of these backwoods of science, not as subordinates of some great executive officer, but joined by the desire, indeed by the spiritual necessity, to understand the region as a whole, and to lend one another the strength of that understanding.[16]

Cybernetics was more than intellectual technology. It was a manifesto. Historians have written about this, but have not yet recognized its greatest implications. Cybernetics became an intellectual movement that aimed at nothing less than a scientific re-evaluation of what it means to be human. In the postwar era, it attracted followers from a wide range of backgrounds, since its method consisted of sweeping aside disciplinary boundaries by categorizing problems in terms of communication and control.

Interdisciplinarity was all the rage in American scientific circles in the 1940s. In 1944, the Inter-Scientific Discussion Group began at Harvard, soon renamed the Institute for the Unity of Science after its European predecessor. The European unity movement had hoped to banish all theology and metaphysics through the power of logical positivism, and forge a purified scientific method that would ensure the exclusion of

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[16] Wiener, *Cybernetics* 2, 3.

pseudo-scientific riff-raff. The American Institute had even grander dreams. Peter Galison writes, "The truly staggering feature...is that in these first months of the *pax Americana*, this group of scientists, humanists, and philosophers could take on God and Morality as problems – and fully expect to solve them."[17] The Institute took a strong interest in cybernetics as a set of methods for solving both technological and social problems. Their can-do optimism is easy enough to understand in the context of the American war effort, but interdisciplinary enthusiasm did not subside during the postwar era. Even in the late 1940s, the interdisciplinary movement "seemed to partake of a naïve and almost desperate optimism, as if the world's most insoluble problems could be magically eliminated."[18] This is remarkable given that the state of postwar science offered few reasons for optimism. Although funding was available on an unprecedented scale, science was increasingly reliant on the military for that funding. The Cold War had sparked an escalating nuclear arms race, and no one could be certain that those weapons would not be used.

And there were other things to worry about: mass strikes in 1946 were symptomatic of the difficulties of American society in returning to a peacetime economy. These difficulties are the subject of many of the films of the late 1940s and early 1950s. The film *The Best Years of Our* Lives (1946, based on MacKinley Kantor's novel) chronicles the troubles of both veterans and civilians in establishing peacetime lives. In *The Man in the Grey Flannel Suit* (1956, based on Sloan Wilson's novel), Tom Rath (Gregory Peck) is haunted by the war. For the majority of the film, he is unable to

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[17] Peter Galison, "The Americanization of Unity," *Daedalus* 127 (1998): 67-8.

[18] William Graebner, *The Age of Doubt: American Thought and Culture in the 1940s* (Originally 1991, Waveland Press, 1998) 88.

commit himself to either his promising advertising career or to his wife and family. Although he does choose domesticity in the end, the film's portrayals of family life are bleak. The end of the war is shown to have brought only a limited kind of relief. In the uncertain postwar world, there were few things that lived up to their promise.[19]

However, faith in science remained largely unshaken, as William Graebner has shown. The majority of scientists held to their conviction that they could help in some small way to make the world a better place. The public shared their faith: even those scientists who were publicly critical of the close ties between science and the military, notably Albert Einstein and Robert Oppenheimer, were powerful moral voices *because* they were scientists. Although the development of the atomic bomb loomed large in societal memory, and the intensifying Cold War subjected scientific work to the pressures of national interest, "the high rationality of science and the high science of reason remained positive forces for most Americans." The development of pesticides and antibiotics were testament to the progress that science could bring. Even when science seemed to be part of the problem, for instance in the social problems caused by industrialization, the solution was often more science, not less. If industry was greedily swallowing the earth's limited natural resources, then science would "provide ample substitutes."[20] Vannevar Bush, director of the Office of Scientific Research and Development (OSRD), likened science to an "endless frontier," as much a part of American destiny in the twentieth century as the Western frontier had been in the

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[19] See Graebner, 14. On Cold War film and culture, see Suzanne Clark, *Cold Warriors: Manliness on Trial in the Rhetoric of the West* (Carbondale: Southern Illinois University Press, 2000) and Steven Cohan, *Masked Men: Masculinity and the Movies in the Fifties* (Bloomington: Indiana University Press, 1997).
[20] Graebner, 124, 126; "Steep Curve to Level Four," *Time*, 2 Jan. 1950, 39.

nineteenth century.[21] Scientists, exhilarated to play such an important role in this nation-making, could transfer their wartime interdisciplinary momentum to postwar problems.

The Josiah Macy Foundation in New York City had funded interdisciplinary work during the war, and continued to do so in the late 1940s and 1950s. Its mandate was to fund projects related to a broadly conceived idea of health, to "search for new methods and ideas…or operational concepts," and to encourage "the integration of knowledge and practice."[22] The key members of the Macy Foundation believed that a united scientific effort would pave the way to universal health and well-being. It was thus an important player in the golden age of interdisciplinary conferences. In 1946, Warren McCulloch secured funding from the Macy Foundation, and inaugurated the first of a series of conferences on cybernetics. McCulloch, Wiener, and nineteen other prominent scientists attended. Between 1946 and 1953, they held ten conferences, all but the last held at the Beekman Hotel at 575 Park Avenue in New York.

The Macy Conferences are a window on an important intellectual and social transition. The late nineteenth and early twentieth centuries had been dominated by metaphors of energy conservation and decline; rapid industrialization had given rise to a new category, the working class, composed primarily of factory labourers. Anson Rabinbach has argued that the new science of thermodynamics gave rise to the conception of the human motor, in his book by that title. The human motor posited the labouring body as a site of energy conservation and conversion. Supported by medicine,

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[21] Vannevar Bush, *Science – The Endless Frontier* (Washington, D.C.: U.S. Government Printing Office, 1945).

[22] Josiah Macy, Jr. Foundation, *Six Year Review, 1930-1936* (New York: Josiah Macy, Jr. Foundation, 1937) 13-14. See also *Josiah Macy, Jr., Foundation: A Review of Activities, 1930-1955* (New York: Josiah Macy, Jr., Foundation, 1955).

political philosophy, and social thought, the human motor dominated the intellectual history of Europe and the United States in the late nineteenth and early twentieth centuries. Beginning in the early decades of the twentieth century, however, and gathering momentum in the 1940s, was a new idea of the human being whose history has not been written until now. That was the idea of the human being as a thinking and communicating device, an idea that in the 1950s was at the pinnacle of its influence on American thought and culture. The labouring body had by now only a weak hold on the American imagination, and the new conception of a communicating and thinking device had taken its place. Thanks to a successful union movement and factory automation, the notion of the working class had changed substantially, and no longer supported the older conception. Cybernetics, which contributed to the technological accomplishment of automatic machinery, also developed the new metaphors that shaped the social and political changes taking place. The cybernetic metaphors of information and communication were explicit replacements for the older metaphors of energy conservation and decline. By the end of the 1960s, the new metaphors had achieved dominance; the information society had arrived. But the late 1940s and early 1950s were a period of transition between energy and information, between industrial and postindustrial. The Macy conferences on cybernetics help in understanding the intellectual and scientific developments that powered this transition.

Naturally, the cyberneticians saw themselves as the vanguard of a scientific revolution. For Wiener, it was a science that would be equal to the demands of an increasingly complex world: "The thought of every age is reflected in its technique….If the seventeenth and eighteenth centuries are the age of clocks, and the later eighteenth and nineteenth centuries constitute the age of steam engines, the present time is the age of communication and control."[23] He saw in cybernetics a powerful meta-science, and a unique opportunity for scientists to work together to solve the urgent problems of the age. Although the Macy conference participants varied in just how they thought this would happen, they shared the conviction that cybernetics held the answers to both technological and social problems. Frank Fremont-Smith, an executive with the Macy Foundation who attended all of the conferences, warned in 1949 that "the physical sciences have developed to such a point and have gotten so far ahead of the social sciences that there is grave possibility that social misuse of the physical sciences may block or greatly delay any further progress in civilization." He went on to suggest that the interdisciplinary work of the conferences might produce solutions to the growing problem of Cold War hostility.[24] Given these lofty ambitions, it is hardly surprising that the image that cybernetics has left behind, as Jean-Pierre Dupuy observes in a recent history, "is that of a conquering *scienza nuova* that set itself up as a rival to physics and set itself the goal, in substituting form for matter, of putting an end to physics' ancient domination of the sciences."[25]

But Dupuy argues that the idea that cybernetics marks an essential break with the thought of modern science is a mistake. "The attempt to propose a unified theory of machines and living creatures...represented a spectacular increase in the extension of

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[23] Wiener, *Cybernetics*, 39.

[24] *Transactions* vol. 6, 10.

[25] Jean-Pierre Dupuy, *The Mechanization of the Mind: On the Origins of Cognitive Science*, trans. M.B. DeBevois (Princeton NJ: Princeton University Press, 2000) 47; originally published as *Aux origines des sciences cognitives* (Paris: La Découverte, 1994).

science, hardly a rupture with it."[26] According to Dupuy, cybernetics was just as committed to a materialist, mechanist vision as had been previous generations of scientists. It is true that the cyberneticians sometimes had to remind themselves of the subtlety and complexity of human potential to keep from degenerating into a caricature of Cartesianism. For example, John Stroud, of the U.S. Naval Electronic Laboratory in San Diego, presented a paper at the 1949 conference in which he described "the human operator surrounded on both sides by very precisely known mechanisms and the question comes up, 'What kind of a machine have we placed in the middle?'" Stroud believed that the standard idea of machine was insufficient to describe the range of human capacity. Indeed, the human being was perhaps a better machine than the machines themselves. While describing the results of an experiment "to find out how a man would add up information about brightness in time," he commented,

> It was amazing the degree of accuracy that these people could achieve. I built a 5 percent instrument and thought it would be good enough. More exactly, I built a good instrument and calibrated it with an accuracy of 5 percent. My observers' data were so internally consistent that they showed up my poor calibrations very painfully. If I ever do this sort of thing again, I am not going to make the mistake of selling the human operator short. If you ask him the right questions, he is capable of giving you beautiful and precise answers.[27]

Stroud's descriptions of his 'human operators' indicate that Dupuy is largely correct to argue that there is more continuity between cybernetic thought and the scientific thought of earlier eras than is generally recognized. The very notion of the human being as a communicating device shows that a certain kind of mechanism was at

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[26] Dupuy, 47.

work in cybernetics and in the broader culture. (It was not straightforwardly materialist, as I will presently argue.) Nevertheless, the vast majority of historians, philosophers, and others have seen in cybernetics the birth of a new science. Why have so many taken the cyberneticians at their word, and proclaimed cybernetics a *scienza nuova*?

The structure of historiographic revolutions

The reasons that cybernetics appears to be a *scienza nuova* can be grouped into three categories: its efforts to reform science, changes in the funding and role of science during World War II, and the ideas of self-regulation and self-organization in cybernetics. Those who emphasize these qualities usually do so because of particular historiographic and philosophical perspectives, but that does not mean their descriptions are without merit. Dupuy may be right to warn that stressing these qualities neglects the intellectual continuity between cybernetics and the science that preceded it, but he misses the characteristics that made cybernetics stand out from much of the science around it, notably its crusading, reformist character.

Not all the cyberneticians shared the belief that cybernetics could be put to work solving social problems. At one end of the spectrum was the enthusiasm of sociologist Gregory Bateson and the more moderate optimism of Norbert Wiener. At the other was the neurophysiologist Warren McCulloch, who was notoriously skeptical that the human race had even a chance of solving the problems it had created for itself. However, Wiener's was the public voice of cybernetics. His popular writing style attracted a large, non-specialist audience convinced of his importance. It was a prophetic voice (for

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[27] *Transactions* vol. 6, 27-28, 39-40.

instance, "The hour is very late, and the choice of good or evil knocks at our door") but unlike so much of the popular scientific writing of the time, it did not deteriorate into vapid futurism.[28] As historian Steve Heims writes, "Norbert Wiener's first commitment was to intellectual honesty, and that seemed to foreclose any long-term optimism, but a philosophical stance encompassing a sense of the tragic was congenial to him."[29]

Wiener's popular writing captured a widespread worry that science and technology were out of control; their breakneck speed was the cause of looming unemployment due to automation, the rise of faceless bureaucracy, and the terrifying spectre of nuclear war. Technology critics such as Lewis Mumford (and later Jacques Ellul) kept the public well-supplied with skeptical arguments about science and technology, but Wiener was one of the few scientists writing on the topic. The Western world had a particularly conflicted relationship with science and technology in the twentieth century; despite widespread mistrust, many still wanted to believe that science and technology might provide solutions to the very problems they produced.[30] Wiener captured this fervent hope that the judicious use of science and technology would pull those enterprises back from the brink of self-destruction.

Although this reformist impulse is in keeping with intellectual currents of the time, it nonetheless implies a schism between cybernetics and earlier scientific thought. Its ambivalence towards progress and its efforts to tame the complexity of the postwar world have inspired many historians to see cybernetics as a sign of the emergence of

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[28] *Cybernetics*, 186.

[29] Heims, 177.

[30] See Lewis Mumford, *Technics and Civilization* (New York: Harcourt Brace Jovanovich, 1934); Jacques Ellul, *The Technological Society*, John Wilkinson, trans. (New York: Knopf, 1964).

postmodernity. Many historians have given cybernetics and other efforts based on communication and information a common name, the better to demarcate the post- from the prewar sciences. Andrew Pickering called cybernetics part of the "cyborg sciences," which include operations research and computer engineering. Evelyn Fox Keller coined the term "cyberscience" to describe "information theory, cybernetics, systems analysis, operations research, and computer science," which "developed to deal with the messy complexity of the postmodern world." Peter Galison, Donna Haraway, and Lily Kay have all made similar arguments that identify cybernetics with the beginnings of the postmodern world.[31]

Cybernetics did have things in common with the other cyber- or cyborg sciences. The historian William Graebner describes them as part of "the culture of the whole" that characterized the 1940s and early 1950s. "Scientists, social scientists, and engineers developed new, more unified and synthetic approaches to knowledge that either merged existing disciplines or conceptualized their subjects in more encompassing frameworks." This interdisciplinary enthusiasm was one version of the idea that "it was both possible and good to make one out of many."[32] Wiener's hope to reform the role and practice of

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[31] Andy Pickering, "Cyborg History and the World War II Regime," *Perspectives on Science* 3 (1995): 3-48; Evelyn Fox Keller, *Refiguring Life* (New York: Columbia Univ. Press, 1995) particularly pages 84 and 85; Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21 (Autumn 1994): 228-266; Lily Kay, "Who Wrote the Book of Life? Information and the Transformation of Molecular Biology, 1945-55," *Science in Context* 8 (1995): 609-634 and "Cybernetics, Information, Life: The Emergence of Scriptural Representations of Heredity," *Configurations* 5 (1997): 23-91; Donna Haraway, "The High Cost of Information in Post-World War II Evolutionary Biology: Ergonomics, Semiotics, and the Sociobiology of Communication Systems," *The Philosophical Forum* XIII (Winter-Spring 1981-82) and "The Biological Enterprise: Sex, Mind, and Profit from Human Engineering to Sociobiology," *Simians, Cyborgs, and Women* (New York: Routledge, 1991) 43-68.

[32] Graebner, 86, 70, 72-73.

science was not so far removed from some of the other efforts to remove traditional boundaries and borders in the 1940s. It was a time when many Americans were optimistic about the United Nations and the new International Monetary Fund; a few even pinned their hopes to notions of world citizenship. As Cold War politics became more entrenched in the 1950s, fewer Americans were likely to espouse this internationalism. In the late 1940s, however, scientific work benefitted from this interdisciplinary fever, and the conviction that only by setting aside our differences and working together would ensure global survival.

In addition to this, a growing national administrative structure in the United States encouraged collaboration across scientific disciplines. The OSRD under Vannevar Bush provided federal funding for war-related research up until 1945. The demands of military technology often drove scientists to seek out researchers trained in other disciplines, since the projects often required work from physics, mathematics, and engineering in order to achieve completion. The budgets for the projects varied widely, but the totals are often staggering. The Radiation Laboratory at MIT, harnessed for the atomic bomb effort, employed some 4000 people and had contracts amounting to $80 million.[33] The Cold War's permanent wartime economy further swelled government research and development coffers. By the 1950s, the Department of Defense was the largest single underwriter of scientific research in American universities, ushering in what Senator J. William Fulbright would later call "the military-industrial-academic complex."[34]

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[33] Daniel Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Alfred A. Knopf, 1978) 307-8.

[34] Stuart W. Leslie, *American Science in the Cold War: the Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993) 2.

The periodization of the history of twentieth-century science has taken its cue from these related changes in funding and practice. Forty years ago, Derek J. De Solla Price observed of the growth of science, "Without doubt, the most abnormal thing in this age of Big Science is money."[35] Although historians have tried to bring a little nuance to the idea that funding drives scientific practice – and therefore historical periodization – it has proven difficult to shake completely, since changes in funding were only a part of the changes in administrative structure taking place in the postwar United States. The expansion of science demanded unprecedented levels of organization.

The rise of bureaucracy and the class of social managers had been underway for nearly a century, but this tendency was highly accelerated during and following the war. A greater and wealthier population contributed to the expansion of the welfare state and the managerial class necessary for an expanded public sector. The trend toward bureaucratization, identified by thinkers from Alexis de Tocqueville to Max Weber, was intensifying. These social and political shifts are the basis for the historical periodization of twentieth-century science, which takes its cue from organizational characteristics. The rise of government funding and the military-industrial-academic complex was preceded by a period when science got its funding from large philanthropic foundations. The drawback to this fairly sensible periodization is that any scientific movement coinciding with the end of the war can look more paradigm-forging than it in fact was. Like any standard periodization, it can obscure many of the connections to which the people involved would have been highly sensitive.

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[35] Derek J. de Solla Price, *Little Science, Big Science* (New York: Columbia University Press, 1963) 92.

Although cybernetics was in no way a Big Science – this term applies to large-scale projects such as particle accelerators and space exploration – it was coincident with Big Science's beginnings. From the perspective of intellectual history, however, it is best seen as part of the transition from one period to the other. This is true not only because the Macy conferences received their funding from a private philanthropic foundation, but because the dominant metaphors in cybernetics drew on earlier metaphors for understanding humanity, and remained essentially mechanist in spirit. Nor did the idea of man as a communicating device originate solely within cybernetics, although cybernetics did much to further and popularize it.

There is a third reason that cybernetics seems distinct. It was a science that was based in physics and electrical engineering, those most mechanist of sciences, yet it seemed to have embraced ideas of self-regulation and self-organization. These had traditionally been the province of vitalist or organicist biology, which held an explicitly antimechanist position. To some critics of science and technology, this aspect of cybernetics was especially promising: it represented a conversion of at least a few die-hard mechanists to a more mystical and respectful perspective. Stewart Brand – idealist, futurist, and communitarian popularizer – was drawn to cybernetics for exactly this reason. In *Two Cybernetic Frontiers*, published in 1974, he wrote, "Cybernetics has little to do with machines unless you want to pursue that special case. It has mostly to do with life, with maintaining circuit. I came into cybernetics from a preoccupation with biology, world saving, and mysticism."[36] The early history of cybernetics is much more mundane

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[36] Stewart Brand, *Two Cybernetic Frontiers* (New York: Random House, 1974) 9. Brand also founded the *Whole Earth Catalog*, *Whole Earth Review*, and the grandaddy of bulletin board systems, the Whole Earth 'Lectronic Link (the WELL).

than this recklessly matched and swashbuckling trio. True, many of the cyberneticians believed that cybernetics and science would build a better world, but they were generally more cautious than Brand, who was also deeply involved with the counterculture in the San Franscisco Bay Area. And although they were deeply interested in biology, the cyberneticians' goal was to make the life sciences as precise as physics and engineering. There is little evidence of mysticism – except insofar as any dedicated scientist might be said to be seeking communion with the divine by understanding the mechanisms of the universe, likely a more mediated experience than Brand had in mind. However, the worst flaw in Brand's understanding of cybernetics is his failure to explain or even acknowledge its military origins.

To be scrupulously fair, Wiener's own published work discourages readers from dwelling too much on those military origins, since he frequently condemned the martial atmosphere of the Cold War. However, he had been anxious to contribute to the scientific mobilization for war in 1940, and was soon at work on antiaircraft fire control. In 1943, Wiener and his colleague Julian Bigelow, an engineer, were working on a device that would predict the movements of an enemy pilot evading ground-based artillery fire and use a statistical analysis of that pilot's past movements.[37] Wiener had always had a strong interest in the broader implications of his scientific and technical work. In this case, his imagination was caught by the phenomenon of servomechanism "hunting," when the heavy, ground-based guns oscillated endlessly around their target. He turned to the physiologist Arturo Rosenblueth, whom he had known since 1933, to see if there was an

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[37] The antiaircraft predictor has been well covered in the secondary literature, in Peter Galison's *The Ontology of the Enemy* and more briefly in David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Baltimore: Johns Hopkins, 2002) 276-283.

analogous condition in human beings. Rosenblueth said that there was – injury to the cerebellum could result in a purpose tremor, which would cause the patient to reach for things but be unable to touch them. The similarity to the hunting servomechanism was striking. Wiener, Rosenblueth, and Bigelow excitedly collected more of these man-machine analogies, and published them in the paper "Behavior, Purpose, and Teleology."[38]

Their title implies that people like Stewart Brand were correct, that cybernetics was bringing a teleological transfusion to cold, mechanist science. But the paper, as Jean-Pierre Dupuy points out, could not be more opposed to holism in its philosophical commitment. It is resolutely behaviourist and mechanist. It begins, "This essay has two goals. The first is to define the behavioristic study of natural events and to classify behavior. The second is to stress the importance of the concept of purpose." However, "the term purposeful is meant to denote that the act or behavior may be interpreted as directed to the attainment of a goal – i.e., to a final condition in which the behaving object reaches a definite correlation in time or in space with respect to another object or event." This hardly seems the stuff of world-saving mysticism. Dupuy sums it up: "Cybernetics, in the form in which it was anticipated in the article of 1943, undeniably treated the objects it studies as devices transforming input messages into output messages."[39]

Although Wiener's work was central to cybernetics, he was not the movement's sole founder. Warren McCulloch had also been hard at work developing mechanico-

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[38] Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow, "Behavior, Purpose, and Teleology," *Philosophy of Science* 10 (1943): 18-24.

[39] Ibid.; Dupuy, 46.

mathematical models that applied to organisms as well as machines. In 1943, he published, "A Logical Calculus of the Ideas Immanent in Nervous Activity," with the mathematician Walter Pitts. The paper is a good example of the scope of McCulloch's ambitions, which proposed nothing less than a neurophysiological basis for all human thought. Where Wiener focussed on analogies between organisms and machines, McCulloch later summarized his work with the radical statement, "Everything we learn of organisms and machines leads us to conclude not merely that they are analogies to machines but that they are machines."[40]

These two 1943 papers are the basis for Dupuy's rejection of the idea that cybernetics represents a rapprochement between holism and modern science. He writes, "Cybernetics was not, contrary to the usual, mistaken view, concerned with making the machine human – it was concerned with mechanizing the human."[41] Dupuy argues that the idea that cybernetics represents the acceptance of self-organization by the hard physical sciences is true of cybernetics during the 1960s, when it was taken up by developmental biologists, but not of cybernetics in its early years. He grudgingly admits that an antimechanist position is "consonant with the tone of Wiener's work," (so Brand's sin is possibly just excessive enthusiasm). Overall, however, he believes cybernetics to be the very model of modern mechanism.[42]

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[40] Warren S. McCulloch, "*Mysterium Iniquitatis* of Sinful Man Aspiring to the Place of God," (1955) reprinted in *Embodiments of Mind* (Cambridge: MIT Press, 1965) 163.

[41] Dupuy., 51.

[42] Ibid., 80. cf. Tara Helen Abraham, *"Microscopic Cybernetics": Mathematical Logic, Automata Theory, and the Formalization of Biological Phenomena, 1936-1970* (Ph.D. dissertation, University of Toronto, 2000).

Still, it is best to be cautious about accepting Dupuy's position wholesale, for there is far more ambiguity in cybernetics than he allows. Dupuy picks the staunchly mechanist McCulloch for his hero, thus turning the usual Wiener-centred histories upside-down. McCulloch has been unfairly neglected, but Wiener's popular work was highly influential – in his rush to crown McCulloch, Dupuy largely ignores the wide readership of Wiener's criticism of some aspects of mechanism. Wiener claimed that "the first industrial revolution, the revolution of the "dark satanic mills," was "the devaluation of the human arm by the competition of machinery....The modern industrial revolution is similarly bound to devalue the human brain, at least in its simpler and more routine decisions."[43]

Perhaps it is Dupuy's narrow scope that allows him to sweep such popular criticism aside. He examines only the Macy conference transcripts and the scientific papers that the participants produced. Wiener's scientific work betrayed barely a whiff of his critical interest, and remained – like the 1943 paper – committed to the philosophical standards of physical science. It was in his popular works that Wiener, freed from the constraints of scientific editors, expounded his vision of what science ought to be. The rest of the cyberneticians occupy a range of positions on mechanism, with McCulloch espousing the most extreme position. From the perspective of understanding the resonance of cybernetics with mainstream culture, Wiener is the most important of the cyberneticians. McCulloch plays an important secondary role, for his idea of a mechanical mind was something that many Americans reluctantly and fearfully accepted.

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[43] *Cybernetics*, 27.

The contradiction between Wiener and McCulloch is a good representation of cybernetics, for cybernetics was neither truly mechanist nor truly antimechanist. It set out a rigourous, predictive scientific method very much in the spirit of mainstream physical science, but its analytical conceptions were information flows and messages rather than the cogs and gears of thoroughgoing mechanism. Although it analyzed the world in terms of exchanges of information, and conceived of human beings as information or communicative devices, it maintained the basic commitments of the mechanist vision, which held that human beings could understand, predict, and replicate the behaviour of the universe. As communication technology developed into computing technology, these metaphors became more explicitly based on computers. But even in the late 1940s and early 1950s, there was an important shift from earlier conceptions of man as a motor, engine, or source of energy, to man as an information machine.

The philosopher Gaston Bachelard described nineteenth-century physical science, which focussed on energy, field, and force, as imbued with a spirit of "dematerialized materialism:" "The very fact that energy changes matter results in a peculiar shift in scientific language from metaphor to abstraction."[44] The cybernetic understanding of information flows shares this trait with earlier physics; like thermodynamics, it was physical without being readily tangible. In the nineteenth century, the conceptual revolution brought about by thermodynamics caused the pristine mechanist explanations of the eighteenth century to give way to explanations based on energy conservation and conversion. Throughout the middle decades of the 1800s, scientists articulated the idea that electricity, heat, and mechanical force were different manifestations of a single

[44] Bachelard, *The New Scientific Spirit*, trans. Arthur Goldhammer (Boston: Beacon Press, 1984) 69.

phenomenon. The particular manifestations could be converted from one form to another – mechanical force could become heat – but their ultimate existence was beyond creation and destruction.

Cybernetics is part of a transition not from mechanism to antimechanism, but from one dematerialized materialism to another. It is therefore unsurprising that it shared much in common with its nineteenth-century predecessor. Both were reflections of the hope and despair of their time, both were ways to think about the limits of human adaptability and stability, both – to various degrees – lent credibility to ideas of social reform, and both gave rise to metaphors that changed our ideas of what it means to be human.

Aftershocks of modernity: the limits of adaptability

There is a clutch of technological, social, and artistic changes that we identify with the emergence of the experience of modernity, such as rapid industrialization, increased social freedom, non-linear time, self-referential art and literature, and mass communication. Modernity is "the tradition of the new."[45] New factories were built to produce new goods, which were distributed through a web of roads and railway lines that speed over the water on great, soaring bridges. "Make it new," demanded Ezra Pound, and countless numbers threw themselves into this dizzying world. The morning newspaper carried ever more recent news, thanks to new technologies of communication:

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[45] Daniel Bell, *The Cultural Contradictions of Capitalism* (New York: Basic Books, 1978) 100. On modernity, newness, and time, see Marshall Berman, *All That is Solid Melts into Air: The Experience of Modernity* (New York: Simon and Schuster, 1982); Stephen Kern, *The Culture of Time and Space, 1880-1918* (Cambridge: Harvard Univ. Press, 1983); David Gross, "Time, Space, and Modern Culture," *Telos* 50 (Winter 1981-82): 59-78.

in 1887, a journalist from the *Boston Globe* used a telephone to deliver a report on a speech made in Salem, Massachusetts; in 1880, the *Times* of London installed a direct telephone line to the House of Commons so that they could receive news on late night debates a precious forty-five minutes earlier.[46] The city in which a man grew up would no longer be there for his children; physically and socially, the city was constantly reinventing itself. As Marshal Berman described it, "To be modern is to find ourselves in an environment that promises us adventure, power, joy, growth, transformation of ourselves and the world – and, at the same time, that threatens to destroy everything we have, everything we know, everything we are."[47] The increased pace of change strains the limits of human adaptability. Its worrying, headlong pace is chronicled in what Stephen Kern calls "the dark side of modernity… mournful jeremiads, snap judgments, and threatening prognoses."[48]

Many physicians believed that the nervous complaints they heard in increasing numbers in the last decades of the nineteenth century were caused by the shocks and jolts of modern civilization. Neurasthenia, the condition that worried the New York City Noise Commission, was a diagnosis developed by the physician George Miller Beard in the 1860s. To Beard, a New York City resident himself, it was clear that neurasthenia was a disorder peculiar to the fast-paced, modern way of living. "The chief and primary cause of this…very rapid increase of nervousness is *modern civilization*, which is distinguished from the ancient by these five characteristics: steampower, the periodical press, the telegraph, the sciences, and the mental activity of women." Modern civilization

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[46] Kern, 115.

[47] Berman, 15.

[48] Kern, 124. See also 124-130.

represented decline, not progress. An individual had only limited "nerve-force," and the vicissitudes of modern living were forever draining this resource, just as entropy drained natural energy resources. "The force in this nervous system…is limited; and when new functions are interposed in the circuit, as modern civilization is constantly requiring us to do, there comes a period…when the amount of force is insufficient to keep all the lamps burning."[49] The loud, arrhythmic noise that so excited the Italian Futurists was another cause of neurasthenia:

> Manufactures, locomotion, travel, housekeeping even, are noise-producing factors, and when all these elements are concentrated, as in great cities, they maintain through all the waking and some of the sleeping hours, an unintermittent vibration in the air that is more or less disagreeable to all, and in the case of an idiosyncrasy or severe illness may be unbearable and harmful.[50]

The mental exhaustion of neurasthenics could show up in any combination of more than thirty symptoms – including insomnia, bad dreams, tenderness of the gums, fear, back pain, vertigo, incontinence, and balding – none of which was accompanied by any obvious organic disorder. Neurasthenia was the toll taken on the body by a world that was speeding out of control. The onset of neurasthenia marked the limits of human adaptability.

However, there was great individual range to these limits. Even the gloomy Beard did not leave his patients without hope. He noted "that it is possible to adapt the system to noises that are at first disagreeable, so that they cease to have any appreciable or at least

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[49] George M. Beard, *American Nervousness, Its Causes and Consequences* (New York: Putnam, 1881) vi, 99.

[50] Ibid., 106-7.

demonstrable effect."[51] Adaptation allowed a kind of stability in the face of constant change. William James, too, believed in the possibility of adaptation. In 1907, he wrote:

> The rapid rate of life, the number of decisions in an hour, the many things to keep account of, in a busy city man's or woman's life, seems monstrous to a country brother. He doesn't see how we live at all. A day in New York or Chicago fills him with terror. The danger and noise make it appear like a permanent earthquake. But *settle* him there, and in a year or two he will have caught the pulsebeat. He will vibrate to the city's rhythms; and if he only succeeds in his avocation, whatever that may be, he will find a joy in all the hurry and the tension…and get as much out of himself in any week as he ever did in ten weeks in the country.[52]

The psychic damage of the rapid pace of change was not inevitable.

Anson Rabinbach has studied the metaphors of work and energy that animate these studies of energy and fatigue in his book *The Human Motor*. The human motor drew on the ideas of thermodynamics and the ideas of energy conservation and entropy to develop scientific, physiological, and social visions of progress and its limits.

> Their vision of a society powered by universal energy offered continental Europe, undergoing its industrial revolution, an exhilarating explanation for its astonishing productivity. In that vision, the working body was but an exemplar of that universal process by which energy was converted into mechanical work, a variant of the great engines and dynamos spawned by the industrial age.[53]

The human motor is the link between the worries of Beard and the New York City Noise Commission and the scientific attempts to extend the capability of the labouring body by

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[51] Beard, 107.

[52] William James, "The Energies of Man," *Essays in Faith and Morals* (New York: Longmans Green, 1943) 216.

[53] Rabinbach, 1.

careful economizing of its energy. While physicians and social reformers saw the body and mind deteriorating under the demands of modernity, some scientists and engineers saw the invigorating prospect of a perfectly tuned and efficient human motor. Machines have often produced this dual inspiration, where they are used both as exemplars of inefficiency (through the thousand possible ways they can break down or wear out), and as exemplars of perfect efficiency, running on in the same way forever. If fatigue and neurasthenia were the signs of the inherent imperfections of machines, twentieth-century scientific management was the flourishing of the idea that such machines could be tinkered with and tuned to run with perfect efficiency.

Frederick Winslow Taylor's work in the early 1900s on scientific management held that the barrier between human imperfection and ideal productivity was simply a matter of training the worker in economy of movement. It was the consummate engineer's perspective. The human body was a machine that could be analyzed through "time and motion" studies that would determine the most efficient way to accomplish a particular job. This was combined with division of labour into replicable tasks, the standardization of equipment, and the linking of wages to output in order to maximize efficiency, productivity, and profit. It was a method that placed the control of the factory in the hands of competent, trained professionals, and extended the ideology of engineering from the control of machines to the control of human workers. As much of the pro-automation writing of the 1940s and 50s shows, it was but a small step to extend this to a particular idea of the perfect factory: rather than maximizing the efficiency of recalcitrant workers, why not maximize the efficiency of the machines so that the workers can be done away with altogether?[54]

Cybernetics had a response to such ruthless engineering. Wiener described the spectre of mass unemployment when the machines took over. More importantly, cybernetics substituted for the idea of the human as factory machine the idea of the human as communication device. In 1910, the physician William Osler had lectured his audience, "The ordinary high-pressure business or professional man may find relief, or even cure, in the simple process of slowing the engines."[55] By the mid-twentieth century, this engineering mentality was more often primarily concerned with the management and dissemination of information; "slowing the engines" took a backseat to communication engineering, eventually achieving an unexamined dominance. Social theorist Barry Glassner wrote in 1989,

> The fit body-cum-self is cognized as an information-processing-machine, a machine which can correct and guide itself by means of an internal expert system. When information from the medical and psychological sciences or from health crusaders is received via exercise and diet instructions or the media, the self-qua-information-processor is able to use that information to change its own behavior for the better."[56]

The cyberneticians recognized that they were shifting the focus from thermodynamics and motors to communication. At the sixth Macy Conference, Warren McCulloch emphasized, "Again, I think that if we wanted to use the word "energy" it

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[54] See Chapter 3.

[55] Cited Robert Kugelmann, *Stress: The Nature and History of Engineered Grief* (Westport CT: Praeger, 1992) 89.

[56] Barry Glassner, "Fitness and the Postmodern Self," *Journal of Health and Social Behavior* 30 (1989): 17, cited Kugelmann, 170.

would certainly be wrong. Power is also the wrong notion to think of. It is a matter of organization and information."[57] Henry Quastler, who attended the last two Macy Conferences, also edited the book, *Essays on the Use of Information Theory in Biology* (1953). In the introduction, he too contrasted the new with the old:

> One of the basic tools in natural science is the energy concept. In recent years, another concept has begun to attain comparable dignity. It is something more subtle and elusive than energy; it is derived from a desire for dealing methodically with problems of complexity, order, organization, specificity...it is known as *entropy* or *amount of information*, and plays a prominent role in the new fields of information theory, communication theory, and cybernetics.[58]

Our ideas of human adaptability and stability would now take their cue from cybernetics and communication to build a new vision of a world without decline.

The idea of stability was a fundamental part of cybernetics, starting with the technology from which it drew its inspiration. The antiaircraft predictor had very quickly presented a stability problem. Fire control tended to rely on a simple extrapolation of the enemy pilot's flight path at any given moment, but any sudden movements would send the system into wild oscillation. To solve this, Wiener and Bigelow designed a filter that predicted the enemy's path using a statistical analysis of his previous movements, which had the effect of smoothing the signal.[59] Although the project was eventually cancelled because it was taking too long to develop into something that the military could use, it

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[57] *Transactions* vol. 6, 99.

[58] Henry Quastler, ed. *Essays on the Use of Information Theory in Biology* (Urbana: University of Illinois Press, 1953) 1.

[59] Galison discusses the details of the predictor in "The Ontology of the Enemy."

encouraged Wiener's thoughts about stability and communication in general.[60] The 1943 paper he co-authored with Rosenblueth and Bigelow is largely about regaining stability in the face of sudden change.

Wiener had approached Rosenblueth looking for examples of physiological stability and instability. Rosenblueth had been an assistant to the famous physiologist Walter Cannon, who had coined the term 'homeostasis' to refer to the body's ability to remain stable in the face of rapidly changing external conditions, so his expertise was a good fit for the kind of work Wiener had in mind. And the ground was well prepared for such analogical work in the case of homeostatic adaptation. Cannon's own descriptions of homeostasis are clearly mechanical, such as this example from a 1929 article:

> The highly developed living being is an open system having many relations to its surroundings...Changes in the surroundings excite changes in this system, or affect it directly, so that internal disturbances of the system are produced. Such disturbances are normally kept within narrow limits, because automatic adjustments within the system are brought into action, and thereby wide oscillations are prevented and the internal conditions are held fairly constant."[61]

Homeostasis served as a biological correlate of the damping effects of the engineer's negative feedback, and so conferred on cybernetics the legitimacy of being found in nature.[62]

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[60] Mindell suggests that Wiener's politics and "inability to conform" may have had something to do with the project getting cancelled. *Between Human and Machine*, 282.

[61] Walter Cannon, "Organization for Physiological Homeostasis," *Physiological Reviews* 9 (July 1929) 400. Cannon introduced the term homeostasis in the *Transactions of the Congress of American Physicians and Surgeons: Jubilee Volume for Charles Richet* (1926) 91.

[62] Homeostasis was not, however, the inspiration for cybernetics. Such foundational work came later. See Donald Fleming, "Walter B. Cannon and Homeostasis," *Social Research* 51, no. 3 (Autumn 1984) 640.

The 1943 paper subdivided behaviour into a number of branching categories: purposeful behaviour, the authors declared, was behaviour that appeared to be goal-directed: a frog striking at a fly, for example. Rosenblueth, Wiener, and Bigelow drew a distinction between kinds of purposeful behaviour – the frog's behaviour was non-teleological, because it did not use feedback in order to catch the fly. It could not redirect its tongue if the fly suddenly moved. A guided torpedo, on the other hand, was teleological – if the target moved, the torpedo would adjust its motion accordingly. Such motion was teleological, they declared, since it was "synonymous with 'purpose controlled by feedback.'" (Obviously, this was a highly materialist version of the idea of teleology, which arguably had little to do with its Aristotelian versions.)[63]

Teleological behaviour was further subdivided into predictive and non-predictive behaviour. A person running to catch a falling object, for example, exhibits predictive behaviour, and is required to be aware of both spatial and temporal coordinates. The antiaircraft predictor, had it ever come to fruition, would have exhibited similar predictive behaviour in tracking and shooting down an enemy pilot. The work on the predictor was classified, so it was not mentioned in the paper. However, there is a definite martial influence on the authors' choice of examples. The frequent mention of weapons is particularly striking given Wiener's renunciation of military work after the war.[64]

Nowhere did the authors say that machines and animals were the same; only that they yielded to the same behaviourist analysis. However, they did use the behaviour of

[63] Wiener and Rosenblueth were later at pains to explain that they had not meant 'teleological' to mean final cause. "Purposeful and Non-Purposeful Behavior," *Philosophy of Science* 17 (1950) 318-26.

[64] The reasons for this are discussed in Chapter 2.

machines to fuel speculation about the behaviour of animals. They give a detailed description of a cerebellar patient who is carrying a glass of water to his mouth:

> [He] will execute a series of oscillatory motions of increasing amplitude as the glass approaches his mouth, so that the water will spill and the purpose will not be fulfilled....The analogy with the behaviour of a machine with undamped feedback is so vivid that we venture to suggest that the main function of the cerebellum is the control of the feed-back nervous mechanisms involved in purposeful motor activity.[65]

Rosenblueth first presented the paper in 1942 to the Conference on Cerebral Inhibition in New York. Also attending the conference were the neuropsychiatrist Warren McCulloch and his young assistant, Walter Pitts, who presented their work on logical modelling of the brain. McCulloch and Rosenblueth had known each other for some time, and McCulloch expressed a keen interest in sharing ideas further in a more informal atmosphere.[66] They met informally at Princeton in late 1943 and early 1944, a group of engineers, mathematicians, and neurophysiologists. Others soon expressed an interest in the same ideas, including the mathematician John von Neumann, who met with Wiener and McCulloch in early 1945. Wiener later wrote, "I found on the part of each group a great willingness to learn what the other groups were doing and to make use of their terminology. The result was that very shortly we found that people working in all these fields were beginning to talk the same language."[67] It was not long after this that McCulloch secured funding for what would become known as the Macy conferences on cybernetics.

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[65] Rosenblueth, Wiener, and Bigelow, "Behavior, Purpose, and Teleology," 20.

[66] Steve J. Heims, *John von Neumann and Norbert Wiener: From Mathematics to the Technologies of Life and Death* (Cambridge: MIT Press, 1980) 184-85.

But cybernetics did not achieve a public profile on the basis of the Macy conferences. Wiener published the book that gave the new field its name in 1948, and followed this with the popular exposition *The Human Use of Human Beings* in 1950. These books propelled the metaphors of communication engineering, such as feedback and information theory, as ways of understanding ourselves. But just as importantly, they soundly defended the idea that human beings were not machines. This contradiction, and an ambivalence about the relationship between man and machine, were already present in American thought. Wiener's books also gave a scientist's imprimatur to the fear that human beings might easily become machines. The period following the war was full of examples of human beings behaving in mindless or machine-like ways, from the conformity that had some sociologists highly concerned, to oft-repeated stories of the blind obedience of Communists. The popular success of cybernetics was due to its resonance with these worries that animated broader American thought. In the following chapter, we turn to the relationship between cybernetics and American Cold War culture.

[67] Wiener, *I Am a Mathematician*, 269.

Chapter 2: Cybernetics and the Cold War

Cybernetics is the metaphysics of the atomic age.[1]

The natural sciences reached a new high in prestige in the early years of the Cold War. Physics, the undisputed queen of the sciences, enjoyed "an authority that drew both from the momentous achievements of quantum mechanics early in the century, as well as from the very fresh acclaim accruing to physicists for their role in winning World War II."[2] The atomic bomb, however, was an ambiguous achievement. As a technological feat, it was spectacular proof of physicists' ability to discover and exploit nature's secrets. But as horrifying casualty statistics came in from Japan, both physicists and the public asked whether science had blood on its hands. Some wondered whether it would be better for physics to eschew government and military projects, and stick with the pursuit of knowledge for its own sake. Non-atomic scientists were also prone to this soul-searching: it was a rare scientist who had not been involved in the war effort in some capacity. Perhaps the speed in achieving the bomb could serve as an example of the capacity of science to meet peaceful goals. The funding and administration of science were in tremendous flux. The role of science in American society was changing. In the years following World War II, many scientists, moved by regret, moral fervour, the ideal of pure science, or a conviction that collaboration on the scale of the Manhattan Project could be put to improving humanity's lot instead of destroying it, sought a clear answer to the question of what postwar science was to be.

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[1] Interview with Martin Heidegger, "Nur noch ein Gott kan uns retten," *Der Spiegel* 23 (31 May 1976): 193-219. Cited Dupuy, 90.

[2] Evelyn Fox Keller, *Secrets of Life, Secrets of Death* (London: Routledge, 1992) 42.

The Macy Conferences on cybernetics were one forum where this discussion took place. It was a good framework for such deliberations: unlike atomic physics, cybernetics was not guilty. Its adherents included people trained in those hard sciences that were currently experiencing a combination of notoriety and prestige, but none had worked on the bomb – a fact that historians have curiously overlooked. Cyberneticians were developing machines and ideas that further provoked the long-running controversy over automation, but the bomb usually dwarfed that problem. The participants in the Macy conferences could discuss the future of science largely free of any sense of personal culpability. At the same time, the conferences reflect postwar worries about the disappearance of the individual and dehumanization. Norbert Wiener was highly aware of his role as the public voice of cybernetics, and he was aware of his audience's concern about the future of science and humanity. His work is an excellent example of the sense of urgency typical of the scientific and intellectual movements of the time, an urgency that can only be understood against the mingling of triumphalism and fear that marked the first years of the Cold War.

When Harry S Truman assumed the presidency of the United States following Roosevelt's death, he had little experience in foreign affairs. Eager to prove his authority, he made several quick decisions that amounted to a much tougher approach to the Soviet Union than had been the case under Roosevelt. He was encouraged in this by the late president's advisers, who had long believed that the only way to deal with the Russians was to take a firm stand. On April 23, 1945, Soviet Foreign Minister Molotov stopped in Washington on his way to San Francisco where he was attending a conference on the organization of the United Nations. Presidential advisers informed Truman that the

Soviets had little intention of establishing free elections in Poland, as the Americans believed had been agreed at the Yalta Conference two months earlier. Truman unleashed the full force of his impatience with the Russians on Molotov, with a tongue-lashing the likes of which rarely occurred in diplomatic circles. As historian John Lewis Gaddis describes the meeting,

> Truman lectured him in the manner of a World War I artillery captain shaping unruly troops into line. An agreement had been made at Yalta, the president stated, and all that remained was for Stalin to carry it out. When Molotov tried to explain that the Soviet government was carrying out what it considered to be the correct interpretation of the Yalta agreements, Truman cut him off. The United States wanted cooperation with Russia, he snapped, but not as a one-way proposition. The usual imperturbable Molotov emerged from this experience badly shaken. 'I gave it to him straight,' Truman later bragged, 'one-two to the jaw.'[3]

The president's recalcitrance was more symptom than cause of worsening Soviet-American relations. Russia had emerged from the war broken and vulnerable. Much of its land and industry had been destroyed; twenty million of its citizens were dead. Stalin had hoped to use American lend-lease aid to underwrite postwar reconstruction. But Washington ordered a sharp curtailment in lend-lease only three days after the German surrender, and followed that by cutting off reparations from the American zone in Germany.[4] In addition to being a painful economic punishment, it was indicative of the

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[3] John Lewis Gaddis, *Russia, The Soviet Union, and the United States*, 2nd ed. (New York: McGraw-Hill, 1990) 168.

[4] See Thomas G. Paterson, *Soviet-American Confrontation: Postwar Reconstruction and the Origins of the Cold War* (Baltimore: Johns Hopkins Press, 1973) 8-14. This book, like much of the revisionist history of the early 1970s, is sympathetic to Soviet perceptions. A later school of post-revisionist history attempted to balance accounts of Soviet and American rights and wrongs. Daniel Yergin, *Shattered Peace* (Boston:

growing American conviction that high technology and wealth were the rewards of democracy. The United States, it was believed, provided the best possible conditions for democracy to thrive, and only nations friendly to the U.S. would be allowed to share in American bounty.

The U.S. in the postwar period was in better shape than anyone could have hoped, often proving right publisher Henry Luce's famous 1941 prediction that the twentieth century would be "the American century."[5] The liberal economist Stuart Chase concluded that the postwar economy beat even the most optimistic goals of the New Dealers. "The facts," he said, "show a better break for the common man than liberals in 1938 could have expected for a generation."[6] Life expectancies and incomes had increased from 1941 to 1945, and the Servicemen's Readjustment Act (better known as the GI Bill) promised millions of veterans a better education and a prosperous future.[7] Despite this –

Houghton Mifflin, 1977); Thomas G. Paterson, *On Every Front* (New York: Norton, 1979); John Lewis Gaddis, *The Long Peace* (New York: Oxford University Press, 1987). For a post-post revisionist account, see Roger S. Whitcomb, *The Cold War in Retrospect: the Formative Years* (Westport CT: Praeger, 1998). There is a growing body of work in English on Soviet cybernetics, none of which is relevant to this thesis, but makes for interesting comparison: *Soviet Cybernetics Review* (translations of Soviet work, published by RAND from 1967 to 1974); Oliver J. Caldwell, ed. *Moscow in May 1963: Education and Cybernetics, an Interchange of Soviet and American Ideas Concerning Education, Programmed Learning, Cybernetics, and the Human Mind* (Washington, D.C.: U.S. Dept. of Health, Education, and Welfare, 1964); George Martin Weinberger, *Soviet Cybernetic Technology* (Lanham MD: University Press of America, 1985); Stuart A. Umpleby and Vadim N. Sadovsky, eds. *A Science of Goal Formulation: American and Soviet Discussions of Cybernetics and Systems Theory* (New York: Hemisphere, 1991); Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002).

[5] Henry Luce, "The American Century," reprinted in Michael J. Hogan, ed., *The Ambiguous Legacy: U.S. Foreign Relations in the "American Century"* (Cambridge: Cambridge University Press, 1999) 11-29.

[6] James T. Patterson, *Grand Expectations: the United States, 1945-1974* (New York: Oxford University Press, 1996) 284.

[7] See William L. O'Neill, *American High: the Years of Confidence, 1945-1960* (New York: Free Press,

or maybe because these changes prompted such high expectations – the agencies and commissions responsible for postwar development frequently pointed out that many obstacles remained in the way of universal good fortune, particularly if you were poor, black, or both. Art historian Serge Guilbaut exaggerates only a little in his assertion that "Bright promise often met with failure and contradiction, which gave rise to a mood of anxious pessimism that within a few years had permeated through all the strata of society."[8]

Scientists were not so much pessimistic as uneasy. Millions of dollars were pouring into research, but much of it was a continuation of World War II funding and priorities. The exigencies of preparing for war with the Soviet Union meant that the U.S. devoted a significant proportion of its wealth both to basic research and to the development of new technologies. As Paul Edwards describes the Cold War relationship between technology and international relations, "The primary weapons of the Cold War were ideologies, alliances, advisors, foreign aid, national prestige – and above and behind them all, the juggernaut of high technology."[9] In the decade and a half after the war, the number of scientists engaged in industrial research ballooned from 50,000 to 300,000.[10] University and industrial labs were swimming in military money. By 1950, defense R&D expenditures were back to the peaks they had reached during the war.[11]

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[8] Serge Guilbaut, *How New York Stole the Idea of Modern Art*, Arthur Goldhammer, trans. (Chicago: University of Chicago Press, 1983) 102.

[9] Paul Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge MA: MIT Press, 1996) 1.

[10] Richard Nelson and Gavin Wright, "The Rise and Fall of American Technological Leadership: The Postwar Era in Historical Perspective," *Journal of Economic Literature* 30 (December 1992): 1931-1964.

[11] Stuart Leslie, *The Cold War and American Science* (New York: Columbia University Press, 1993) 8.

Cold War funding followed the model set up during World War II.[12] During the war, annual federal investment in scientific research skyrocketed from 48 million dollars to 500 million dollars.[13] Two new organizations channeled these R&D dollars: the National Defense Research Council, founded in 1940, and the more powerful Office of Scientific Research and Development, founded the following year. Both organizations were under the chairmanship of "the nation's most influential wartime scientist," Vannevar Bush.[14] They were very successful, but Bush lobbied to dismantle them once the war had ended. His feeling, shared by many scientists, was that the government should have minimal involvement in the direction of peacetime science. Many scientists were reluctant to be beholden to the military now that the war had been won.

The same sentiments had occurred after World War I: although feeble in comparison with their World War II counterparts, the National Research Council and the Navy Consulting Board were unpopular with civilian scientists after 1918. The Navy Consulting Board, under the chairmanship of no less than Thomas Edison, had reviewed more than 100,000 inventions submitted by civilians, but even at the height of the war it did not coordinate or direct research. Its unstructured approach had an unenviable record: a mere 38 inventions were judged of sufficient technical merit and only one ever went into production.[15] Nevertheless, scientists were adamant that the organizations' reason for

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[12] See Nathan Reingold, "Vannevar Bush's New Deal for Research; or The Triumph of the Old Order," in *Science, American Style* (New Brunswick NJ: Rutgers University Press, 1991)

[13] Daniel Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Alfred A. Knopf, 1978) 341.

[14] Kevles, "The National Science Foundation and the Debate over Postwar Research Policy, 1942-1945," *Isis* 68 (1977): 13.

[15] Bruce L. R. Smith, *American Science Policy since World War II* (Washington D.C.: Brookings Institute, 1990) 29.

being had ended. Historian Bruce Smith concludes, "The NRC failed to remain the central coordinating agency for science because the leaders of the scientific community were unwilling to concede the need for or the desirability of such a role in peacetime."[16]

This was not due to any ingrained distaste for political involvement. Although the United States did not officially enter the war until December 11, 1941, three years earlier thirteen hundred scientists and scholars from more than 160 institutions issued a declaration condemning Nazism and fascism. "Any attack upon freedom of thought in one sphere, even as nonpolitical a sphere as theoretical physics, is an attack on democracy itself," they announced. The scientific community counted Jews and German refugees among its members, all deeply worried by Nazism and unwilling to discount the implications of the promotion of a truly German science. This was likely why "the American scientific community moved away from isolationism rapidly, and at a faster pace than the nation at large." [17] Their anxiety increased when the Germans succeeded in splitting the uranium atom in 1939; more than anyone else, they understood where this could lead. Scientists wanted to help the Allies in whatever way they could. The military, not noted for eager cooperation with civilians, knew it had long been hobbled in developing new technologies by small budgets and little coordination between different services: it was ready to accept civilian involvement, especially since the inability to detect enemy aircraft was becoming increasingly serious.

The NDRC and OSRD coordinated science on an unprecedented scale. By 1945, the OSRD's annual spending exceeded $100 million. Bush, as a firm believer in the autonomy of science, had planned a system in which the OSRD would let contracts to

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[16] Ibid., 30.

individual laboratories. But the research effort soon became too large for this kind of administration, and the OSRD gradually developed a system of large central laboratories. Paul Edwards remarks,

> It would be almost impossible to overstate the long-term effects of this enormous undertaking on American science and engineering. The vast interdisciplinary effort profoundly restructured scientific research communities. It solidified the trend to science-based industry – already entrenched in the interwar years – but it added the new ingredient of massive government funding and military direction.[18]

Wartime science was increasingly characterized by large budgets, large bureaucracies, and specifically directed research.[19] Andy Pickering has argued that these changes, which "served to transform science's inner economy," were so specific to World War II that he refers to the postwar period not as the Cold War, but as the "World War II regime." He goes so far as to suggest that science and the military became completely interdependent: civilian scientists dreamed about "the future of scientific warfare" and military strategy grew reliant on high-tech warfare. [20]

Of course, there were strong similarities between the science of World War II and that of the Cold War. The majority of scientific funding remained allied with the military in the late 1940s and 50s, and military R&D expenditures continued steady and strong at about ninety percent of all federal R&D.[21] However, scientists were much less sanguine

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[17] Kevles, *The Physicists*, 287.

[18] Edwards, 46, 47.

[19] See Paul Forman, "Behind Quantum Electronics: National Security as Basis for Physical Research in the United States, 1940-1960," *Historical Studies in the Physical and Biological Sciences* 18 (1987): 149-229.

[20] Andy Pickering, "Cyborg History and the World War II Regime," *Perspectives on Science* 3 (1995): 20.

[21] Edwards, 52, citing Forman, 152. On page 1 of *The Cold War and American Science*, Leslie uses the figure 80 percent. Understandably, these kinds of percentages are difficult to work out exactly; the point is

about this situation than they had been during the war, when it had been thought at worst a disagreeable necessity. After the war, many scientists – and others – thought that science needed to move in a different direction. Just what that direction would be was less clear.

In 1945, Vannevar Bush issued a blueprint for postwar research and funding. Called *Science – The Endless Frontier*, it was the major written contribution to the debate on the relationship between science and the military.[22] The ties between science, the military, and big industry had grown stronger during the war. Industrial labs gobbled a disproportionate share of federal R&D contracts, often receiving the patent rights accruing to this publicly funded research. Submissions to the OSRD from smaller organizations were said to get short shrift. Despite frequent cries of a critical shortage of trained scientists and engineers, "spokesmen for numerous colleges, universities, and a volunteer technical group reported that they had offered their services and laboratories to the government only to be politely thanked and ignored." It was "a trend that thoughtful liberals found troubling."[23]

Thoughtful liberals found their spokesman in Democratic Senator Harvey M. Kilgore of West Virginia, a staunch New Dealer, who drafted a bill suggesting "that research ought to be organized to serve national needs as formulated by democratically elected representatives of the people."[24] Although the influential science editor of the

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that they were very high.

[22] Vannevar Bush, *Science, the Endless Frontier* (Washington, D.C.: U.S. Government Printing Office, 1945).

[23] Kevles, "National Science Foundation," 6-7.

[24] David Hollinger, "Free Enterprise and Free Inquiry: The Emergence of Laissez-Faire Communitarianism in the Ideology of Science in the U.S." in *Science, Jews, and Secular Culture: Studies in Mid-Twentieth*

New York Times, Waldemaer Kaempffert, frequently agreed with Kilgore's vision for structuring science, many academic and industrial scientists were skeptical; some chafed even in anticipation of Kilgore's nonprofessional administrative plan. More importantly for the fate of Kilgore's bill, Bush disagreed. He agreed with Kilgore that a national science advisory board needed to be established and that funding for basic research had to be assured. But he was critical of the idea of directed scientific research in peacetime, even if it was directed to the advancement of the common good. As Daniel Kevles comments, "Bush and his colleagues wanted an agency run by scientists mainly for the purpose of advancing science."[25]

Although the first interdisciplinary meeting on cybernetics was in 1942, it was after the war, in the thick of this debate over what postwar science was to be, that cybernetics became more firmly established. Neurophysiologist Warren McCulloch had been present at the 1942 meeting, and it was at his urging that the medical director of the Josiah Macy, Jr. Foundation, Frank Fremont-Smith, organized a conference in 1946 to continue exploring the fruitfulness of applying the idea of purposeful behaviour to both organisms and machines. For the participants, the conference stood as a model of what science could be. In his history of the Macy conferences, Steve Heims writes that they "promised to generate a new kind of link between engineering, biology, and mathematics on the one hand and psychology, psychiatry, and all the social sciences on the other." In fact, the social sciences were very nearly left out: Gregory Bateson, who had also been at the 1942 meeting, returned from Southeast Asia just in time to convince Fremont-Smith

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Century American History (Princeton: Princeton Univ. Press 1996) 102.

[25] Kevles, "National Science Foundation," 16

to include social and behavioural scientists in the invitation-only conference.[26] Their inclusion was well received, even if the natural scientists sometimes viewed the social sciences as yet embryonic. Conference participants from the mathematical and physical sciences frequently presented concepts they thought would benefit the social sciences; this was especially true for game theorists hoping to teach economists and political scientists how to better their disciplines. This condescension was wasted, however, as no economists or political scientists were ever invited to the conferences.

The emphasis on psychology and psychiatry at the expense of the less individualistic social science was, Heims suggests, "in part a manifestation of the...social atomism and retreat from politics popular at mid-century, and in part indicates that even the interests of the cyberneticians lay in the first instance in mind and brain." [27] Cybernetics was indeed primarily interested in mind and brain, and this had much in common with the mainstream concern with individualism. At a time when individualism and individuality seemed under attack from multiple fronts – the rationalization of white- and blue-collar work, the new affordable but identical suburbs, computers able to usurp human roles – mind seemed to be the key to human uniqueness. However, even those few sociologists and anthropologists invited to the Macy conferences (at Bateson's urging) inadvertently reveal something else about the relationship between cybernetics, science, and postwar society. They studied societies geographically and culturally remote from postwar America, at a time when it was commonly thought that these social sciences were preserving – in the archives and in scholarly commentary – societies still free from Western contamination, societies still pure.

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[26] Steve Heims, *The Cybernetics Group* (Cambridge MA: MIT Press, 1990) 17.

This idea of purity, and the concomitant idea that pure cultures could shed light on Western social problems, fit neatly with the ideal of pure science through the belief that the pursuit of pure science was a necessary condition for an ideal society. The natural sciences shared the tendency of anthropology and sociology to simplify international relations and to yearn for a pure, bygone Western society. They subscribed to a kind of scientific internationalism; they saw their own dealings with one another, based on a shared conviction in the benefits resulting from the pursuit of knowledge for its own sake, as a model for what any human society could achieve. In such an environment, individuality could flourish, for they did not see themselves as an aggregate, but – like the scientists in Bush's plan for postwar science – as a "collectivity of heroic individuals." The idea of the scientific community was a mere speck on the radar.[28] This is perhaps why political scientists and economists, who studied the complicated details of modern Western societies, were not invited. Their field of study was at odds with the prevailing ideology of the cyberneticians, and so was at most a minor presence in the cybernetic imagination. Had they been in attendance, they might have brought the ideals of pure science and scientific internationalism crashing back to earth. Heims touches on the significance of this when he remarks, "Discussions of political science and

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[27] Heims, 18.

[28] Hollinger, 100. The books that brought attention to the idea of a scientific community include Fritz Machlup, *The Production and Distribution of Knowledge in the United States* (Princeton: Princeton University Press, 1962); Derek J. de Solla Price, *Big Science, Little Science* (New York: Columbia University Press, 1965); Don K. Price, *The Scientific Estate* (Cambridge MA: Belknap Press, 1965); Karl Hill, *The Management of Scientists* (Boston Beacon Press, 1964); Warren Hagstrom, *The Scientific Community* (New York: Basic Books, 1965); and of course, Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).

economics, unlike psychology and engineering, were more likely to lead to loaded political issues."[29]

Pure science and guilty men

Pure science was a powerful ideal in the late 1940s and 50s in part because the reality was so very different. It had taken so long to establish the National Science Foundation that the military had continued to fund the majority of R&D until well after the war. Bush may have won the debate, but military funding of science was too well established to go away easily. By 1950, when it was clear that the U.S. was involved in a new kind of war, military R&D quickened its pace, which reinforced the idea of pure science among believers. In his history of Cold War science, Stuart Leslie summarizes the influence the military held:

> In the decade following the Second World War, the Department of Defense became the biggest single patron of American science, predominantly in the physical sciences and engineering but important in many of the natural and social sciences as well.[30]

The emphasis on R&D was partly a continuation of the trend toward more technological warfare. As in civilian life, automation had reduced the need for human operators. Under Eisenhower's New Look defense policy, technology requiring little human presence had become at least as important as standing armies. This was not only to keep costs under control, but also because Americans, already with the largest peacetime armed forces they had ever had, were reluctant to see them grow even larger. Paul Edwards writes, "Instead of universal conscription, the United States chose the technological path of

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[29] Heims, 19.

massive, ongoing automation and integration of humans with machines."[31] The antimilitarist streak in the American psyche found a happy partner in the American love of technology. Americans could keep more of their young men safe at home by relying on faster planes and more powerful bombs.

A defense policy that rested on big technology ensured constant employment for scientists and engineers. The successful development of the atomic bomb was the most dramatic example of what organized science could accomplish, but this had not come cheap. By 1944, the Manhattan Project had developed vast plants and employed tens of thousands of workers. Its total expenditures would run to more than two billion dollars. For most of the course of the project, its leading scientists ignored the prospect of the bomb's actual use, concentrating instead on the rhetorical potential of the bomb: J. Robert Oppenheimer and Leo Szilard each suggested that a demonstration of the bomb's power – without significant loss of life – would be sufficient to scare the Japanese into surrender.[32] By July of 1945, the first atomic bomb test had shown these scientists how destructive their weapon was. They had cracked what Evelyn Fox Keller calls "the secrets of death."[33] The bomb would be in the background of every postwar discussion about science. Science would never be the same.

In 1946, the joint Army-Navy Strategic Bombing Survey issued a report on the results of the bomb on Hiroshima and Nagasaki. Hiroshima had suffered "an unprecedented casualty rate. Seventy to eighty thousand people were killed, or missing

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[30] Leslie, 1.

[31] Edwards, 58.

[32] Spencer R. Weart, *Nuclear Fear: A History of Images* (Cambridge: Harvard University Press, 1988) 97.

[33] Keller, *Secrets of Life, Secrets of Death.*

and presumed dead, and an equal number were injured." Nagasaki, thanks to its more mountainous terrain which confined most of the destruction to the valley floor, experienced fewer casualties, about half the Hiroshima total by the Survey's conservative estimates. The Survey stated that the exact numbers of dead and injured might never be known.[34] More recent estimates confirm that by 1950, deaths related to the bombings had reached 200,000.[35]

These were the tragic results of the largest-scale R&D project the world had yet seen. Despite the widely-held opinion that the bomb had shortened the war and therefore saved lives, many scientists were dismayed that control of the project had not been, in the end, their own. The only journalist admitted to the test at Los Alamos had captured the feeling of many scientists when they heard the first bomb: It "warned of doomsday and made us feel that we puny things were blasphemous to dare tamper with the forces heretofore reserved to The Almighty."[36] That such sentiments quickly became clichéd does not diminish the depth of the scientists' distress. They had strong doubts about their ability to contain such power, and even stronger doubts that national governments would be able to restrain themselves.

The bomb had changed the image of science for scientists and the public. In the original version of Berthold Brecht's *Galileo*, written in 1938, a heroic Galileo fought valiantly against the Inquisition. In Brecht's 1944-45 version, Galileo had become a man

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[34] U.S. Strategic Bombing Survey, *The Effects of the Atomic Bomb at Hiroshima and Nagasaki* (Government Printing Office, 1946), reprinted in Ernest R. May, *Anxiety and Affluence 1945-1965* (New York: McGraw-Hill, 1966) 3.

[35] Richard Rhodes, *Dark Sun: The Making of the Hydrogen Bomb* (New York: Simon and Schuster, 1995) 734.

[36] Cited Weart, 101.

who was opportunistic, selfish, and thoroughly detestable. Brecht explained in the preface to the new edition, "The atomic age made its debut in Hiroshima while we were in the midst of our work. Overnight the biography of the founder of modern physics read differently. The infernal effect of the great bomb placed the conflict of Galileo with the authorities of his age in a new and sharper light."[37] The third version, written in 1953, combines the first and second Galileos to produce a highly ambiguous figure, neither hero nor villain.

The histories of cybernetics have tended to emphasize the prestige of postwar science at the expense of this ambiguity.[38] But Wiener, perhaps conscious of his position as the public face of cybernetics, often described the failings of science. Of American scientific and technological prowess, he caustically remarked,

> Our papers have been making a great deal of American "know-how" ever since we had the misfortune to discover the atomic bomb. There is one quality more important than "know-how" and we cannot accuse the United States of any undue amount of it. This is "know-what," by which we determine not only how to accomplish our purposes, but what our purposes are to be.[39]

It is interesting that in a piece on the need to make careful choices Wiener described the deliberate construction of the atomic bomb as both discovery and misfortune. This sleight-of-hand (probably unconscious) was not unusual for postwar

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[37] Cited Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge: Cambridge University Press, 1985) 176-177.

[38] Heims, *The Cybernetics Group*, introduction. Although N. Katherine Hayles believes that cybernetics occupied an ambiguous position, her books shows little evidence of the ambiguity of science in general in the postwar period. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

[39] Norbert Wiener, *The Human Use of Human Beings* (Cambridge MA: MIT Press, 1950) 183.

scientists: a strange but understandable combination of confessing that the bomb was unnecessary and insisting that its development was inevitable. For atomic scientists, this manner of thinking was likely a way of alleviating just a little of the guilt they felt. For instance, J. Robert Oppenheimer, who deeply regretted the destruction of Hiroshima and Nagasaki and was a prominent critic of the postwar arms race, nevertheless believed that the bomb's development had been unavoidable:

> If you are a scientist, you cannot stop such a thing. If you are a scientist you believe that it is good to find out how the world works; that it is good to find out what the realities are; that it is good to turn over to mankind at large the greatest possible power to control the world and to deal with it according to its lights and values.[40]

It is small wonder, under the circumstances, that so many prominent scientists turned their backs on military research and embraced the austere beauty of the ideal of pure science.

Pure science came into the mainstream of American thought and culture in 1925 with Sinclair Lewis's major novel, *Arrowsmith.* Its hero is a research scientist who finds in science "a system of values which guide and sanction his stumbling quest for personal integrity."[41] The compromise inherent in academic science eventually proves too much for Martin Arrowsmith, a latter-day Thoreau, who leaves his laboratory, wife, and infant son in New York for the perfection of the Vermont woods. To his colleague already there, Martin exclaims, "I'll get six months' leave from the Institute, and have Joyce stay at some hotel near here, or do *some*thing. Gee! Back to real work....Work!"[42] Similarly,

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[40] Cited Rhodes, 761.

[41] Charles E. Rosenberg, "The Scientist as Hero," *American Quarterly* XV (1963): 447.

[42] Sinclair Lewis, *Arrowsmith* (New York: Harcourt, Brace and Co., 1925) 454 (italics and ellipses in

Albert Einstein spoke publicly of his belief that academic institutions stood in the way of pure science: of his work in the Swiss patent office, he said, "a practical profession is a salvation for a man of my type; an academic career compels a young man to scientific production, and only strong characters can resist the temptation of superficial analysis." Outside his day job, Einstein was free to think deeply – on his own – about physics.[43] Bush's *Science – The Endless Frontier* was less reflective (Bush was not much given to public soul-searching) but nonetheless appealed to many scientists who itched to be free from bureaucratic oversight, as all the while the government role in funding and directing research continued to increase.

In the aftermath of the war, pure science was very attractive to many atomic physicists. Some wed the idea to a utopian internationalism in what became known as "the scientists' movement." The journal they founded to promote their views was *The Bulletin of the Atomic Scientists*, which frequently argued that nuclear weapons facilities ought to be under the direction of international inspection teams – ideally composed of the scientists who best understood how they worked and who could not possibly have any ulterior motive. "The scheme was modeled on the open, self-regulating, peaceful community that scientists already enjoyed," writes historian Spencer Weart, "and at the same time resembled H.G. Wells's vision of virtuous technocrats enforcing peace and bringing a Golden Age."[44] These scientists believed that their highest loyalty was to the pursuit of knowledge. Scientific information ought to flow freely without the

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original).

[43] Carl Seelig, ed. *Helle Zeit; Dunkel Zeit* (Zurich, 1956) 12, cited in Ronald W. Clark, *Einstein: The Life and Times* (New York: World Publishing, 1971) 51.

[44] Weart, 116; H.G. Wells: *The Time Machine; An Invention* (New York: H. Holt, 1895).

impediments dreamed up by short-sighted national governments. Paul Boyer concludes that the scientists' movement was "sustained by a prevailing belief, among scientists and nonscientists alike, that a commitment to science almost automatically gave one a global perspective and unique vantage point."[45] If scientists were in control of nuclear facilities, politicians would have no choice but to emulate their noble selflessness and settle their worldly differences. There was only one small step between the world as it was and universal peace.

The link between science and peace was idealistic and naïve, but made sense given common thinking about science and scientists. More specious was the belief that a vote for science was a vote for democracy. Scientific internationalism proposed a world that was far from democratic. The proposed international inspections teams had more in common with Bush's laissez-faire science than Kilgore's unpopular plan for democratic oversight. The scientists' movement proposed a world in which everything important was the purview of science; everything trivial was left to the elected representatives. Nevertheless, many scientists continued to insist that science and a healthy democracy were somehow linked. Prominent social scientists, such as the sociologist Robert K. Merton, aided the scientists' conviction that a vigorous scientific culture was in some way dependent on a democratic society. In 1947, Edward Teller wrote in the *Bulletin of the Atomic Scientists*, "the dignity of man and the freedom of science…can be maintained only under a democratic government."[46] The free exchange of information was thought to

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[45] Paul Boyer, *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* (Chapel Hill: University of North Carolina Press, 1985) 51.

[46] Edward Teller, "The Two Responsibilities of Scientists," *Bulletin of the Atomic Scientists* (December, 1947), reprinted in *The Atomic Age*, Morton Grodzins and Eugene Ravinowitch, eds., (New York: Basic Books, 1963) 124.

be the lifeblood of science, an exchange more readily secured in a democratic society. Wiener complained that during the war, when some of the guarantees of American democracy had been suspended, military secrecy prevented him from seeing results that would have accelerated his own work by six months to a year.[47] Some made the bolder claim that science and democracy were mutually dependent. *Science and the Citizen* was a popular introduction to twentieth-century science that, despite its heft, went through four editions and several printings between 1930 and 1956. As in other expressions of its point of view, the term democracy is used very loosely, and stands more for an ideal American society than as a detailed political program. It escaped the notice of many of these politically active scientists that the society they championed was meritocratic, not democratic. "The social contract of scientific humanism," *Science and the Citizen* proclaimed, "is that the sufficient basis for rational cooperation between citizens is scientific investigation of the common needs of mankind." At times it is downright contemptuous of politics, trotting out the claim that if only science were left free from political interference, progress, peace, and plenty would come to be.[48]

A more sophisticated analysis of the relationship between science and democracy came from Bertrand Russell. In his 1952 lecture, *The Influence of Science on Society*, Bertrand Russell suggested that science, by turning the common man into a cog in the machine, posed a threat to democracy. Nevertheless, the scientific spirit was important to a free society:

> The triumphs of science are due to the substantiation of observation and inference for authority....One of the greatest benefits that science confers

[47] Wiener, *Human Use*, 122.

[48] Lancelot Hogben, *Science for the Citizen*, 4th edn. (London: George Allen and Unwin, 1956) 1131, 1127.

> upon those who understand its spirit is that it enables them to live without the delusive support of subjective certainty. That is why science cannot favour persecution.[49]

The influential Russell, however, was not a scientist, and was not responsible for any of science's sins. It was the Manhattan Project scientists that *Time* labelled "guilty men." It was J. Robert Oppenheimer who lamented that he had "known sin." The deadly practicality of the nuclear bomb was proof to the scientists' movement that they ought not to collaborate on government or military projects. Pure science, by contrast, was good science, moral science, a straight and narrow path away from guilt and sin. This ideal combined powerfully with the idea that science was foundational to the American way of life, and for a brief period, American leaders agreed that scientists were uniquely qualified to make political decisions. When scientists testified at the 1946 hearings on atomic energy, a sociologist observing the interaction commented that the senators saw the scientists as primitive people did their shamans: the scientists were "in touch with a supernatural world of mysterious forces whose terrible power they alone could control."[50] Scientists had never before held such influence in politics. A contemporary observer wrote, "The prestige of the physical scientist as the creator of these marvels was never higher. What a physical scientist says on almost any subject is thought more important than what anyone else says."[51]

The idea that scientists were to be feared and respected reached its apotheosis in the public imagery of Albert Einstein. His work had little to do with either the idea or manufacture of atomic weapons, but $E=mc^2$ was inseparable from the bomb in the

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[49] Bertrand Russell, *The Impact of Science on Society* (London: Unwin Books, 1968) 102.

[50] Weart, 112.

popular imagination. Einstein's prematurely old, sad, drooping face became the icon of postwar regret and guilt. As Alan J. Friedman and Carol C. Donley write in their excellent history of Einstein's cultural influence, "Einstein reappeared in postwar newspapers and literature as a tragic figure. In a new version of the myth of Prometheus, Einstein brought the atomic fire to mortal men." In a 1946 cover story, *Time* magazine described him as responsible for the bomb through both the 1939 letter to Roosevelt urging its construction *and* his famous equation of mass and energy, yet at the same time "almost saintly." It was a subtle twist on the myth of Promethean pride and greed. Having been simply in the pursuit of knowledge, Einstein was allowed – unlike Oppenheimer – to maintain a certain innocence. It was a flaw, but not a fatal one, in the ideal of pure science, for something greater was at fault than the fateful action of a single man. Friedman and Donley suggest that "the evil coming from science, exemplified by the transformation of gentle Einstein's $E=mc^2$ into the terror of atomic holocaust, can be seen as a failing not of the man, but of the society, or of society's abuse of knowledge."[52]

Nevertheless, one of nature's secrets had been cracked, which gave suitably penitent scientists enormous moral influence. The remarkably short time it had taken the Manhattan project scientists to achieve their annihilative goal demonstrated that science, given adequate resources and purpose, was capable of amazing things. The bomb instantly became a worldwide symbol of American scientific and technological superiority.[53] If applied science could accomplish such things, who knew what marvelous

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[51] Robert Redfield, "Consequences of Atomic Energy," *Phi Delta Kappa* 27 (April 1946): 223.

[52] *Einstein as Myth and Muse* 156, 192.

[53] "Holstered or unholstered, the atomic bomb had become a spectacular symbol of American technological ingenuity and supremacy – of American power." Thomas G. Paterson, *On Every Front: The Making and Unmaking of the Cold War*, revised edn. (New York: Norton and Co., 1992) 116-117.

results could come from such effort and brilliance in peacetime? Pure science became conflated with a science that was pure at heart, a science applied to noble goals. The possibility of greatness strengthened the resolve of the politically active scientists, and sent others in the direction of putting science at the service of utopian dreams. The fresh moral urgency engendered by the bomb convinced them that they could find techniques to save the world as well as destroy it. Paul Boyer remarks, "The atomic bomb project itself was a technological achievement of staggering magnitude. In such a climate, it is hardly surprising that at least some scientists became convinced that comparable wonders might be possible in the political realm."[54] Vannevar Bush was moved in 1949 to deliver the following manifesto:

> We fought a war well and applied science in the process in ways which startled the world....The applications of science yet to come are manifold and far-reaching. With them we can establish a standard of living in this country far higher than we have ever had; we can make more goods and have them more generally available throughout the population. We can prolong our lives and escape the ravages of old age, overcoming the scourges of mankind, epidemic disease, cancer, senility, to an extent that we can now barely grasp. We can create an environment in which the creative arts can flourish, in which the human spirit has an opportunity to rise and aspire. We can build a society in which there will be justice and good will. All this in within our grasp; we know it, for the performance of the past ten years is a guarantee of the effectiveness of the system under which we operate and of the fundamental principles to which we adhere. All we have to do to bring it about is to preserve that system and improve it and hold fast to those ideals and the faith from which they arise."[55]

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[54] Boyer, 99.

[55] Vannevar Bush, *Modern Arms and Free Men: A Discussion of the Role of Science in Preserving*

Scientists frequently emphasized the possibility of such a prosperous and healthy future: atomic energy would provide a cheap and infinite source of electrical power, the standard of living would continue to rise rapidly, more wonder drugs would join penicillin and streptomycin to wipe out disease. Only four days after the bombing of Nagasaki, the executives of General Motors demonstrated their confidence in the capacity of science by establishing the Sloan-Kettering Institute for cancer research at Memorial Hospital in New York to "conquer this so-called 'incurable' disease."[56]

Cybernetics was in an interesting position with respect to all these trends. As a scientific effort, it could draw on its authority as a confidant of nature's secrets, and as a non-atomic science, it had never overstepped the bounds of propriety. The moral authority enjoyed by the atomic scientists' movement waned considerably after 1946, when major opinion journals such as the *New York Times* began to question whether scientists were qualified to speak on foreign policy.[57] Cybernetics, which had never sought immediate political influence, was in an excellent position to benefit from a public confidence that needed new anchors. In 1948, the Sunday *New York Times* told its readers of the promise of cybernetics and its "mechanical brains":

> Since each mechanical brain provides the knowledge with which to build a better mechanical brain, it is conceivable that eventually we may build machines that will surpass the best human brains in thinking capacity, that may not only do all man's work for him, but also solve such problems as the control of the atomic bomb and how to reconcile East and West.

Democracy (New York: Simon and Schuster, 1949) 18-19.

[56] Patterson, *Grand Expectations*, 67.

[57] See Boyer, 94-95.

It added ominously (or perhaps sarcastically): "All that would be left for man to do would be to devise ways to stop the machine from destroying him."[58] A guest at the 1949 Macy conference suggested to Wiener that the style of interdisciplinary scientific conversation, as practiced in cybernetics, might be precisely the solution to the bleak prospect of nuclear war:

> I have been faced with the idea that it was necessary for the preservation of our culture that very practical methods of communication be established between the pure scientists on the one hand – and the people who understand the weapons of hostility...and the people who understand...the motivation of hostility.[59]

Thus was made a link between cybernetics' rarified scientific discussion of communication and the possibility that better everyday communication between the physicists and the psychiatrists might preserve the world from nuclear destruction.

Cybernetics was ideally placed to take advantage of science's new moral authority, especially as public opinion began to go against atomic science. The cyberneticians couched their moral pronouncements and speculation in terms of the concerns of cybernetics: automation, thinking machines, and the role of man in a world dominated by machines. However, the participants in the Macy conferences never showed signs of becoming a lobby group. Generally, their efforts were directed towards the organization and purpose of science after the war, not to explicit political action. It was through changing science that they hoped to change society. Their more humble methods kept them far from the spotlight trained on the atomic scientists, despite the fact

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[58] William L. Laurence, "Cybernetics, a New Science, Seeks the Common Elements in Human and Mechanical Behavior," *New York Times* (19 December 1948): E9.

[59] *Transactions* vol. 6, 101.

that cybernetics had its origins in a wartime project that, while far smaller than the Manhattan project, just as surely aimed to kill people.

Individualism and the closed world

Cybernetics was, according to Wiener, "the entire field of control and communication theory, whether in the machine or in the animal."[60] Its inspiration was his wartime work on an antiaircraft device that would predict the path of an enemy pilot avoiding fire, thus taking much of the guesswork out of antiaircraft fire. Had he been successful, it would have been a very clever machine, better at a certain kind of calculation – or thinking – than most human beings. It is not hard to see how the living became theoretically linked to the machine, because a thinking machine seems like it is alive. At the very least, it was a mechanical model of a pilot's mind: the predictor was designed to use the past behaviour of a particular pilot to guess at his response to a new round of gunnery. In his paper on the history of the antiaircraft predictor, Peter Galison writes,

> 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.[61]

Galison argues that cybernetics, like other wartime scientific research, postulated a "mechanized Enemy Other," a purely rational, perfectly intelligent opponent. Wiener would later call such a cunning enemy a "Manichean devil." It was the same kind of

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[60] Wiener, *Cybernetics: or Control and Communication in the Animal and the Machine* (Cambridge MA: MIT Press, 1948) 11.

[61] Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical*

opponent as in John von Neumann's more familiar game theory, but in addition to brains and ruthlessness, an enemy pilot had speed and power on his side in the form of his aircraft. This gave rise to thinking about the pilot and aircraft as a single unit – a machine with a mind. "It was a vision," Galison suggests, "in which the enemy pilot was so merged with machinery that (his) human-nonhuman status was blurred."[62]

Galison's argument is that the tenets of cybernetics came directly from this wartime thinking. Wiener's version of the history concurs: from the AA predictor, he learned to treat human beings as particular kinds of intelligent machines, even though he continued to insist that there was something distinct and special about humanity. If Galison is right that these intelligent machines were part of "the ontology of the enemy" and the world of "strategy, tactics and maneuver," then they were inseparable from the war itself.[63] It would not be surprising if cybernetics slipped into a similar kind of thinking about a mechanized enemy other during the Cold War. Paul Edwards, for one, concludes that this is the case: cybernetics simply substituted a more up-to-date version of a rational, calculating enemy.[64] But while it continued to generate machine metaphors of the enemy, cybernetics was different from sciences with more obvious military applications, such as operations research and game theory. In the late 1940s and early 50s, cybernetics existed principally as a series of meetings, and not as specific laboratory work. It was not established as a scientific discipline; rather, it carved out a space to discuss the aims and organization of science, and by extension, society. It was not allied

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Inquiry 21 (Autumn 1994): 229.

[62] Ibid., 233.

[63] Ibid.

[64] Edwards, 186.

with the military, and only one military scientist was ever invited to make a presentation. Cybernetics may have been born of military funding, but few of the Macy conference participants wanted anything to do with the military after the war. Wiener was particularly vocal, lambasting "the tragic insolence of the military mind."[65]

They were not alone in realigning their loyalties. Political thought was changing in the late 1940s and 1950s. The naïve individualism of pure science – the lonely, dedicated scientist in his lab pursuing the secrets of nature without assistants, secretaries, or grant applications – had a more sophisticated counterpart among artists and intellectuals. The new editors at that bastion of radical thinking, *The Partisan Review*, took up a much more liberal position after the war, shifting from "studies of the artist's alienation (a radical notion connected with society) to studies of neurosis (connected with the individual)."[66] Many writers and thinkers were convinced that individuality was under attack by the forces of conformity and the mindless materialism of everyday life. In 1950, David Reisman and Nathan Glazer published *The Lonely Crowd*, a widely-discussed and influential criticism of the changing American character. Americans had lost their self-sufficiency and independence, Reisman and Glazer claimed. They now took their cues from their peers and neighbours. William H. Whyte concluded in *The Organization Man* (1956), "that suburbs, together with large bureaucratic corporations, were threatening the individualistic and entrepreneurial drives that had made America great."[67] A flurry of books elaborated these themes: C. Wright Mills's *The Power Elite* (1956), Vance

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[65] Wiener, "A Scientist Rebels," *Atlantic Monthly* 179 (January 1946): 46. Also reprinted in Wiener, *Norbert Wiener: Collected Works*, Pesi Masani, ed. Vol. 4 (Cambridge: MIT Press, 1985) 748.

[66] Guilbaut, *How New York Stole Modern Art*, 165.

[67] Patterson, 338. See also Richard Pells, *The Liberal Mind in a Conservative Age: American Intellectuals in the 1940s and 1950s* (New York: Harper and Row, 1985).

Packard's *The Hidden Persuaders* (1957) and John Kenneth Galbraith's *The Affluent Society* (1958). Sloan Wilson also captured this anxiety in his best-selling novel, *The Man in the Gray Flannel Suit* (1957), as did the movie based on the book. The fear that individuality would be or had already been obliterated was sharp and imminent. It is the same fear of the dehumanization, of becoming merely an obedient automaton, that Norbert Wiener wrote about in 1950:

> When human atoms are knit into an organization in which they are used, not in their full right as responsible human beings, but as cogs and levers and rods, it matters little that the raw material is flesh and blood. *What is used as an element in a machine, is in fact an element in the machine.*[68]

This worry, characteristic of Wiener's work, prompts N. Katherine Hayles to declare that Wiener suffered from "cybernetic anxiety" at the prospect of "liberal subjectivity imperiled."[69] Hayles is both a literary and science studies scholar, heavily indebted to the postmodern techniques that have been called "the hermeneutics of suspicion."[70] Here, it is Wiener's endorsement of "liberal humanist values" that arouses Hayles's suspicion: Wiener insisted on defending the idea of the individual even when it should have been clear that the dissolution of the boundaries between organic and machine, spelled the end of such notions. While it is possible that cybernetics disturbed the theoretical foundations of humanism and the individual, it is more likely that Wiener's concerns were part of the zeitgeist, and although cybernetics might have provided an intellectual (or even scientific!) justification for declaring the death of the

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[68] Wiener, *Human Use*, 185 (emphasis in original).

[69] Hayles, 84.

[70] The phrase is from Alan Wolfe, "The Opening of the Evangelical Mind," *The Atlantic* (October 2000); archived online: http://www.theatlantic.com/issues/2000/10/wolfe3.htm.

individual, it was not the origin of such shattering claims.[71] In Hayles's view, Wiener ought to have recognized that his own contributions to science and technology had rendered the individual a troublesome anachronism. But Hayles's report of the individual's death in the 1950s is greatly exaggerated. The preservation of the individual, so central to the thought of the time, was also central to cybernetics, particularly in Wiener's thinking.

The perpetual fear of dehumanization demanded a constant vigilance that is consistent with Paul Edwards's idea that scientific and technological thinking during the Cold War postulated a "closed world." The term, borrowed from Shakespearean criticism, describes "a radically bound scene of conflict, an inescapably self-referential space where every thought, word, and action is ultimately directed back toward a central struggle." Edwards goes further, however: for him, cybernetics belongs to the closed world because the boundary it muddied between organism and machine was fundamental to "cyborg discourse." Cyborg discourse, which "helped to integrate people into complex technological systems," was generated by the "militarized knowledge production" of the Cold War. Cybernetics, therefore, belonged to the closed world in large part because national military goals were inseparable from science and high technology. Edwards admits that such an ambitious analysis leaves him vulnerable to the charge that he "overstate[s] the influence of military agencies and their priorities."[72] Perhaps so. But cybernetics sometimes provided scientific support to Cold War nightmares. John Stroud, a civilian scientist with the U.S. Naval Electronic Laboratory, who was working on

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[71] Hayles, 108-112. She sees these as moribund, often oppressive, in common with other posthumanist scholars. I will deal with this in detail in the final chapter.

[72] Edwards, 12, 2, 178, xiii-xiv.

gunnery servomechanisms and the associated difficulty of human gunners, said at the sixth conference:

> As you know, in the firing of guns we have to use human operators to make certain decisions but we have to fire them very rapidly. We have tried our level best to reduce what the man has to do to an absolute minimum....the operator has only the function of deciding when the target is a target. Once he makes up his mind and makes his decision known to the machine, the machine then works all by itself.[73]

The rigid and narrow cybernetic definition of communication, purged of feeling, raised the dark possibility of an intelligent machine that could not be turned off.[74] The twist on this ancient western trope was that the human being had become the machine: in the 1964 film *Failsafe*, for example, even the pilot's tearful, pleading wife cannot get him to turn back from his mission once the order to bomb Moscow has been mistakenly given by a machine.[75] Cybernetics does belong in part to the militaristic, dehumanizing, automated, closed world.

But cybernetics is slippery, since it also stood guard against such dehumanization. Soon after the war, Wiener began working on the development of prostheses to replace lost hearing or sight. In 1950, he presented his progress to the Macy conference participants, describing devices that would convert the information normally gathered by the damaged sense into a form that was understandable by one of the remaining senses. Sound waves and light waves were converted to physical vibrations. It was a strange understanding of the human body: the mind needed the input of the body's physical

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[73] *Transactions* vol. 6, 28.

[74] One of the Macy conference participants commented, "I would sort of like to turn myself off," implying that the usual conception of a machine at least offered the prospect of some relief. *Transactions* vol. 6, 52.

senses in order to meet the highest possible potential, but at the same time the body could be replaced – at least in part – by Wiener's ingenious machines. Wiener also seems to have seen the loss of more than one sense as leaving a person a little less than human, though perhaps not irreparably so: "We are trying to educate the deaf-mute so they can speak decently without the horrible sound they generally use; that is the problem of having the deaf-mute monitor himself."[76] The prostheses were likely a deliberate attempt to put science to work fixing the damage caused by military technology. Many ex-servicemen had lost their hearing during each of the world wars. When his work, still in the earliest stages of development, appeared in *Life* magazine, Wiener received dozens of letters from distraught parents asking him if he could please bring their son's hearing back.[77] Steve Heims points out the antimilitarism inherent in such work:

> His interest in the subject seemed to stem, at least in part, from a desire to use his scientific knowledge and talent for humane ends, to turn swords into ploughshares. It reveals a gentleness that was often hidden by his awkwardness, a wish to heal, to repair the kinds of damage done by the weapons of war on which he had worked.[78]

Cybernetics also did not suffer from the worst of the closed world paranoia. The Macy conferences took place in a very informal, open atmosphere. From the beginning, the conferences explicitly adopted a spirit of exploration; participants came with few

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[75] See Weart, 275, 276.

[76] *Transactions* vol. 6, 203.

[77] The article appeared in *Life* on January 9, 1950. The letters are collected in box 7, files 100-114 of the Norbert Wiener Archive at MIT. See also *Transactions* vol. 7, 58-122; Wiener, "Sound Communication with the Deaf," *Philosophy of Science* 16 (1949): 260-262; Wiener, "Problems of Sensory Prosthesis," *Bulletin of the American Mathematical Society* 56 (1951): 27-35.

[78] Steve Heims, *John von Neumann and Norbert Wiener: from Mathematics to the Technologies of Life and Death* (Cambridge MA: MIT Press, 1980) 214.

concrete goals. Although the participants did commit themselves to a particular style of thought – as Heims describes it, the "discourse at the meetings…was intended to be neutral, scientific, and apolitical" – the conferences were otherwise very wide-ranging. Argument was encouraged: "strong differences in view concerning practices in psychiatry, the mental health movement, the validity of the mathematical utility function, the psychology of perception, and many other topics were aired at the meetings."[79] This vagueness frustrated the biologist Max Delbrück, who was invited to the fifth meeting, but declined to attend any thereafter. Years later, he remained dismissive of the vague aims of the Macy conferences: "You understate if you guess that the broad interdisciplinary approach made the discussion too diffuse for my taste. It was vacuous in the extreme and positively inane."[80] The neurophysiologist Ralph Gerard warned the participants that freewheeling scientific discussion was tempting fodder for journalists, who often distorted their statements: "We started our discussions and sessions in the 'as if' spirit. Everyone was delighted to express any idea that came into his mind, whether it seemed silly or certain or merely a stimulating guess that would affect someone else."[81] Cybernetic thought may have been part of the closed world, but the Macy conferences were committed to the old-fashioned idea of advancing knowledge through vigorous debate. In 1950, Warren McCulloch described the sometimes raucous style of the conferences to new participants and asked returning participants to please restrain their exuberance:

[79] Heims, *The Cybernetics Group*, 19.

[80] Evelyn Fox Keller, *Refiguring Life: Metaphors of Twentieth Century Biology* (New York: Columbia University Press, 1995) 92.

[81] *Transactions* vol. 7, 11.

> Sometimes we become agitated and interrupt a person too often, or we find that we are asking him questions about the sentence he is going to say next. When we let someone have the floor, we should permit him to have his say at once, interrupting only if we don't understand what he is saying.[82]

The conferences are best characterized as a forum: at a time when the future direction of science and humanity was up for grabs, the cyberneticians threw themselves passionately into the debate. "Thus our conferences are in contrast to the usual scientific gatherings," wrote Fremont-Smith. "Presentations are not designed to present neat solutions to tidy problems, but rather to elicit provocative discussion of the difficulties which are being encountered in research and practice."[83]

Contrast this with the atmosphere at the Atomic Energy Commission at the same time. The AEC, like its progenitor the Manhattan project, made scientific information government property, available only to those with the proper security clearance to get past the miles of chain link fence that put its laboratories beyond the reach of prying outsiders. There were many complaints about AEC secrecy from other scientists, from journalists, and from neighbours of the AEC's flagship laboratory, Brookhaven. Even the congressional Joint Committee on Atomic Energy insisted "repeatedly and bitterly that the AEC was barring them from important facts." In 1950, the AEC forced *Scientific American* to burn 3000 copies of freshly-printed magazines containing an article on hydrogen bombs. The article did not include any secret information.[84]

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[82] Ibid., 9

[83] *Transactions* vol. 9, viii.

[84] Weart, 180.

Wiener was scornful of such attempts to secure ownership of information. In 1954, he railed against "the blind and excessive classification of military information," a contradiction in a world in which the technologies of communication were so sophisticated. Information ought not to be kept secret: "To be alive is to participate in a continuous stream of influences from the outer world….to be alive to what is happening in the world, which means to participate in a continuous development of knowledge and its unhampered exchange."[85]

AEC secrecy combined with the Eisenhower administration's anticommunist efforts resulted most infamously in the case of J. Robert Oppenheimer, who was stripped of his security clearance and fired from his job as a government consultant in 1954. In the six months of investigation that followed, the public learned that the FBI had been recording Oppenheimer's conversations for fourteen years. It was widely recognized that although he had many left-wing friends and relatives, including his wife, Oppenheimer was a security casualty not because of his party politics, but because of his high-profile opposition to the development of the hydrogen bomb. Security regulations were a convenient way to punish his outspokenness. However, his career would never recover, and some scientists remained too afraid even to talk to him.[86]

Cybernetics was mercifully free of the poisonous fear of communist infiltration. Its enemy was more abstract, heir to the wartime "mechanized enemy other." The enemy was not the scientist in the room with you, but a cunning and sophisticated intelligence who could exploit the similarities between mind and machine to devastating effect.

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[85] Wiener, *Human Use*, 122.

[86] Patterson, 264; S.S. Schweber, *In the Shadow of the Bomb: Bethe, Oppenheimer, and the Moral Responsibility of the Scientist* (Princeton: Princeton University Press, 2000), especially chapter 2.

The use of machine metaphors and the communist enemy

During the Korean War, Colonel Frank H. Schwable of the U.S. Marine Corps was among those taken prisoner by the Chinese communists in Korea. After months of intense psychological pressure and physical deprivation, he signed a confession that the U.S. was engaged in bacteriological warfare against the communists. His confession was highly detailed, giving specific missions, strategy meetings, and names. Many other POWs made similar confessions. The Chinese communist Party immediately used this valuable document as propaganda: "The United States is fighting the peace loving people of China by dropping bombs loaded with disease spreading bacteria," they cabled the world, "in violation of international law."[87] When the prisoners were eventually repatriated to the United States, a third were accused of having collaborated with the enemy. Twenty-one chose not to return at all.[88] Although some commentators blamed weaknesses in American moral fiber, others believed that the POWs had been the victims of brainwashing, "a powerful, manipulative, psychological weapon that could break even the most hardened soldier."[89] Immediately upon his return to the U.S., faced with court

[87] Cited in Joost A.M. Meerloo, *The Rape of the Mind* (New York: World Publishing Company, 1956) 1.

[88] One prisoner initially refused to return, but changed his mind, returning to the U.S. to face court martial in 1953. Virginia Pasley, *22 Stayed: The Story of the 21 American GIs and One Briton Who Chose communist China* (London: W.H. Allen, 1955). Their brainwashing had a fictional precedent in George Orwell's descriptions of communist 'thought control' in his novel *1984* (1949).

[89] Ron Robin, *The Making of the Cold War Enemy: Culture and Politics in the Military-Intellectual Complex* (Princeton: Princeton Univ. Press, 2001) 163. Recently, some scholars have suggested that the confessions may not have been false at all, that the U.S. really was experimenting with germ warfare in Korea. See Stephen Endicott and Edward Hagerman, *The United States and Biological Warfare: Secrets of the Early Cold War and Korea* (Bloomington: Indiana University Press, 1998). The book met with skeptical reviews in John Ellis van Courtland Moon, "Dubious Allegations," *Bulletin of the Atomic*

martial, Schwable repudiated his confession. He said, "The words were mine, but the thoughts were theirs. That is the hardest thing I have to explain: how a man can sit down and write something he knows is false, and yet, to sense it, to feel it, to make it seem real."[90]

Americans who were afraid of communism were reluctant to believe that a betrayal of such magnitude could be anything other than the result of devious communist thought control. But even social scientists skeptical of brainwashing who hastened to reassure the public that thought control could not be effected by contaminating the water supply, were nonetheless firm in their belief that the American POWs had undergone some kind of psychological strong-arming. "Coercive persuasion," was Edgar H. Schein's term to lend respectability to an idea that had science fiction overtones. Schein participated in a government program in 1951 to see if the POWs had indeed been coercively persuaded. His conclusion was that they had, by the application of "intensive indoctrination in combination with techniques to undermine group cohesion."[91] It may not have been black magic, but there was nonetheless a method that could break down mind and will. Many government officials were ready to believe this, as historian Ron Robin relates.

> Based on recurring reports of public confessions of treason by prominent dissenters behind the Iron Curtain, American officials speculated that communist adversaries had developed an insidious form of psychological

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Scientists (May/June 1999) and in "Wartime Lies," *New York Times Book Review* (27 June 1999).

[90] Cited Meerloo, 20.

[91] Edgar H. Schein, *Coercive Persuasion* (New York: W.W. Norton and Co., 1961) 8.

manipulation, a methodic, scientific mechanism for reprogramming the thoughts, beliefs, and values of defenseless victims.[92]

A slew of books and movies about brainwashing followed, notably *The Manchurian Candidate* (the film, released in 1962, was based on the 1959 novel by Richard Condon). Skepticism about brainwashing among experts did little to dispel an acute national anxiety that was due to more than just dismay with accounts of dishonourable POW behaviour in Korea. The more louche science fiction movies also took up the theme of the loss of control of one's mind, in gems like *Invaders from Mars* (1953) and *Invasion of the Body Snatchers* (1956). Susan Sontag has pointed out that early disaster movies – such as *King Kong* (1933) – usually depicted man's struggle with beastliness, savagery, and desire. In the 1950s, however, this inner struggle with animality was supplanted by a different fear: the fear of dehumanization, of being transformed into a machine. The new protagonist, taken over by interplanetary invaders, "has simply become far more efficient – the very model of technocratic man, purged of all emotions, volitionless, tranquil, obedient to all orders....Now the danger is understood as residing in man's ability to be turned into a machine."[93] Nor did the fear of brainwashing fade as the POW scandal receded. As late as 1957, Walter Cronkite warned that brainwashing and the question of "our preservation as individuals" was "one of the underlying themes" of the twentieth century. [94] The fear of dehumanization, exacerbated

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[92] Robin, 167. On the behavioural critique of brainwashing, see pp. 170-8.

[93] Sontag, "The Imagination of Disaster," *Against Interpretation* (NY: Farrar, Strauss, and Giroux, 1961) 222. See also Robin, 169. One reader has commented that Fritz Lang's 1926 film *Metropolis* indicates that this fear arose earlier. But *Metropolis* shows the fear of being treated like a machine (the workers pushing the hands of giant clocks) and the dangers of a machine that looks like a human being (the false Maria). It does not portray human beings turning into machines.

[94] Susan L. Carruthers, "Redeeming the Captives: Hollywood and the Brainwashing of America's Prisoners

by the terrifying prospect of nuclear annihilation, was made more immediate by the news coming from science: if scientists could develop and control electronic brains, what was to prevent their tricks from being used on the human brain?

The fear that the human mind might be nothing more than an organic machine, vulnerable to communist exploitation, seemed to be supported by the example of communist societies themselves. It was inconceivable to the majority of American thinkers that communism could be a deliberate choice; much of the literature describes communists as machines or automata. The Dutch-born Columbia University psychiatrist Joost Meerloo was among those convinced that communism succeeded only by transforming its citizens into mechanical imitations of human beings. Uniquely human characteristics, such as intimacy or self-expression, were stunted and extinguished. It was the "ghastly future of the robotized man, trained as a machine on a standard of conformity."[95] The same metaphor occurs in Hannah Arendt's celebrated *Origins of Totalitarianism*, in which she wrote that those who sacrifice their lives for a totalitarian movement "die the death of robots."[96]

The extravagant public confessions of some former members of the communist party were also testament to the idea that communism gained its adherents by turning them into machines. Typical of these is the 1950 self-published pamphlet of Kenneth Croft, in which he described the brainwashing techniques he was taught while a member of the party in Milwaukee in the late 1930s. The Kremlin, he said, ordered that these

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of War in Korea," *Film History* 10 (1998) 275. See also Margot Henriksen, *Dr. Strangelove's America: Society and Culture in the Atomic Age* (Berkeley: University of California Press, 1997).

[95] Meerloo, 117.

[96] Hannah Arendt, *The Origins of Totalitarianism* (New York: Harcourt Brace and World, 1951) 363.

techniques be taught because world domination was assured only by capturing and transforming people's minds. Croft, who seems to have wanted his readers squirming in their seats, or even better running to the authorities to report suspected communist sympathizers, explained that brainwashing was no great trick. It was simply a matter of exploiting the Pavlovian vulnerability of human beings:

> Man is a stimulus-response animal. His entire reasoning capabilities, even his ethics and morals, depend upon stimulus-response machinery....Having no independent will of his own, Man is easily handled by stimulus-response mechanisms. It is only necessary to install a stimulus into the mental anatomy of Man to have that stimulus reactivate and respond any time an exterior command source calls it into being.[97]

Merely tinker with the machine through post-hypnotic suggestion, drugs, duress, or in the toughest cases, brain surgery: you'll soon get the results you want.

On the home front, Americans were experimenting with their own forms of thought control. The CIA was administering the drug LSD to human test subjects, an episode that continues to arouse controversy because the subjects, who included POWs, federal prisoners, and psychiatric patients, had not been told what was happening. But their early efforts met with unpredictable results. Some recipients became anxious or panicked, dashing hopes that LSD would be a reliable truth serum. The CIA turned to academic scientists, including Harold Abramson, a Columbia University physician who became one of the CIA's chief LSD researchers. He was also a friend of Frank Fremont-Smith, who invited him to the sixth Macy conference. Abramson participated in the discussions, but his involvement with the cybernetics group ended there. However,

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[97] Kenneth Croft, *Brainwashing: A Synthesis of the Russian Textbooks on Psychopolitics* (self published, printed by the Englewood Company, 1950) 35.

Fremont-Smith organized three series of conferences on LSD in which Abramson was heavily involved. Not only was Abramson involved, the CIA was involved: the Macy Foundation provided a respectable name and the CIA provided the funding to bring together academic and government researchers.[98]

The idea that science could unlock the secrets of the mind and control it like any other machine was also a recurring topic at the cybernetics conferences. Lawrence Kubie, a neurophysiologist turned successful psychoanalyst, asserted that analysis, which promised understanding of the human mind, made the analyst into a kind of machine in the name of scientific neutrality: "Some of the details of analytic technique…make the analyst seem inhuman. He can only be effective by achieving a detached position."[99] He did not, however, believe that the human mind could be exposed in the way that the workings of a machine could. Mathematician Walter Pitts was skeptical of some of psychology's basic assumptions about the human mind, particularly the unconscious. He played devil's advocate, provoking a response from Fremont-Smith:

> *Pitts*: Suppose you did not have one [an unconscious], what would happen?
>
> *Fremont-Smith*: That is like what happens to the rectangle when you remove the width. What kind of rectangle have you got?
>
> *Pitts*: It is not obvious to me why it is not conceivable to have the human being without one of these objects called the unconscious. How would he act and what would he do wrong?[100]

Such exchanges happened frequently, and the social scientists sometimes chastised the natural scientists for their behaviouism. Heinrich Kluver once rebuked the participants,

[98] Heims, 167.

[99] *Transactions* vol. 6, 120.

> It looks as if the human organism is often viewed here as merely a marvelous device for registering incoming stimuli, for receiving and coding of information, and for doing a large number of equally remarkable things. For the psychologist, the picture is unfortunately much more complex; unfortunately he cannot see such simple outlines.[101]

Kubie was even more direct:

> In multiprofessional gatherings, the psychologist, the psychiatrist, and especially the psychoanalyst functions as a naturalist, reporting on the facts of human nature as observed by him, facts which are dismayingly complex. The experimentalist and mathematician then offer their explanations, whereupon, the naturalist presents additional observations which confront the experimentalist and the mathematician with an even more complex version of natural phenomena.[102]

The psychologists and psychiatrists believed that they stood alone, the last defense of the human being. Probably participants like McCulloch and Pitts would have turned the human being into a machine long since had it not been for the constant objections of the social scientists. Certainly the natural scientists met with little resistance when they treated animals as machines.[103] The human being stood barely apart by virtue of a thin argument that only he possessed a developed mind. Although cybernetics was busy chipping away at that distinction, many people – especially those outside of cybernetics – held that the most human quality we can have is the ability to think. The 1950s emphasis on thinking man came at a time when automation and associated social

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[100] *Transactions* vol. 7, 217.

[101] *Transactions* vol. 8, 210.

[102] *Transactions* vol. 9, 48.

[103] See J.Z. Young, "Discrimination and Learning in Octopus," *Transactions* vol. 9, 109-119; Herbert G. Birch, "Communication between Animals," *Transactions* vol. 8, 134-172.

changes had made the human body in many ways obsolete. Much heavy labour had already been relegated to machines, and it was believed to be only a matter of time before all physical tasks were automated. Mind was all that was left. The cyberneticians, naturally, had much to say on the subject of automation. It is to that subject that we now turn.

Chapter 3: Homo Sapiens and Automatic Machinery

The average worker, I am sorry to say, wants a job in which he does not have to put forth much exertion – above all, he wants a job in which he does not have to think.[1]

Henry Ford made this contemptuous remark, and although his was never the majority opinion, there were many industrialists and efficiency experts – and probably a few average workers – who agreed. But as mechanization and automation reduced the need for hard labour, and laws to protect workers from physical strain came into place, observers of the industrial scene paid increasing attention to the worker's mind.[2] By the 1950s, when computers touched off a new and vigourous round of debates on automation, the opinion that factory work was inhumane because it extinguished human thought and individuality was widespread. In the economically buoyant 1950s, worry about technological unemployment often took second place to the worry that humanity's reason for being had been cut adrift by advancing technology. Although very few people suggested that the new machines be completely abolished – they were indisputably faster and better at certain tasks – many believed that automation demeaned human beings. Machinery had already rendered the physical power of the human body obsolete; now it threatened that most human quality, the ability to think.

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[1] Henry Ford, *My Life and Work* (Garden City: Doubleday, Page, and Co., 1922) 103.

[2] The term "automation" was introduced by Delmar S. Harder in 1948 to refer to factory production using machines that were self-regulating. (*Fontana Dictionary of Modern Thought*, London: 1977). Prior to this coinage, "mechanization" sufficed. That a new word was thought necessary is consistent with the perception that machines were changing significantly, and therefore the human role as well. However, both words were in use, with the vote tipping in favour of automation. By the 1950s, automation was standard usage.

Among the cyberneticians, Norbert Wiener advanced a particularly influential version of the argument that machines that rivalled our capacity for thought were dehumanizing. Machines to automate factory work used feedback devices to replace jobs – such as monitoring temperature – that had previously required some human thought and judgment. Many scientists, engineers, and technocrats believed that these new machines would foster human talent by giving workers something more demanding to do than monitoring temperature. They also argued that automation, which was explicitly linked to the culture of consumption and leisure in public policy, would provide the free time necessary to develop and refine the mind. Automation promised to make us more fully human. Critics retorted that the culture of leisure simply abandoned individuality – mass man had abdicated his responsibility to think.[3] Behind all these points of view was a rich lode of ideas about the meaning of machines in American thought and culture.

The ambiguous machine

In the 1930s and 40s, there were a number of ambitious photography projects. The largest underwritten by a private sponsor was the Standard Oil Photography Project, from 1943 to 1950.[4] Standard Oil of New Jersey (more commonly known as Jersey Standard) hoped that the photography project, which proposed to show "how oil seeped

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[3] Among the cyberneticians, Paul Lazarsfeld investigated the sociology of mass society and mass communications. He attended the Macy conferences in order to find mathematical techniques for improving his statistical analysis, but did not use any of the techniques of cybernetics in his work. (Steve Heims, *The Cybernetics Group*, 193.) The connection between mass society and cybernetics is therefore quite subtle. It is taken up in the last part of this chapter.

[4] The federal government also sponsored photography projects, through the Historical Division of the Farm Security Administration (a New Deal agency), some of which were larger. Roy Stryker was in charge of this agency until 1942, when he left to join the Standard Oil of New Jersey project.

into every joint" of a nation increasingly dependent on technology, would draw attention away from the scandalous revelation of their collusion with the German petrochemical firm I.G. Farbenindustrie.[5] In 1929, Jersey Standard had agreed to drop its synthetic rubber research in return for Farbenindustrie's promise not to compete on American soil. They were found out in 1941, and fraternizing with a German company left their reputation in tatters. They wanted the photography project to show that they were not indifferent to the lives of ordinary Americans – although it was influential white-collar Americans whose opinions they hoped to sway.

Roy Stryker was one of several photographers hired for the project. He shot pictures of cloverleaf highway ramps, industrial landscapes, and workers with their families. The presence of food in his photographs is striking: agricultural workers sorting a vast pile of beets, a farm cellar filled with baskets of apples and preserves, families at the dinner table. Likely the images of home front plenty struck the right note in a country at war. But food, its manufacture, and its distribution, put a human and domestic face on agricultural industry. Agriculture had long since adopted labour-saving machinery, and artists and social observers had begun to group it with the more obvious industries that relied on assembly-line production. Stryker seems to have drawn no distinction between agriculture and other industries. Industry, he wrote, "consists of people whose efforts and skills are the basis of productivity....people and not the machines they work with are what is important in our industrial civilization."[6] Yet Stryker did not lionize workers, as

[5] Steven W. Plattner, *Roy Stryker: U.S.A., 1943-1950* (Austin: University of Texas Press, 1983) 11. See also Maren Stange, *Symbols of Ideal Life: Social Documentary Photography in America, 1890-1950* (Cambridge: Cambridge University Press, 1989) 141-146.

[6] Roy Stryker, untitled manuscript (n.d.) 1. Cited in Plattner, *Stryker* 11.

did Lewis Hine's well-known photos of the devil-may-care adventurousness of skyscraper construction workers, nor patronize them, as in *Let Us Now Praise Famous Men.*[7] Nor did he aestheticize industry, as Charles Sheeler did in his 1927 photographs of Ford's River Rouge plant, which are remarkable for "the complete absence of the famous assembly line and the nearly complete absence of the worker from the scene of production."[8] What Stryker did was capture in photographs the tense relationship between man and machine in the 1940s.

In a photograph of the commercial district in Springfield, Massachusetts, a policeman stands in front of the Springfield Public Market. Above it are the workplaces of the dentist and the tailor who help make the town hum. Beauty salons and jewelers occupy the next two floors: the culture of consumption is propped up by the more basic services below. Above all is an enormous banner, blanketing the windows of one of the beauty salons. "Workers Are Needed in West Coast Navy Yards," it proclaims. A giant arrow over a map of the United States confirms the message: go west, young man. Work is changing – change with it or be left behind and alone. The photos are a paean to a small-town way of life that many felt was bound for extinction. The story that began with industrialization had not yet had an unambiguously happy ending. Once again, automation was changing the nature of work. Stryker seems to have been certain about

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[7] Lewis Hine's skyscraper photos were part of the series *Men at Work: Photographic Studies of Modern Men and Machines* (1931), and were a pronounced contrast to his pre-1917 work, which documented the oppression of child labour. Alan Trachtenberg, *Reading American Photographs* (Hill and Wang, 1989). James Agee and Walker Evans, *Let Us Now Praise Famous Men* (Originally 1941, reprinted Boston: Houghton Mifflin, 1988).

[8] See Miles Orvell, *After the Machine: Visual Arts and the Erasing of Cultural Boundaries* (Jackson: University Press of Mississippi, 1995) 17, 18.

the fate of his subjects, although they maintain a quiet dignity in the face of their inevitable defeat by the machine.

There is a long tradition in American thought of understanding man and machine as locked in a tragic and venerable struggle. In the enduringly popular 1870s folksong, John Henry dies nobly, beating the steam drill brought in to replace him. He may have died, but it was a hero's death, and the machine's strength was diminished by the power of human dignity. Stryker's photos, however, admit a more complex relationship. The juxtaposition of bucolic plenty with the fierce workings of industry on the landscape – which scraped back its skin to expose its ganglia and smoothed its surfaces with concrete – forces the recognition that all that food comes not from an undisturbed garden, but from fertilized fields, mechanical pickers, and fast highway transportation. Stryker's photographs are an example of the "complex pastoralism" that Leo Marx famously attributed to twentieth century American literature:

> Again and again they invoke the images of a green landscape…as a symbolic repository of meaning and value. But at the same time they acknowledge the power of a counterforce, a machine or some other symbol of the forces which have stripped the old ideal of most, if not all, of its meaning.[9]

American thought also embraced a less troubled idea of the machine. From the exuberance of Walt Whitman, "Singing the strong light works of engineers," through Thorstein Veblen's technocratic ideals, American thought has celebrated the triumph of the machine as often as it has mourned the defeat of the man.[10] In the visual arts,

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[9] Leo Marx, *The Machine in the Garden* (London: Oxford University Press, 1964) 362-3.

[10] Walt Whitman, "Passage to India" (1868). Reprinted in Arthur O. Lewis, Jr., ed. *Of Men and Machines* (New York: E.P. Dutton and Co., 1963).

Americans developed Precisionism, a native counterpart to European Bauhaus and Futurism. As for Bauhaus and Futurism, they may have been European-born, but they quickly became associated with the fearless American embrace of technology and the new.[11] In 1927, the German philosopher Richard Müller-Feienfels commented on the pleasure that Americans took not only in the finished product, but in its manufacture: "The average American sets an absolute and positive value on technique. In the American cities it is not only the finished wares that are displayed in the stores; if possible they are actually manufactured before the eyes of the passing crowd."[12]

These ideas about the machine were never resolved into a satisfactory synthesis. Both remained at work, influencing and changing each other, throughout the 1950s debates on automation. Although the aesthetics of the machine and the terms of the contest continued to change, American thought stubbornly refused to abandon either the idea of the machine as a thing of beauty or the idea of the machine as adversary.[13] The automatic machine promised to free humanity from drudgery, and yet was a common

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[11] On the machine aesthetic in the U.S., see Thoman Reed West, *Flesh of Steel: Literature and the Machine in American Culture* (Vanderbilt University Press, 1967); Wilson, Pilgrim, and Tashjian, *The Machine Age in America, 1918-1941* (NY: Brooklyn Museum, 1986); Lisa Steinman, *Made in America: Science, Technology, and American Poets* (New Haven: Yale University Press, 1987); Cecelia Tichi, *Technology, Literature, Culture in Modernist America* (Chapel Hill: University of North Carolina Press, 1987); and Henry Sayre, "American Vernacular: Objectivism, Precisionism, and the Aesthetics of the Machine," *Twentieth Century Literature* 35 (Fall 1989): 99-113.

[12] Richard Müller-Freienfels, *Mysteries of the Soul*, trans. Bernard Miall (New York, 1929). Selection reprinted in Henry Steele Commager, ed. *America in Perspective* (New York: Random House, 1947) 272-279. The passage here is from p. 274.

[13] Kurt Vonnegut's *Player Piano* (1952), which quotes Norbert Wiener and has a Professor von Neumann as a minor character, falls into the machine-as-adversary category. In the opening scenes, a cat is killed running from the automatic cleaning machinery. This is followed by the laments of unemployed machinists and the tortured dreams of the egghead protagonist Paul Proteus, who wants to work with his hands on a

metaphor for the nightmare of nuclear annhilation: 'push the button,' and it was all over. The meaning of the machine was riddled with contradiction. Complex pastoralism became more complex; the layered meanings deepened its ambiguity. In the hands of a sensitive observer, the ambiguity and contradiction could become not something to be resolved, but the very heart of the matter, the centre of the American relationship between man and machine.

Andreas Feininger was another photographer who set out to document industrial society at roughly the same time as Stryker. He, too, included people in his portraits; like Stryker, he was concerned about the effects of automation: "[M]ost pieces of machinery are operated by people – especially in the days before automation and computerization eliminated thousands of jobs and decimated the workforce of the manufacturing industry."[14] But the photographs evoke a different response: when the worker stands in puny contrast to a great engine or oil drill, brashly smiles in an enormous propeller shop or tire warehouse, one cannot help but be aware that he is rendered tiny by the very things he has helped bring into being. It is difficult to say whether this is a bitter and inescapable irony – or if the man and the machine glorify one another, the machine's superhuman capacity final proof of human ingenuity.

The scientists involved in the Macy conferences, which proposed to define the relationship between man and machine, showed at best faint recognition of this contradiction. However, Norbert Wiener would draw on the wealth of metaphors and ideas it generated as inspiration for his own thought about the meaning of human and machine. Wiener was by far the most vocal of the cyberneticians on automation and

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farm.

social change. Unfortunately, his ideas were often muddled. He contributed to machines to automate human work and at the same time proposed ways to secure human dignity with a remarkable – probably naïve – unawareness of the inherent contradiction. Wiener designed the wartime antiaircraft predictor to work automatically by using electronic circuits and servomechanisms to do its calculations. His specific contribution to control theory was a set of mathematical techniques to smooth the noisy signal to the automatic machinery. More generally, he and others – like Claude Shannon and John von Neumann – improved the area of electrical control systems enormously. As David A. Mindell has argued, the feedback theory that governed servomechanisms was a way of understanding not only the individual components of the predictor, but the entire system. By understanding all the components of a technological device as bits and pieces that were in a feedback relationship with one another, scientists like Wiener contributed to a powerful new technology of control.[15] This meant that computers, servomechanisms, amplifiers, and other electrical devices were linked in what David Noble has called "the mature technology of automatic control" that emerged after the war.[16]

But control theory was about more than hardware. Wartime work on control systems treated the human operators as part of the system, too, and social scientists were enlisted to investigate the conditions that might affect the performance of the system as a

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[14] Andreas Feininger, *Industrial America 1940-1960* (New York: Dover, 1981) 72.

[15] David Mindell, "Automation's Finest Hour: Bell Labs and Automatic Control in World War II," *IEEE Control Systems Magazine* (December 1995): 72-80; Stuart Bennett, "Norbert Wiener and Control of Anti-Aircraft Guns," *IEEE Control Systems Magazine* (December 1994): 58-63. See also Galison, "Ontology of the Enemy."

[16] David F. Noble, *Forces of Production* (New York: Oxford University Press, 1986) 49.

whole.[17] The resulting ideas and technologies were a good fit for industry, which had envisioned its workers as potentially perfect machines for decades. The difference was that control theory proposed to substitute machines for mental as well as physical work. Although many of the scientists who had worked on control during the war were eager to spread the word to industry, Wiener was not one of them.[18] He frequently professed worry about the potential of automation to create mass unemployment. But he also spoke of a future where monotonous jobs would be performed by machines, leaving human beings free to pursue more rarified goals. His books on cybernetics were ambiguous enough on the virtues of automation that despite his stated suspicions, "cybernetics" was regularly paired with automation and manufacturing.[19]

While cybernetics did not succeed in pinning down the relationship between man and machine, it did succeed in helping to shift the terms of the debate from the automation of physical labour to the automation of mental tasks. It is ironic that the cyberneticians, many of whom were convinced that the brain was a sophisticated bit of biological machinery whose performance they would eventually replicate in wire and metal, propelled the idea that our humanity depended on our unique ability to think. At the same time that Wiener was making heartfelt pleas for human dignity, cybernetics contributed to the theory and practice of thinking machines, whose increasing capacity

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[17] David A. Mindell, "Engineers, Psychologists, and Administrators: Control Systems Research in Wartime, 1940-1945," *IEEE Control Systems Magazine* (August 1995): 91-99.

[18] Ibid., 52.

[19] e.g., Stafford Beer, *Cybernetics and Management* (London: English Universities Press, 1959); F.H. George, *Automation, Cybernetics, and Society* (New York Philosophical Society, 1959); Charles Dechert, *The Social Impact of Cybernetics* (Notre Dame: University of Notre Dame Press, 1966) – John Diebold was among the contributors to this volume.

convinced some observers that thinking, more than anything else, defined our humanity.[20] In order to understand the twentieth century justification that thinking was the defining human characteristic, we need to delve deeper into the contemporary understanding of human and machine.

Space for their labours and adventures for their souls

Nineteenth-century European scientists and social reformers had worried that work made exhausting demands of mental and physical energy reserves.[21] Twentieth-century thinkers never really gave up this concern, but added to it the anxieties of a culture for which physical work was changing. That the industrial world is crass and shoddy is an old complaint. No less a figure than Adam Smith believed that monotonous work made the labourer ignorant and stupid. In Victorian Britain, William Morris agitated against the "stifling overorganization" of industrial society, and both the American and British arts and crafts movements championed handicraft as more authentic than anything machines could produce.[22] The sociologist Georges Friedmann, writing on the significance of industrial society in the 1950s, summarized nearly two centuries' worth of this criticism:

> From the angle of their own particular doctrine, they proclaimed that the machine empties labor of all intellectual content, and looked longingly back to the time of artisan industry when the worker himself *finished* a

[20] The topic of their thinking machines will be taken up in detail in chapter 4.

[21] Anson Rabinbach, *The Human Motor*. See Chapter 1 of this dissertation.

[22] T.J. Jackson Lears, *No Place of Grace: Antimodernism and the Transformation of American Culture, 1880-1920* (New York: Pantheon Books, 1981) 63. The second chapter of this book covers this topic in detail.

> beautiful object and when he could devote thought and feeling to his task.[23]

Twentieth century critics of automation often embraced a similarly bittersweet nostalgia, but they stressed that these problems had gained new urgency. In 1955, Walter Bloomberg, a sociologist who frequently wrote on automation, contrasted the nineteenth-century industrial revolution with the twentieth-century one. Contemporary workers were "protected in their jobs by trade unions, and have the benefits of unemployment insurance, old age pensions, minimum wages, child labor laws, and other forms of labor and social legislation," but these dignities meant little if automation made human beings obsolete by stripping them of the work in which they saw their worth.[24] In such a world, where certain basic dignities were assured, the critics of modernity turned their attention to the effects of work on the mind, and in some cases, the soul: the fatigue and neurasthenia of the nineteenth century industrial revolution gave way to the threat of mental degradation and spiritual malaise.[25] Beginning in the 1920s and reaching a peak in the automation debates of the 1950s, American thinkers viewed the problem of work as one not of exhaustion, but of obsolescence, degeneration, and wastefulness.

An early example of such thinking comes from 1921, when *The Atlantic* ran a series of articles by Arthur Pound, a historian with a dubious gift for dark prognostication. He argued that industrial automation would cause workers' skills to deteriorate, which would have disastrous effects for the nation. The repetitive work that

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[23] Georges Friedmann, *Industrial Society: The Emergence of the Human Problems of Automation* (Glencoe, Ill: The Free Press, 1955) 131.

[24] Walter Bloomberg, *The Age of Automation, Its Effects on Human Welfare* (New York: League for Industrial Democracy, 1955) 14.

[25] See Rabinbach, *The Human Motor* and chapter 1 of this dissertation.

machines demanded made workers unable to adapt to change. Worse, since industrialization was an urban phenomenon, it would encourage the survival of the inferior people. The urban environment might be inherently unhealthy, but inferior people thrived in its dank, unpromising alleys with the perversity of weeds. Thus Pound brewed an unpleasant mixture of eugenics, popular Darwinism, and worry about the mind with the unspeakable suspicion that industrialization might work in favour of these undesirables. In one passage, astonishing today for its bald racism, Pound wrote,

> In general, swart, short folk withstand congestion better than fair-haired, long-geared peoples of the Nordic strain, who seem to need space for their labors and adventures for their souls. In so far, than, as the Nordic strains are esteemed superior contributors to the institutions we value most highly, industry has helped to depreciate race-quality by concentrating machines and men so thickly in cities.[26]

Machines caused skilled labour to deteriorate and gave the unskilled and less capable the means of survival. Industry, Pound warned grimly, upset the natural order of Darwinism. Idiots would survive. It was possible to take steps to counteract the degeneration: "How far the individual mind may be dulled by close daily association with machinery depends, of course, on the variety of interests that intrigue the mind after working hours, and what defenses it can set up against the inroads of pathological fatigue while at work." Wise use of leisure time might be the worker's saving grace, an idea that was to gain wide currency in the 1950s. "Why waste time teaching city children how to work when their chief need is to know how to live?" But even success here was no more than a slim hope, since the mental restlessness of the superior races would soon put them right out of a job:

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[26] Arthur Pound, *The Iron Man in Industry; an Outline of the Social Significance of Automatic Machinery* (Boston: Atlantic Monthly Press, 1922) 177.

> Indeed automatization has now reached a point where individual capacities of workmen count for so little that large employers of labor find less keen minds cheaper than keen minds in many berths, because the less keen mind presents fewer labor complications to the boss, is more easily satisfied, feels labor-strain less, and is less trouble all round.[27]

Pound, of course, was thinking about men – whether desirable or undesirable. However, many of the jobs lost to automation were held by women – notably telephone operators, but also manufacturing jobs, such as radio production or packaged foods. Employing women saved companies money, since women earned between one half and one quarter of men doing similar jobs.[28] In the case of telephone operators, women, like Pound's "less keen minds" were thought to be more pliant, more obedient, and less restless than men, in addition to having a more dulcet tone of voice.[29] Women did what the boss told them to do. Since they were already like machines, it was no insult to replace their work with machinery. In 1945, etiquetteer Emily Post advised, "The perfect secretary should forget that she is a human being....She should respond to [her boss's] requirements exactly as a machine responds to the touch of lever or accelerator."[30] Women's minds could not be threatened by machines, because the perfect woman was already a machine.[31] In his popular 1929 book, *Men and Machines*, Stuart Chase

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[27] Ibid., 173, 207, 183.

[28] Brenda Maddox, "Women and the Switchboard," Ithiel de Sola Pool, ed., *The Social Impact of the Telephone* (Cambridge MA: MIT Press, 1977) 266.

[29] Lana F. Rakow, "Women and the Telephone: the Gendering of a Communications Technology," Cheris Kramarae, ed. *Technology and Women's Voices* (New York: Routledge and Kegan Paul, 1988) 214.

[30] Emily Post, *Etiquette: The Blue Book of Social Usage* (New York: Funk and Wagnalls, 1945) 548.

[31] The exception to this may have been housework. Machines were widely believed to liberate women from their unpaid work, promising benefits similar to those that technocrats hoped to see resulting from the automation of men's factory work. Even then, there are examples of thinking about automated housework

described the presence of machinery in his daily life: the toaster toasted the bread, the percolator percolated the coffee. It is the perfect automatic fantasy until the vacuum cleaner appears, and then we remember that someone has to run all this machinery: the toaster, the percolator, and the vacuum demand the presence of – well, a wife. Chase, however, described these things as running themselves, leaving the wife simply the part that made good the machinery's promise of being fully automatic.[32]

Chase seems at first to have agreed with Pound on the degenerative effects of the machine: "Many urban individuals, instead of knowing how to fend for themselves as did their ancestors, only need to know how to count their change, pull a lever, tighten a belt, pound a typewriter, throw a switch, recognize a delicatessen store when they see one." But "it still has to be proven that it is a more evil thing to be at the mercy of a weekly paycheck than at the mercy of the tides, the storms, the seasons, the Black Death, the lord of the manor, the pig sty, and the gods."[33] He was highly critical of blanket judgments about the machine. It was not mechanization that was the problem, he insisted, but monotony, a state not peculiar to the industrial era. The problem was specific: industrial society had provided its workers with more leisure time, but monotonous work had left them unable to use that time creatively. "The factory…has so conditioned the worker that

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that made the woman a part of a machine – see below.

[32] Stuart Chase, *Men and Machines* (New York: MacMillan, 1929) 1-2. Women who were not like machines (i.e., emotional) were no safer. Commenting on William Whyte's study of waitresses, who were – surprise! – sometimes unhappy, David Reisman said, "When I see an Automat, I would like to bow down and salaam to it as a blessing, because it gets rid of the crying waitress." *Fortune* (October 1953) 190.

[33] Chase, 140, 141.

he has *lost the very faculty of playing*. More free hours will simply mean more gasoline, more bleacher seats, and more speakeasies."[34]

Similar opinions came in from the other side of the Atlantic. George Orwell wrote, "It is only in our own age, when mechanization has triumphed, that we can actually *feel* the tendency of the machine to make a fully human life impossible." Machines, by removing the difficulty and pain that were part of the human condition, made us soft, and the leisure they promised would be taken up by constrained and stunted activity.[35] The French sociologist Hyacinthe Dubreuil, who generally defended American practices of rationalization and automation, lamented that after spending time on the floor of auto factories in Detroit, his ability to concentrate was sadly impaired. Dubreuil attributed this to the noise of the machinery of manufacture, however, rather than to their imposition of monotony or their degenerative effects: "If one can speak of the crushing of the worker's intellectual life, the noise of the machinery should perhaps be considered its cause above anything else."[36]

In 1951, psychologists at McGill University undertook an experiment to illuminate "this age of semi-automation, when not only military personnel but also many industrial workers have little to do but keep a constant watch on instruments." The laboratory setup designed to mimic the effects of routinization reveals how dreadful the scientists thought such work must be. The voluntary subjects wore cotton gloves to dull

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[34] Ibid., 158, 265. Chase attributed the opinion that factory work is degenerative to nameless others; however, he agreed that automated work plus leisure presented a serious problem (emphasis in original).

[35] George Orwell *Road to Wigan Pier* (1937). Selection republished in Arthur O. Lewis, Jr. *Of Men and Machines* (New York: E.P. Dutton, 1963) 247-259. The passage here is from p. 248.

[36] H. Dubreuil, *Standards* (Paris: B. Grasset, 1929) 264.

their sense of touch, an opaque plastic visor to dull their sense of sight, and the lab's air conditioners kept up a low hum that dulled their sense of hearing. It was in many ways a less humane environment than one that offered at least some satisfaction in lunch breaks, quitting time, and the performance of a paid job. The experimenters obviously thought routinized work an abomination. The subjects were allowed to quit the experiment whenever they wished – which turned out to be much sooner than those subjects had anticipated. Students and professors who had planned to use their sensory-deprived time to think about problems and projects found that they were unable to concentrate: nearly all the subjects "reported that the most striking thing about the experience was that they were unable to think clearly about anything for any length of time." The experimenters concluded that routine work, by making few demands of the mind, impaired mental ability. "Prolonged exposure to a monotonous environment, then, has definitely deleterious effects." Therefore, a "changing sensory environment" – one that would force people to think – "seems essential for human beings."[37]

Scientists and social critics were much quicker to recognize a threat to workers' mental or spiritual health than policy makers. Federal politicians kept an eye on automation, but in the turbulent 1920s and wretched 1930s, they were primarily concerned with its effects on employment. However, they were conscious that machines could deal a more powerful blow to human dignity than just unemployment. The 1936 congressional hearings on Unemployment Caused by Labor-Saving Devices in Industry concluded,

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[37] Woodburn Heron, "The Pathology of Boredom," *Scientific American* 196 (January 1957): 52-56. Reprinted in *Mass Leisure* (Glencoe, Illinois: The Free Press, 1958) 137, 140, 141.

> If a laborer is unable to stand the strain, he is quickly replaced by a younger one waiting in line and begging for a job that will keep body and soul together as long as that will last in the grim, gruelling contest with a mechanical monster, a mute and inexorable master of man when it should be his servant.[38]

The point of the hearings, however, was to alleviate unemployment. The Acting Commissioner of the Bureau of Labor Statistics, A.F. Hinrichs, put the possibilities bluntly: either the work week must be made shorter, or – his preference – the increased standard of living resulting from technological advance would stimulate an increased demand for goods. But Hinrichs was alone in this suggestion. Most of the witnesses at the 1936 hearings were labour leaders, who promoted a tax on machinery to discourage further automation. But Hinrichs had allies elsewhere. In 1933, when the unemployment rate in the U.S. reached the breathtaking high of 24.9%, economist Morris P. Taylor published a small volume called *Common Sense about Machines*.[39] He argued that although machines contributed to unemployment, the solution was not to get rid of them:

> Mechanization has reduced employment directly and trade indirectly. These are not the necessary effects of mechanization, but occur because production and consumption are out of balance. If production and consumption were kept adjusted, machinery would improve the average standard of living and advance material civilization.[40]

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[38] *Investigation of Unemployment Caused by Labor-Saving Devices in Industry: Hearings before a Subcommittee on Labor, House of Representatives* (74th Congress, 2nd Session, Feb 13, 14, 17, 20, March 2, 1936) 118.

[39] United States Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970* (Washington, D.C., 1975) 135; Morris P. Taylor, *Common Sense about Machines* (Chicago: John C. Winston Co, 1933).

[40] Taylor, iii.

Taylor was also in favour of a shorter work week, unemployment insurance, and strong trade unions. But the key to economic health would be consumption.

From the vantage point of the late 1940s and 1950s, Hinrichs and Taylor seem to have been prophets crying in the wilderness. Postwar policy experts were nearly unanimous in their conviction that goosing consumption was the solution to all economic problems, including any caused by automation. The congressional hearings on automation held in the 1950s were a marked contrast to those held during the Depression.[41] The witnesses this time were scientists, engineers, and bankers. These experts were sure that they had unemployment solved; the problem now was insufficient mental skill. The new machines demanded sophisticated techniques to design, build, and maintain. John Diebold, Harvard Business School graduate and tireless promoter of automation, announced at the 1958 hearings,

> Many of the new jobs that automation will create (supervising the intricate workings of delicate machines, for instance) will require an increasing ability to think and to judge, increased understanding of mathematical and logical methods; in short, increased education in the largest sense of the term.[42]

But automation left many of the factory workers with a dull, repetitive job that insulted human dignity. Of course, education might solve this problem, too, at least in the long

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[41] They were also less well attended. *Business Week* suggested that absences as well as the testimony of witnesses were an indication that "neither Democrats nor Republicans consider automation significant right now." "Congress Delves into Automation," (October 22, 1955): 30-31.

[42] John Diebold, "Bringing Automation up to Date," testimony submitted to the Subcommittee on Automation and Energy Resources, 86th Congress, 2nd Session. Reprinted in Morris Philipson, ed., *Automation: Implications for the Future* (New York: Random House, 1962) 60. Worry about lack of skilled workers also dovetailed neatly with the worry about a knowledge gap between the US and the USSR.

term, when all work would demand the skill to operate complicated machinery. Vannevar Bush embraced this vision of the future at the 1955 hearings:

> If a man can be transferred from monotonous to interesting work there is a social gain....I am always happier when I go through an industrial plant if I see men working on complex machines where they are quite obviously exercising their intelligence, their ingenuity, and their judgment to the utmost, and I always feel there is something wrong with our system if I see a fellow human being performing an operation which call for nothing more than his presence and his manual operations.[43]

The jaunty progressivism of the witnesses is remarkable. Everett J. Livesy, a vice-president of the Dime Savings Bank of Brooklyn, insisted on the social advance that followed in technology's wake: "As recently as 150 years ago, the average man was a drudge who toiled a lifetime, only to leave behind as little as he had at birth. We have come a long way from this." Roger W. Bolz, editor of *Automation* magazine, argued that automation would produce "a slow and gradually spreading effect of tremendous benefit."[44] But they were all aware that these benefits rested on an economy of ever-increasing consumption. One congressman summarized the testimony, "If the purchasing power should turn downward, we would be in real trouble."[45]

Wiener was concerned about technological unemployment, but his suggested defenses were more questionable than the economy of consumption. In 1949, while

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[43] *Automation and Technological Change: Hearings before the Subcommittee on Economic Stabilization of the Joint Economic Committee* (84th Congress, Oct. 14, 15, 17, 18, 24-28 1955) 617.

[44] *Automation and Recent Trends, Hearings before the Subcommittee on Economic Stabilization of the Joint Economic Committee, Congress of the United States* (85th Congress, November 14 and 15, 1957) 44. *Automation* magazine, intended for managers and directors of industry, began publication in August, 1954 and ceased in December, 1976.

[45] *Automation and Technological Change: Hearings before the Subcommittee on Economic Stabilization of*

working on *The Human Use of Human Beings*, he wrote to the president of the United Auto Workers in Detroit, Walter Reuther, advising him that "one of the leading industrial corporations" had requested his thoughts on the feasibility of automatic control machinery in factories. Such machines would be "taped" (or programmed) to perform particular tasks, which would "undoubtedly lead to the factory without employees." Wiener stated firmly, "I do not personally wish to be responsible for any such state of affairs," though he had few practical suggestions for how to mitigate it. Like the tragic figure of the postwar Einstein, Wiener suggested that some knowledge was better suppressed. The idea that the potential of automatic control rivalled that of atomic science is unmistakably present in Wiener's letter.[46] But in 1949, it was far too late to hide self-correcting machines – which, even decades earlier, would have required a conspiracy of enormous proportions. Wiener offered organized labour another course of action: forewarned, they could insist on sharing in the profits of automation. Neither of these suggestions was a strong tactic, and although Reuther expressed interest in Wiener's ideas, nothing more ever came of it.[47] Six years later, Reuther told the congressional hearings that organized labour welcomed automation, its shorter work week, increased standard of living, and "freedom from monotonous drudgery." But as to the problems automation obviously presented, Reuther backed the economy of consumption. Only fast-

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the Joint Economic Committee (84th Congress, Oct. 14, 15, 17, 18, 24-28 1955) 40, 24.

[46] Wiener ran the comparison in the other direction, too. The piece "Responsible Man in the Machine Age" is actually about the problems of atomic weapons. It may be found in Box 29B, folder 658 at the Norbert Wiener Archive at MIT. (Hereafter, NWA.) On Einstein, see Chapter 2.

[47] Wiener's letter to Reuther, Box 7, folder 102, NWA; see also Reuther's reply, which is reprinted in David Noble, *Progress without People: New Technology, Unemployment, and the Message of Resistance* (Toronto: Between the Lines, 1995).

growing markets and an ever-increasing standard of living would ensure high levels of employment in automated factories.[48]

For these technocratic optimists, automation combined with education and training would eventually produce a generation with wealth, leisure, and interesting work. They championed the future; any social problems associated with automation were temporary. Their predictions appear fatuous today, although we do well to remember the protections and benefits that labour enjoys in North America. However, the often-mentioned route of more automation with no acknowledgement of the need for greater scientific and technical training seems to have been especially soft-headed: many social scientists and other observers advocated complete automation as the solution to the monotonous and degrading work imposed by machines. It was not automation that was inhumane, they maintained, but incomplete automation or semi-automation – the factories that forced workers into becoming part of the machine and denied their humanity.

In 1949, Charles R. Walker and Robert H. Guest undertook a study of the effects of the semi-automated factory on workers. Their interviews with these workers provoked expressions of deep dissatisfaction with the company's "disregard of the individual." "They treat the man like machines," complained one; "You're just a cog in the wheel," and "The company just thinks of the men as robots," said others.[49] Walker and Guest were clearly disturbed by this dispirited surrender. They suggested that there was ample

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[48] *Automation and Technological Change: Hearings before the Subcommittee on Economic Stabilization of the Joint Economic Committee* (84th Congress, Oct. 14, 15, 17, 18, 24-28 1955) 101-106.

[49] Charles R. Walker and Robert H. Guest, *The Man on the Assembly Line* (Cambridge: Harvard University Press, 1952) 137, 138.

evidence for "the general hypothesis of a connection between mass production jobs and a high quit rate." Their final recommendation was more automation – complete automation rather than the assembly line that required human beings to do the work of machines.[50] The implication was that there was no way to make factory production more humane. In France, the Groupe de Sociologie de Travail, of which Georges Friedmann was a member, argued that manual labour was bound to disappear anyway, to be replaced by white-collar service jobs in government, trade, education, and healthcare.[51] That the working class had reached the peak of its American power – a quarter of the labour force was unionized in 1956 – was a bitter irony.[52] Larger social changes spelled the decline of factory labour and a particular idea of the American working class. Factory work was the proper provenance of machines. The future of human beings lay elsewhere.

Automated man, thinking man, and cybernetics

Norbert Wiener made a major contribution to the automation debates with his 1950 book, *The Human Use of Human Beings*. Following its publication, he was invited to give speeches to management and engineering societies several times. In these, he stressed the wastefulness of asking a man to do a machine's job.

> The labor of the average factory hand to do low-grade work of discrimination in pasting labels on cans, in turning taps in a chemical factory according to indications of the instruments, and even in the assembly line of such a factory as one finds in the automotive industry,

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[50] Ibid., 116, 155.

[51] See, in addition to Friedmann's work cited above, Michael Rose, *Servants of Post-Industrial Power?:* Sociologie du Travail *in Modern France* (London: Macmillan, 1979)

[52] Bell, *Postindustrial Society*, 139.

> seemed to me to require a minimal part of the human brain, but nevertheless to require this partial exertion of discrimination with such speed and with such an amount of repetition that in the long run the machine should be superior to the brain for this restricted function, and perhaps for this function alone.[53]

John Diebold, the automation promoter who regularly gave expert testimony at the congressional hearings in the 1950s, cited Wiener with warm approval. Like Walker and Guest, Diebold suggested that complete automation was the only humane solution.[54]

But Wiener's position was less clear cut, and often difficult to make out.[55] In *The Human Use of Human Beings*, a very successful book, he compared the chain of command and specialization of the modern, efficient factory with an ant colony. Treating the human being as an ant, he declared, was a poor idea: "I wish to point out that the very physical development of the insect conditions it to be an essentially stupid and unlearning individual." Human beings, by virtue of their ability to think, ought to be valued – unlike the ant, which was no better than "a cheap mass-produced article, of no more individual value than a paper pie plate to be thrown away after it is once used."[56] The cruelty of the assembly line was that it left workers as worthless as the goods they produced. The culture of consumption, which depended on the existence of a broad desire for the new and improved versions of products, ought to have secured the jobs of workers – but obsolescence proved to be infectious. It suggested that human dignity could not find its

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[53] "From the Computing Machine to the Automatic Factory" (speech manuscript), Box 30B, folder 727, NWA, MIT, pp. 9-10. See also *Human Use*, chapter 9.

[54] John Diebold, *Automation, The Advent of the Automatic Factory* (New York: Van Nostrand, 1952).

[55] Noble's *Forces of Production* makes Wiener out to be a hero of the labour movement. Without dismissing Wiener's letter to Reuther, this is a little overblown.

[56] Wiener, *Human Use*, 51.

basis in anything as capricious as the manufacture of goods to suit mass desire. More dismayingly, it hinted darkly that universal human dignity might not exist at all.

Wiener was also ambiguous when it came any firm distinction between human beings and machines: "Theoretically, if we could build a machine whose mechanical structure duplicated human physiology, then we could have a machine whose intellectual capacities would duplicate those of human beings." The actual material – flesh or metal – was incidental. Since human identity was conceived in terms of mind and information, machines held the possibility of one day having a similar identity. At the same time, Wiener's deepest worry seems to have been not the possibility of surrendering our autonomy to machines – he suspected that machines would take a great deal of time to grow that sophisticated – but the prospect of human beings behaving like ideal machines. Game theory had deeply influenced American strategy in the Cold War, and Wiener believed there was strong evidence that the Soviet Union had also adopted it and made important refinements. Game theory, by laying out a program for strategy, was a "sort of *machine à gouverner*." Strategists, by adopting this "mechanistic technique," were a "machine-like group of men."[57] A close reading of Wiener's book might have left the worried observer slightly worse off than before. Human thought had already begun to model itself on something that, in principle, machines could do. Wiener insisted that human beings were special, but it looked like that specialness would be fleeting.

French sociologist Georges Friedmann was unimpressed.

> In addition to many stimulating reflections…there is in the literature on cybernetics a great deal of dogmatism, naivete and pretentiousness….In [*The Human Use of Human Beings*], Wiener is not at all interested in the

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[57] Ibid., 57, 182.

> norms, ends, and means of human action, and he continually discusses man in terms of mechanical analogies. Moreover, he does not even attempt a positive analysis of society.[58]

Freidmann tartly recommended that Wiener pay closer attention to the work of sociologists before he replaced it with limited physical analogies.[59]

Nevertheless, machines seemed poised to take over mental work the way they had once taken over physical work. Wiener was convinced that this was what made the automation of the 1950s revolutionary. It was not just that machines would replace human employees, but they would replace the low-level judgment that had been, despite the mechanical nature of the work, uniquely human. "The tendency of these new machines is to replace human judgment on all levels but a fairly high one," he wrote, "rather than to replace human energy and power by machine energy and power."[60] The development of digital computing during World War II vastly increased the scope of automatic machinery. Wiener recognized that the yes-or-no choices of digital computing looked very much like human judgment: "It then occurred to me that such a machine would have a remarkable resemblance to the human brain, which is also a machine where decisions already made lay the groundwork for new decisions according to a somewhat scheduled plan."[61] Since human beings made their decisions in large part based on past experience, Claude Shannon suggested that a chess-playing machine, capable of comparing present games with a memory of past games, might serve as a model for "the

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[58] Freidmann, *Industrial Society,* 188-9 (The book uses the English translation of the French title of *Human Use, Cybernetics and Society.*)

[59] See also Friedmann's criticism in *La crise du progrès* and Hugh Daziel Duncan's skeptical review of *The Human Use of Human Beings* in *The American Journal of Sociology* 56 (May 1951) 599-601.

[60] "Responsible Man in the Machine Age," Box 28D, folder 613, NWA, 1.

construction of a machine to evaluate military situations and to determine the best move at any specific stage."[62] However, in the early 50s, such a machine was acknowledged to be far off in the future. Machines were capable of only low-level judgment.

Low-level judgment was not necessarily the same thing as thought, in many people's view: "Basically, the computer is still a counter," was the way one book on automation put it, "and the magnificence of its performance lies rather in the genius of the men behind it than in the machine itself." Another was emphatic: "But one of the few things these machines cannot do is think." And a particularly scathing reaction was, "Can machines think? No! Not if thinking means to reason. A computer has less brains than a worm, which is known to be among the lowest forms of life."[63] The very word automatic implied that what the machines did was without thought. But what they did was enough like thought to be threatening, and to fuel the idea that thinking must be a peculiarly human characteristic.

The 1957 film *Desk Set* (the last of the eight classic movies starring Katharine Hepburn and Spencer Tracy) presented a fictional version of this idea. When MIT-trained expert Richard Sumner introduces two enormous computers to a large media corporation, the payroll computer immediately fires the staff in the research department. The research department computer and its stony-faced operator turn out to be unable to cope with the quirky, idiosyncratic public inquiries. The computer begins to cough out punch cards rapidly, expiring in a dramatic whirlwind of paper and electronic wheezing. Meanwhile,

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[61] "From the Computing Machine to the Automatic Factory," Box 30B, folder 727, NWA, 9.

[62] Wiener, *Human Use*, 178.

[63] David O. Woodbury, *Let Erma Do It: The Full Story of Automation* (New York: Harcourt, Brace and Co., 1956), 193. A.W. Zelomek, *A Changing America at Work and Play* (New York: Wiley, 1959) 53. (Dr.) Joe Harrington, cited in Woodbury, 234.

the computer in the payroll department has fired everybody, including the president of the company. The moral of the story is that while computers might be useful tools, they are an absurd substitution for a thinking human being. Sumner stresses that the computer was always intended to be a tool to support the work of the research staff, not a replacement for them. Computers and humans were not the same.

Defining human beings in opposition to machines could lead to especially strange news stories. In 1959, famed psychoanalyst Bruno Bettelheim wrote an article on an autistic child that appeared in *Scientific American*. The child, Joey, wanted to be completely automatic, a wish that Bettelheim interpreted as wanting to be rid of his humanity. Joey insisted that he needed a carburetor in order to breathe, and fashioned one "from masking tape, cardboard, wire, and other paraphernalia." One of Bettelheim's later books, *The Uses of Enchantment* (1976), argues that fairy tales are a way of helping children through the stages of psychological growth, so it is not surprising that Bettelheim's account of Joey's life follows the outline of a fairy tale: as Joey experienced love (like the beast loved by Beauty) he at last "became a human child."[64] But Joey, of course, had always been human. Nevertheless, Bettelheim took him at his word, and ascribed to him a literal automatism: "A human body that functions as if it were a machine and a machine that duplicates human functions are equally fascinating and frightening. Perhaps they are so uncanny because they remind us that the human body can operate without a spirit, that body can exist without soul."[65] It is a strange conclusion

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[64] Bettelheim, "Joey: A Mechanical Boy," *Scientific American* (March 1959): 117, 127. Bettelheim believed that autism was the result of an unstimulating early environment – naturally, the mother's fault. Many of his theories have since been discredited.

[65] Ibid., 117. The Bettelheim article is still interpreted as an example of a literal cyborg. The implication is that you are a machine if you imagine yourself to be one. It is included in the exhibition catalogue for the

to draw from the case of a boy whose mind might have been quite different, but was unquestionably still there. Bettelheim's account, however, is the exact inverse of the worries about computer autonomy: if it was possible for a human child to think his way into being a machine, then how could we defend that last desperate preserve of our humanity?

Bettelheim stated that boy and machine were uncanny because they were functionally identical, but the story's spookiness really derives from the idea that Joey *looked* exactly like a human child, but was in fact (according to Bettelheim) a machine. For the cyberneticians, such verisimilitude was anachronistic. Physically, automatic machinery, computers, and robots were more distinct from human beings than ever, unlike the automata and the robots popular from the eighteenth century until just before World War II. As Alfred Chapuis and Edmond Droz noted in their comprehensive history of automata in 1958,

> Robots made to look like human beings were soon forgotten with the war of 1939....now in our own era, we try to make the machine as primarily something of practical value, no longer copying the mere movements of a human being but imitating his actions and replacing him in the fulfillment of his work.[66]

Cybernetics was based on this idea of the functional similarity of not only the physical potential of humans and machines, but their potential to think.

However, even among the cyberneticians, machines and men were not treated perfectly symmetrically. Programmed machines were threatening because they appeared

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Vancouver Art Gallery's 2002 cyborg exhibition. *The Uncanny: Experiments in Cyborg Culture*, Bruce Grenville, ed. (VAG/Arsenal Pulp Press, 2002).

[66] Alfred Chapuis and Edmond Droz, *Automata: A Historical and Technological Study*, trans. Alec Reid

to think; curiously, human beings doing the same work were merely acting mechanically. Assembly line work was degrading precisely because it did not demand thinking. One popular writer on automation was dismayed by its effects:

> This subtle enslavement of the most advanced nation on earth to the greasy mentality of machines has written our standard of living almost entirely in terms of cars and TV's and self-defrosting refrigerators, thus making captives of millions who could do better....The human being, long dispossessed of his right to use his muscles, is also losing his right to use his head because, in occupying a little part of it, machines immobilize the rest.[67]

The assembly line reduced thinking man to automatic man, an impoverished servant to the machine. Automation optimists continued to insist that further automation would wipe out this problem: the new machines would demand greater skill of workers. "Labor will be more and more 'up-graded' into the kinds of functions performed by the engineer, the designer, the production planner, the skilled maintenance and repair man, the organizer and manager."[68] Automation would spur human beings to the realization of their potential. Machines were not so much a threat to human uniqueness as the catalyst for our full development as human beings.

Sociologist Robert K. Merton warned that the effects of the "enforced obsolescence of skills" brought about by labour-saving machinery would produce "acute psychological and social problems for the worker." The machines themselves would

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(Neuchâtel: Éditions du Griffon, 1958) 386, 387.

[67] Woodbury, 11-12.

[68] Eugene Stanley, *Technology and Human Values* cited by Diebold, *Automation,* 164. See also Michael Argyle, "Social Aspects of Automation," in E.M. Hugh-Jones, *The Push-Button World: Automation Today* (Norman: University of Oklahoma Press, 1956) 116.

work against the possibility of upgrading, since they would destroy the worker's self-image and confidence. Labourers, Merton pointed out, came overwhelmingly from social classes that had neither a history of pursuing higher education nor the means to do so. The technical expertise that the machines demanded meant that managerial jobs would go to wealthier classes, and "the prospect of workers rising through the ranks" would be "progressively dimmed." The upward mobility enthusiastically preached by automation's defenders would never come to be. Class and rank would be increasingly hard to break.[69]

Psychological testing presented a dark picture, too. Throughout the 1940s and 50s, intelligence tests consistently held that assembly-line work tended to be performed by those with the lowest scores.[70] The economist Henry Winthrop was skeptical about the possibility of retraining such workers. Training the newly unemployed as skilled mechanical and electrical engineers "calls into play intellectual abilities only sparsely distributed among the semi-skilled and unskilled." So "all talk of extensive upgrading is so much poppycock."[71] The semi-skilled and unskilled were doomed to failure; the machines had made them obsolescent. " 'Creeping unemployment' which refers to young

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[69] Robert K. Merton, "The Machine, the Worker, and the Engineer," *Science* 105 (January 1947): 79-81. Reprinted in Simon Marcson, ed. *Automation, Alienation, and Anomie* (New York: Harper and Row, 1970) 396.

[70] See Donald E. Super, *Appraising Vocational Fitness by Means of Psychological Tests* (New York: Harper, 1949) and H.J. Eysenck, *Uses and Abuses of Psychology* (London: Penguin Books, 1953).

[71] Henry Winthrop. "Some Psychological and Economic Assumptions Underlying Automation," *The American Journal of Economics and Sociology* 17 (July 1958): 399-412; continued vol. 18 (October 1958): 69-82; reprinted in Robert P. Weeks, ed. *Machines and the Man: A Sourcebook on Automation* (New York: Appleton-Century-Crofts, 1961) 300. It is interesting that the use of the term 'skill' shifts during this period, applying both to higher-level assembly line work and to the abilities of the high-level white collar workers who were thought to be in short supply. Winthrop avoids this slippage by referring to 'semi-skilled' factory work. 'Skill' increasingly came to refer to the professional jobs, suggesting that it was always tagged to something uniquely human, something that the automatic machine could not do.

people who would have found a place in industry if certain skills had not become obsolescent, is also with us." Winthrop stated, "In this creeping type of unemployment the person most seriously affected is the one not hired." 'Upgrading' was no solution, despite prevailing cocktail party conversation.

> The standard anecdote which is repeated *ad nauseum* in this connection is the story of the upgraded Ford worker who told a newspaper man that he used to go home every evening jittery with exhaustion. After upgrading, everything was different. 'Now,' he said, 'I run a whole battery of machines by pushing buttons and reading dials and go home feeling like talking to my family and reading.'[72]

Nonsense, Winthrop retorted. Many workers were unable to keep up with their upgraded jobs, and went home more tense than ever before. They were highly unlikely to take up practices that demanded extensive mental concentration, such as conversation or reading.

The importance of intelligence testing to this argument suggests a cultural explanation of why automatic machinery might have been said to think. In 1948, Geoffrey Gorer undertook the task of explaining to his fellow Britons the American fascination with IQ tests, standardized admissions tests, and quiz shows, in which "no intelligence of any sort is involved, merely the recollection of abstruse quotations and snippets of history." This was Taylorism applied to knowledge, he argued. "Just as gestures, movements, and machines have been split up into their smallest component parts, so has knowledge tended to be reduced to a series of disconnected and isolated facts."[73] Knowledge and thinking were conceived of in machine terms. Once the

[72] Ibid., 309, 300, 301.

[73] Geoffrey Gorer, *The American People: A Study in National Character* (New York: W.W. Norton and Co., 1948) 145-146, 145.

machines were able to perform similar tasks in record- and fact-keeping, they might be said to be thinking as well.

The threat posed by machines was specific to thought because the machines were getting good at certain kinds of thinking, displacing human workers and disrupting lives. Although our creative abilities have been considered proof of our humanity as often as our ability to think, few found the possibility of machine-created art a threat to equal automation. Computer-generated music, the only computer art form to achieve any presence in the 1950s, aroused little reaction. In 1956, the Burroughs Corporation used a computer to compose a piece of music. In 1957, they achieved national radio play for another song, "Pushbutton Bertha."[74] The same year, Lejaren Hiller, director of the Experimental Music Studio at the University of Chicago, used the university's Illiac computer to compose the *Illiac Suite*. "The result was by no means music to shake the world," noted one critic dryly. Although the composition produced interesting combinations of sounds, it was dull overall, and "has not been heard of since."[75] Computer music remained unusual. Although computers offered the means to experiment further with the "chance music" promoted by avant-garde composers like John Cage, they were still too rare and too big to afford composers much opportunity for use.

It was not until the 1960s and 70s that computers came into more extensive use in the arts.[76] Even then, computer-generated art was not considered dangerous in the way

[74] Carole Spearin McCauley, *Computers and Creativity* (New York: Praeger, 1974) 73.

[75] David Ewen, *Composers of Tomorrow's Music* (New York: Dodd, Mead, and Company, 1971) 121-2.

[76] See the catalogue for the exhibit held at the Institute of Contemporary Arts, London, August 2-October 20, 1968: Jaisa Reichardt, ed. *Cybernetic Serendipity: the Computer and the Arts* (London: Studio International, 1968). See also Jasia Reichardt, ed., *Cybernetics, Art, and Ideas* (Greenwich, Conn.: New York Graphic Society, Ltd., 1971) and Andy Pickering on Gordon Pask's exhibit, "Cybernetics and the

that computer thinking was. Artists did not stand to lose their jobs; nuclear weapons were not controlled by artistic judgments. The division of art into "high art" and everything else further softened any threat computer art might have posed. If it was high art, then its audience was conversant with avant-garde ideas, and saw computer art as a continuation of the exploration of randomness already several decades old. If it was popular art, such as "Pushbutton Bertha," then it was an interesting novelty, but our essential humanity was not staked to something as insubstantial as a novelty song. A machine that produced such music was no threat since the songs were not believed to require much talent to compose. George Orwell, mocking the apparent mindlessness of popular music, once proposed a "versifier," which would produce popular lyrics "untouched by human brains."[77] The critics of mass culture were convinced that it produced little evidence of human thought or talent, and nothing that was of lasting value. It produced merely kitsch (from the German word for trash). Culture mirrored the workers' assembly line, turning out cheap products to satisfy mass taste. Theodor Adorno and Max Horkheimer bitterly called it "the culture industry," the final result of a technological rationale set in motion centuries earlier.[78] In this case, though, the machine was more symptom than cause of something basically awry in Western thought and culture.

Mangle: Ashby, Beer, and Pask," paper given at the Centre Koyré in Paris in March 2000, pdf document archived on-line at www.soc.uiuc.edu/faculty/pickerin/cybernetics.pdf.

[77] Dennis Gabor, "Technological Civilization and Man's Future," in *Cybernetics, Art, and Ideas*, 18.

[78] Theodor Adorno and Max Horkheimer, *Dialectic of Enlightenment* (New York: Continuum, 1982).

A soul of one's own

The sharp-tongued critics of mass culture attacked its mediocrity; rarely did they hone in on its dependence on an ever-increasing standard of living. It is difficult now to credit the largely uncritical acceptance of the economy of consumption. But the hardships of the Depression and the war years had left most Americans longing to fulfill the dream of a consumer paradise.[79] Besides, the economy of consumption seemed to be working. In 1952, President Eisenhower reported that civilian employment had risen by three million workers since 1947, to a total of 61 million. By 1956, it had risen by 3.7 million more. Total annual output rose by 22 % over Eisenhower's first term to 330 billion dollars a year. By 1956, it was 412 billion. This success, despite periodic recessions, Eisenhower attributed to "the opportunities which our free economy provides for the improvement of well being….Rising incomes enabled consumers to expand their purchases of virtually all types of goods."[80]

The justification of the economy of consumption occasionally ran in the other direction. Rates of consumption were increasing; there were not enough workers to allow them to continue to increase at the same pace. The increased productivity and demand due to automation called for further automation. "If automation increases at its present rate, every available worker will have to be putting in 40 hours a week to keep raising our standard of living," wrote Carroll W. Boyce in *Factory Management* magazine. Once again, complete automation – and a reduced work week – were the key to prosperity.

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[79] See Graebner, *The Age of Doubt*, 7-8.

[80] *The Economic Report of the President 1952* (Government Printing Office: 1952) 1-8, 13-14, 17-20, 24 and *The Economic Report of the President 1957* (Government Printing Office, 1957) iii-v, vii. Reprinted in Ernest R. May, ed. *Anxiety and Affluence 1945-1965* (New York: McGraw-Hill, 1966) 353.

"The antidote, not the cause, is automation," he concluded.[81] During a roundtable discussion organized by *Fortune* magazine in 1953, sociologist David Reisman speculated that since the next generation was being brought up in homes replete with labour-saving machinery, they "lacked the industriousness and work-mindedness of the present generation. The development of the Automatic Factory is salutary if only to keep the level of production rising to meet the growing population's needs."[82]

Henry Winthrop, naturally, was skeptical of such an easy transition to the culture of leisure and consumption. He warned that there might be a limit to the purchasing power necessary "to absorb all the industrial manna from heaven." It was possible that if the fully automatic factory came to be, throwing a large part of the population out of work, that there might develop a tendency for goods to become nearly or completely free, "thus playing havoc with the very *raison d'être* of an industrial economy." It was "a fantasy of economic existence," "a world that only dreamers of the type represented by William Morris could have created."[83] It was unfair of Winthrop to drag Morris's name through this mud; Morris, after all, had been no friend to either machinery or capitalism's "ceaseless creation of wants."[84] However, Morris's name was by them widely associated with worthy aesthetic pursuits, for which the culture of consumption promised ample time to everybody. When Wiener spoke to an audience at City College in New York on the implications of the automatic factory, he praised the American Society of Mechanical Engineers for their recognition that

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[81] Cited in Woodbury, 154

[82] "The Automatic Factory: A *Fortune* Roundtable," *Fortune* (October 1953): 195.

[83] Ibid., 305-6.

[84] Morris, "The Aims of Art," in Holbrook Jackson, ed. *William Morris on Art and Socialism* (London, 1947) 89, cited in Lears, 63 (see note 23).

> new opportunities for leisure must be accompanied by new valuations of leisure and of the human beings who have that leisure. Indeed, I was astonished to find how close a number of hard-headed business men and management experts were willing to come to the position of a William Morris utopian society.[85]

The fully automatic factory was a powerful idea. In 1946, two engineers wrote an influential article on the fully automatic factory for *Fortune* magazine. "Imagine if you will a factory as clean, spacious and continuously operating as a hydroelectric plant," they invited. It would be run with "accurate" and "untiring" machines.[86] Once former factory workers had been retrained, and younger generations educated to meet society's new needs, a cultural renaissance would result. At the 1955 Congressional hearings, one witness could barely contain his excitement: "In the America of the future, we will have more people in the sciences and the professions…We will have fewer people providing for our elementary needs…and more people providing for our spiritual and cultural requirements."[87] This utopian vision was repeated frequently during the 1950s. Management's promotion of automation was, of course, far from altruistic: there was a strong desire to control labour and to stamp out unions.[88] Still, it is likely

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[85] "From the Computing Machine to the Automatic Factory," 14.

[86] Eric W. Leaver and J.J. Brown, "Machines without Men," *Fortune* (November 1946).

[87] Marshall G. Munce, "Abundance through Economic Freedom," reprinted in Robert P. Weeks, ed. *Machines and the Man: A Sourcebook on Automation* (New York: Appleton-Century-Crofts, 1961) 169.

[88] Noble, *Forces of Production*. Noble writes from a Marxian perspective, where the factors leading to automation are management's desire to control labour and its enchantment with technological progress. His trump card is the failure of record/playback technology, which used the movements of a skilled machinist to develop a program for automation. Instead, numerical control dominated, in which pointy-headed engineers developed the programs in offices far from the factory floor. Note that in either case, the

that professions of faith in technological utopia were genuine. With machines to do both physical labour and dull but necessary mental labour, human beings would have the time for cultural and intellectual pursuits. Automation promised an Athens without slavery.

Even if the fully automatic factory remained some years off, many social observers believed that any increase in leisure was a net gain for society. According to a 1945 book on recreation, assembly line work might be boring, specialization might dull creativity, and automatic machinery might turn housework into routinized tasks, but the leisure time resulting would more than make up for the shortcomings of the efficient modern world. "It is in his time-off-the-job, his free choosing time, his earned leisure, that man must find compensation for the deprivations of his work. It is then that he may discover his potentialities and may venture into chosen pastures at the dictates of his appetites and talents." The author insisted that leisure ranked with the freedoms that inspired Norman Rockwell's patriotic covers for the *Saturday Evening Post*: "To the freedom of speech and worship, to the freedom from want and fear, must be added the freedom of choice of pursuits for one's enjoyment and satisfaction…in one's earned leisure." This would be the time when the downtrodden and weary worker could "call his soul his own."[89]

During the postwar period, worried social observers produced a battery of books designed to help workers cope with their newfound leisure. "What constituted the so-

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machinist was out of a job. It is not clear what solace R/P technology might have offered under such circumstances, and Noble does not enlighten us.

[89] G. Ott Romney, *Off the Job Living: A Modern Concept of Recreation and Its Place in the Postwar World* (Washington D.C.: McGrath Publishing for the National Recreation and Park Association, 1945) 3, 8.

called 'problem,'" according to a pair of skeptical historians, "was that masses of Americans were unprepared to deal meaningfully with this abundance of time."[90] The director of the Institute for Psychoanalysis in Chicago, Franz Alexander, claimed that the American "feverish race for achievement" meant that a large number of his patients were "truly terrified at the idea of leisure or inactivity." Alexander lamented that the point of the vast improvements to material life enabled by the machine had been forgotten. The "ultimate aim of all these improvements" was "a higher cultivation of our specifically human faculties" – art, architecture, science, aesthetic pleasure, and "educating and developing the powers of the mind."[91] He suggested that this constructive use of leisure might even defuse the international tension of the nuclear age. In 1962, one observer believed that automation might bring about the American dream of a wealthy yet classless society – if only people could be educated to use their leisure wisely.

> Through most of history, back-breaking manual labor for long hours has been the lot of both men and women, leaving little time or energy for cultural activity….Automation will accelerate the development of a new leisure class. Far from being an aristocratic élite, it will be democratic in composition and temper….With increasing time to himself, man is more than ever in need of improved taste, more diversified interests, more constructive social values, a more active sense of citizenship, and higher individual ideals.[92]

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[90] John Huntsman and William Harper, "The Problem of Leisure Reconsidered," *Journal of American Culture* 16 no. 1 (Spring 1993): 47.

[91] Franz Alexander, "Mental Hygiene in the Atomic Age," Lyman Bryson, et al. eds., *Conflicts of Power in Modern Culture* (New York: Harper and Bros., 1947) 277, 278.

[92] Henry M. Winston, "Perspective," *Automation and Technological Change*, John T. Dunlop, ed. (Englewood Cliffs NJ: Prentice Hall, 1962) 171-172.

Historian Steven M. Gelber points out that spare time in American culture was tainted by long-standing proscriptions on idleness, which held that time not working was time in trouble.[93] In rushed the experts to assist ordinary people in developing the skills that leisure demanded. Famed psychiatrist William C. Menninger emphasized the need for leisure to balance work: "Successful professional men" ought to "set aside their cyclotrons, computations, and competitions to take up manual work after hours." A sociologist prescribed the same course of treatment in more detail:

> Quiet hobbies are needed for people living or working in noisy surroundings; outdoor hobbies for people working indoors, and vice versa; active hobbies for desk workers; lively hobbies for people working at routine tasks; headwork hobbies for people engaged in handiwork and vice versa.[94]

Gelber argues that the hobbies that conferred these psychological benefits increasingly took on the characteristics of work. Clement Greenberg noticed this in 1953: "Leisure – even for those who do not work – is at bottom a function of work, flows from work, and changes as the nature of work changes." Another close observer noted, "A recent development in American culture is the emergence of what we may call 'fun morality.' Here fun, from having been suspect if not taboo, has tended to become obligatory....Boundaries formerly maintained between work and play break down."[95]

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[93] Steven M. Gelber, *Hobbies: Leisure and the Culture of Work in America* (New York: Columbia University Press, 1999) 1.

[94] William C. Menninger, *Enjoying Leisure Time* (Chicago: Science Research Associates, 1950) 37; E.S. Bogardus, "Hobbies in War and Peace," *Sociology and Social Research* 27 (1943): 221. Cited in Steven M. Gelber, *Hobbies: Leisure and the Culture of Work in America* (New York: Columbia University Press, 1999) 50.

[95] Clement Greenberg, "Work and Leisure under Industrialism," *Commentary* 16 (July 1953): 57-61 and Martha Wolfenstein, "The Emergence of Fun Morality," *Journal of Social Issues* 7, no. 4 (1951). Both

The blurring of leisure and work reached its ultimate expression with the popularity of injection-molded plastic model kits in the 1950s. Unlike balsa wood kits of previous decades, the plastic parts required no tracing or cutting on the part of the hobbyist. "The package meant that the hobbyist did not have to engage the hobby at a higher level of abstraction." No mental work was necessary. Gelber concludes,

> The kit was the ultimate victory of the assembly line. Whereas craft amateurs had previously sought to preserve an appreciation for hand craftsmanship in the face of industrialization, kit hobbyists conceded production to the machine. They became the leisure-time equivalents of the apocryphal Ford worker who, as his last wish before retiring, requested permission to finish tightening the bolt he had been starting for thirty years.[96]

The thinking that had brought Americans such abundant leisure in the first place had left them unable to spend their leisure in cultural and intellectual pursuits. Thinking machines might push this contradiction to its crisis point. In 1960, Charles K. Brightbill despaired at the introduction of game-playing machines. As if machines at work were not enough, "automation follows the worker from his job into his private domain of leisure."[97]

Perhaps even more dismaying, though, was the possibility that we would not take up any hobbies at all. Machines had so debilitated our minds that we would be unable to do anything improving with our spare time. Jay B. Wash, a professor of education at New York University, expressed this worry in 1938: "The machine age has, of course, already supplied an unexampled wealth of leisure and what happens? The average man who has time on his hands turns out to be a spectator, a watcher of somebody else, merely because

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reprinted in Eric Larrabee, ed., *Mass Leisure* (Glencoe, Illinois: The Free Press, 1958) 38, 86.

[96] Gelber, 262.

that is the easiest thing."[98] According to Clement Greenberg, as play matched work in banality, culture inevitably became middlebrow.[99] Leisure, based on automation and the culture of consumption, would not lead to a new renaissance. These critics, who exude a mournful romanticism, agreed with the promoters of automation that human beings were capable of great things. But they were sure that the path society was on would lead only to mindless, thoughtless conformity. Our fundamental humanity was thought to lie in our ability to think – all the more disappointing, then, if we seem not to bother.

Both our individuality and our humanity were at stake. Wiener's impassioned defense of human uniqueness is no less moving because of his contributions to control theory. Human uniqueness, however, seemed an increasingly fragile idea. It was beset by mass culture critics who viewed the bulk of humanity (their august selves excluded) as stupid and easily manipulated, beset by the rationalization of work that denied their ability to think, and beset by the ever-growing capacity of machines. As scientists and engineers improved the capacity of machines to the point where many reasonable people agreed that they were doing something like thinking, critics insisted more strongly that human uniqueness lay in our ability to think. It was a dangerous gambit. Wiener's own ambivalence about machines may have belonged squarely within the traditions of American thought, but other cyberneticians were making great progress both toward a machine that would be capable of high-level thought and toward a sophisticated and mechanical account of the human mind.

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[97] Charles K. Brightbill, *The Challenge of Leisure* (Englewood Cliffs, NJ: Prentice-Hall, 1960) 20.

[98] Jay B. Wash, *Spectatoritis* (New York: A.S. Barnes and Co., 1938) 4-5.

[99] Greenberg, 38.

Chapter 4: Mechanical Minds and Other Little Cybernetic Monsters

When asked whether he thought machines could 'think,' he replied: 'You bet. I'm a machine and you're a machine, and we both think, don't we?'" [1]

In the nineteenth century, the physicist Hermann von Helmholtz used the examples of the great automata of the eighteenth century to demonstrate the impossibility of world without decline. The automata were meant to persuade his audience of the futility of perpetual motion. Yet automata powerfully suggest such a thing. They do not complain when they tire; they do not cry out when they need to be repaired. It is a small imaginative step from automata to immortality. Christoph Asendorf's remark on machines in general is especially true of automata: "The sight of the machine appears to guarantee humans their status as *perpetuum mobile*, to release them from the fear of death."[2] The great eighteenth-century automaton builder Jacques de Vaucanson created several "sublime toys" that hinted at immortality. As models, they implied that their human observers were much the same. One could only conclude that with careful maintenance, neither human nor automaton would wear out. Close observers of cybernetics recognized that the cyberneticians had taken up the mantle of the eighteenth- and nineteenth-century craftsmen. As a pair of French philosophers observed, "Jacques de Vaucanson, more than Descartes or Condillac, was a cybernetician *avant la lettre*."[3]

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[1] Claude Shannon, as reported by John Horgan, "Claude E. Shannon," *IEEE Spectrum* 29 (April 1992): 72-73.

[2] Christoph Asendorf, *Batteries of Life: On the History of Things and Their Perception in Modernity*, Don Reneau, trans. (London: University College Press, 1993) 111.

[3] A. Doyon and L. Liaigre, "Méthodologie comparée du biomécanisme et de la mécanique comparée," *Dialectica* 10 (1956): 293. "Sublime toys:" see Alfred Chapuis and Edmond Droz, *Automata: A Historical and Technological Study* trans. Alec Reid (Neuchâtel: Éditions du Griffon, 1958) 379.

But cybernetics developed very different kinds of automata. To begin with, they no longer looked like human beings. In their history of automata, Alfred Chapuis and Edmond Droz observed, "Robots made to look like human beings were soon forgotten with the war of 1939....Today the robot is essentially an *automatic machine*."[4] In the eighteenth and nineteenth centuries, automata were built as models of what human beings or animals might *do* – such as digest food – and as models of physically-dependent skill – such as playing a musical instrument. From the mid-twentieth century, automata were no longer displays of such craftsmanship. Their appearance stripped down to functional physical parts, they were more often models of human thought and decision-making. If automata "are receptacles into which we project our ideas and feelings about what it is to be human," then the cybernetic automata are evidence of a profound change.[5]

In earlier times, automata-builders were brought before the Inquisition under suspicion of practicing the dark arts. The twentieth century was too sophisticated to believe in magic, but there was nevertheless a fascination and uneasiness that indicates that the old fear of witchcraft faintly lingered. However, it was the computers, the electronic brains, that unsettled people the most. Both the scientific and the mainstream press treated the cybernetic automata as intensely interesting, and often entertaining, but with considerably more balance than they brought to computers. Even Norbert Wiener, so anxious about computers and automation in the workplace, took pleasure in the growing capacity of these automata that could solve mazes and learn to come when a whistle was blown. The historian Jean-Claude Beaune aptly dubbed them "little cybernetic

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[4] Chapuis and Droz, 386.

[5] Linda Strauss, *Automata: A Study in the Interface of Science, Technology, and Popular Culture, 1730-1885* (Ph.D. Thesis, University of California, San Diego, 1987) 288.

monsters," these devices that were far less menacing than electronic brains.[6] It is not hard to understand why the automata were so much more acceptable than the computers. To begin with, they were much smaller. They threatened no one's livelihood, and their behaviour was similar enough to that of babies or pets that the mainstream reaction was often charmed indulgence. The exception to this was chess-playing machines, which provoked a reaction more muted than automation, but anxious nonetheless. Unlike the cybernetic automata, chess machines played to win.

Mind, brain, and blasphemy

It was perhaps inevitable that Norbert Wiener became the dominant influence in conceptions of cybernetics. Not only had he named the new field, his frequent speeches, popular books, and readiness to accept interviews overshadowed the contributions of other cyberneticians to the public debate. But the other cyberneticians sometimes held ambitions far grander than Wiener's. In 1994, historian and cognitive scientist Jean-Pierre Dupuy attempted to correct Wiener's historiographical influence in his book *Aux origines des sciences cognitives*, published in English as *The Mechanization of the Mind.* Dupuy picked for his hero the brilliant, articulate neuropsychiatrist Warren McCulloch, whom he calls "the soul of the Macy conferences."[7] There is a good case for organizing the history of cybernetics around McCulloch. His work on the physiology of perception was important to specific developments in neurophysiology and cognitive science, while Wiener's mushier ideas about the relationship between man and machine drifted into the

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[6] Jean-Claude Beaune, *l'Automate et ses mobiles* (Paris: Flammarion, 1980).

[7] Jean-Pierre Dupuy, *Aux origines des sciences cognitives* (Paris: La Découverte, 1994) and *The Mechanization of the Mind,* M.B. DeBevoise, trans. (Princeton: Princeton Univ. Press., 2000) 2, 5.

cultural mainstream. However distasteful Dupuy finds this, it is precisely why Wiener is the more important cybernetician from the perspective of the cultural history of science.

Nevertheless, McCulloch ought not to be neglected. Since Dupuy understands cybernetics as the forgotten ancestor of contemporary cognitive science, McCulloch, who had none of Wiener's ambivalence about a thoroughly scientific and materialist understanding of mind, is the natural protagonist. But in his zeal to correct historians' mistakes, Dupuy ranks Wiener little better than a second-rate popularizer, a hack. "Wiener's carelessness as a thinker and his propensity for abusing metaphors and analogies were matched only by McCulloch's rigor in stubbornly pursuing what he solemnly regarded as a philosophical quest." He continues,

> If nonetheless it is fair to say that McCulloch, by force of both his personality and his work, embodied what was at stake in the cybernetic project in a way that Wiener did not, it is because one finds in McCulloch, though not in Wiener, a profound coherence between the ideological commitment of the man and the scientific work itself.[8]

There is little doubt that in the 1950s, McCulloch was the more thoughtful scientist, and it is a shame that he produced little work for a general audience. But this does not make Wiener any less a cybernetician, and he does not deserve Dupuy's damnation. Cognitive science might share McCulloch's materialist ambition, but it would be difficult to argue that it has had a greater effect on mainstream conceptions of man and machine than Wiener's work. Wiener remains influential in both computer science, where his admonition to build machines to suit human beings rather than the other way round still

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[8] Warren McCulloch's important papers were collected in the 1965 volume, *Embodiments of Mind.* I will give the original paper titles and year of publication, but the page numbers correspond to the 1965 volume. Warren S. McCulloch, "Why the Mind is in the Head," 1951. Reprinted in *Embodiments of Mind*

falls on receptive ears, and in much of the pop-philosophy that continues to mold our ideas of man and machine. McCulloch, on the other hand, chaired the Macy conferences and he did much of the work to organize them. But "profound coherence," no matter how much we may admire it, is not a characteristic of scientific and cultural movements. They move in shuddering steps, and although they have a central purpose or idea that allows us to call them movements, they contain variety and disagreement. At the heart of the cybernetics movement lies a great contradiction between the belief that human beings are distinctive by virtue of their ability to think, and the belief that thinking is a material process which machines can also do. The distinctively human nature of thinking was the subject of the last chapter. McCulloch will now serve well as ambassador for the other understanding of man and machine.

McCulloch had studied psychology early in his career, but turned to neurology with the conviction that "psychology for me would be a farce unless I really found out how human brains work." He was scathing in his indictment of a culture in psychology's thrall: "We now have a generation of parents full of superstitious fear that they may be guilty of their children's anticipated neuroses. They cannot suckle, cuddle, swathe or spank the baby, housebreak the child or admonish the adolescent except upon advice of a psychiatrist." He even suggested that psychology might be a predator more dangerous for weak minds than communism.[9] Certain knowledge of the mind could not come from Freud, Jung, or Adler. It demanded the weighty language of organic science. From the start, McCulloch was convinced that mind was incarnated in the brain, or – as he put it later – that the mind was in the head. The only part of the body that was complex enough

(Cambridge: MIT Press, 1965) 111-112. Hereafter, *Embodiments*.

[9] McCulloch, "The Past of a Delusion" (1953). *Embodiments*, 300, 299.

to encompass what we call mind, he insisted, was the brain. Only in the brain were there neurons able to form new connections "as time and circumstance demand." Only in the brain did we have the physiological correlate to learning, perception, and response to change.[10]

Related to the identification of mind and brain was the identification of brain and machine. In 1943, McCulloch and the young mathematician Walter Pitts published the paper that established their reputations, called "A Logical Calculus of the Ideas Immanent in Nervous Activity." Starting from the idea that neurons either fired or did not, something McCulloch had been exploring the implications of since the 1920s, they developed a description of the activity of networks of neurons using propositional logic. In Dupuy's assessment, "The philosophical ambition of this article is considerable, since it attempted nothing less than to give a purely neuroanatomical and neurophysiological basis for a priori judgments, and thus to ground a neurology of mind."[11] It was a model of the brain as a logic machine. It boded well for an end to the dualism that plagued philosophy of mind, since the mind would no longer go "more ghostly than a ghost," a phrase from the physiologist Richard Sherrington, whom McCulloch liked to quote. Not everyone was satisfied with the model. In a letter to Norbert Wiener, John von Neumann suggested that the McCulloch-Pitts work might not be particularly useful for

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[10] McCulloch, "Why the Mind is in the Head" (1951). *Embodiments*, 73.

[11] Dupuy, *The Mechanization of the Mind*, 49. Warren S. McCulloch and Walter Pitts, "A Logical Calculus of the Ideas Immanent in Nervous Activity," *Bulletin of Mathematical Biophysics* 5 (1943): 115-133. For more on this paper, see Gertrudis Van de Vijver, "The Experimental Epistemology of Walter S. McCulloch," [sic] *New Perspectives on Cybernetics*, G. Van de Vijver, ed. (Dordrecht: Kluwer, 1992) 105-123, which strongly resembles Dupuy's argument. Tara Abraham has examined the background to the McCulloch-Pitts paper in "(Physio)logical Circuits: The Intellectual Origins of the McCulloch-Pitts Neural Networks," *Journal of the History of the Behavioral Sciences* 38 (Winter 2002): 3-25.

understanding the human mind. Its very simplification meant that no new knowledge was gained about the actual workings of the nervous system. "After these devastatingly general and positive results, one is thrown back on microwork and cytology – where one might have remained in the first place."[12]

The McCulloch-Pitts model made the brain into a Turing machine, albeit one with a finite memory. Turing had introduced his highly abstract conception of a machine in 1936. His purpose had been to solve a problem in logic originally posed by Hilbert, the decidability problem, or *Entscheidungsproblem*. He imagined an arithmetic computer to solve the problem – not a mathematician with infinite time and an endless supply of paper, but his machine equivalent. The Turing machine performed arithmetic operations on an endless paper tape. Since logic could be expressed arithmetically, it also modelled symbolic thought. Turing had made the leap between a human mind working on a logic problem and an ideal machine. As his biographer notes, "the word 'computer' then meant a *person* doing computing. Turing's model is that of a human mind at work."[13] He went on to show that such a machine could be universal – it could imitate the behaviour of any other Turing machine. As he later explained,

> The existence of machines with this property has the important consequence that, considerations of speed apart, it is unnecessary to design various new machines to do various computing processes. They can all be done with one digital computer, suitably programmed for each case.[14]

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[12] Letter from von Neumann to Wiener, November 29, 1946. Reproduced in full in Pesi Masani, *Norbert Wiener* (Basel: Birkhauser, 1990) 243-7. It appears that Wiener was the only one to read the letter. Wiener's biographer blames Wiener's apparent neglect of the letter for the lack of direct contact between the border area and the emerging field of molecular biology. Masani, 248.

[13] Andrew Hodges, *Turing* (London: Orion House, 1997) 10.

[14] Alan Turing, "Computing Machinery and Intelligence," *Mind* LIX (October 1950): 441-442. This is the

Where the steam-driven factory machines had to be constructed to do particular jobs, a universal machine required only a new program – or in more ambitious renderings, a description of the task of the specialized machine. It had, in principle, an adaptability strongly suggestive of human mental ability. A 1955 article in *Scientific American* exaggerated hopefully, "The universal machine is remarkably human. It starts with very limited abilities, and it learns more and more by imitation and by absorbing information from the outside."[15] Turing's machine was not quite this miraculous, but the magazine had seen a bright vision of the future, and was not about to hold back for the flimsy reason that this was not quite what Turing described.

It was this abstract machine that was McCulloch's ontological cornerstone. Brain and computer were simply different varieties of the same, essential logic machine. He stated his case plainly in 1955:

> Everything we learn of organisms leads us to conclude not merely that they are analogous to machines but that they are machines. Man-made machines are not brains, but brains are a very ill-understood variety of computing machines. Cybernetics has helped to pull down the wall between the great world of physics and the ghetto of the mind.[16]

The "computing machine" here was not the bulky array of vacuum tubes and magnetic tape that fascinated the popular press, but an ideal machine, whose principles ENIAC and Einstein alike followed. According to Dupuy, this is the great difference between Wiener

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paper that introduces the famous Turing Test. The paper that introduced the Turing Machine is "On Computable Numbers, with an Application to the *Entscheidungsproblem*," *Proceedings of the London Mathematical Society* XLII (1936): 230-265 and correction, ibid., XLIII (1937): 544-6.

[15] John G. Kemeny, "Man Viewed as a Machine," *Scientific American* 192 (April 1955): 63.

[16] McCulloch, "*Mysterium Iniquitatis* of Sinful Man Aspiring into the Place of God" (1955). *Embodiments*, 163

and McCulloch: where Wiener merely detected analogies between man and machine, McCulloch came to the bolder conclusion that they were the same thing.[17]

I am not sure that Wiener's analogies and McCulloch's boldness were quite so distinct. The use of analogy is a slippery business. Historians of science, particularly feminist historians of science, have produced a large body of work arguing that the objects of analogy tend to become indistinct from the things to which they are compared.[18] Nor was Wiener's thought consistently analogical. McCulloch's equation of mind, brain, and computer was not radically different from Wiener's conception of human identity in terms of information. Remember that Wiener saw no reason that a machine could not meet the standards of human intelligence if it were modelled on our physiology.[19] This is likely where the difference between McCulloch and Wiener lies: where Wiener believed human physiology (and neurophysiology) to be the model on which any thinking machine would draw, McCulloch idealized thought in terms of logic, which was ontologically prior to both brains and computers. Certainly Wiener was more timid than McCulloch, but very often he was reluctant to damage further an idea of human dignity that McCulloch believed warranted its doom.

"Our adventure is actually a great heresy," McCulloch announced to the Philosophical Club of the University of Virginia in 1948. "We are about to conceive of

[17] Dupuy, *The Mechanization of the Mind*, 50 and Steve Heims, "Encounter of Behavioral Sciences with New Machine-Organism Analogies in the 1940s," *Journal of the History of the Behavioral Sciences* 11 (1975): 368-73.

[18] For example, see Lily Kay, "Who Wrote the Book of Life? Information and the Transformation of Molecular Biology, 1945-55," *Science in Context* 8 (1995): 609-634.

[19] See Chapter 3, 118-119.

the knower as a computing machine."[20] He may have had a stronger sense than most of the gravity of heretical speech. He had been brought up in a religious family and had studied theology at Quaker College in Haverford, Pennsylvania as a young man. His studies in philosophy and science soon convinced him that God was not a satisfactory explanation for anything, but likely he remembered that heresy, speech that directly contradicts church orthodoxy, was a serious transgression.[21] Whether understanding the brain as a machine was heretical is a matter of theological debate. It was certainly blasphemous. It dared elevate man's invention to the level of God's creation. But it was also blasphemous in a different, more secular sense. T.S. Eliot announced in 1934 that it had become "a world in which blasphemy is impossible," since no one truly believed in the things blasphemed.[22] But even if belief in God had become weak, it was not a world without belief. Belief in human uniqueness was strong, even if the mind had largely replaced the soul as the wellspring of humanity. What remained was the ghost of blasphemy, an uneasy shiver that perhaps something sacred was underfoot, but with few convincing reasons for restraint. The claim that mind was no different from machine was this kind of blasphemy, and aroused anger and indignation – although it no longer had the thrust of sin and exile.

When the eighteenth-century physician and philosopher Julien Offray de la Mettrie wrote the materialist treatise *L'homme machine*, accusations of blasphemy forced him to flee to Prussia. The twentieth-century triumph of materialism untethered human uniqueness from the God-given soul, but never went so far as to eliminate it entirely. As

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[20] McCulloch, "Through the Den of the Metaphysician" (1948). *Embodiments*, 144.

[21] Heims, *The Cybernetics Group* (Cambridge: MIT Press, 1991) 32.

[22] T.S. Eliot, *After Strange Gods* (NY: Harcourt, Brace, and Co., 1934) 56, 57.

the psychoanalyst and former Freudian disciple Otto Rank wrote in 1930, "We still hold to the original soul-belief, a naïve belief in immortality, but we do not do so consciously…we are ashamed and deny it."[23] Twentieth-century materialists could make the outrageous suggestion that man was a machine without fearing banishment, but they still upset a great many people. In the non-denominational secular Christianity that expressed most intellectuals' and scientists' cherished beliefs, and which functioned almost as a state religion, human beings were sacred, even if few of these elite believed in a literal soul. Wiener's reluctance to participate in the near-blasphemy of thorough-going materialism might explain why his work fascinated California guru Stewart Brand in the 1970s, and continues to attract technophilic New Age followers today.[24] Perhaps Wiener gained such broad readership because he resolutely defended the status of one of the twentieth century's few remaining sacred things.

Dupuy describes McCulloch as a materialist, but his materialism did not meet any ordinary definition, for it made fundamental an abstraction – logic itself. McCulloch recognized that such materialism took a different form from its predecessors. "But notice that for us matter is far less material than it was once….Nor does our physics let us prophesy from past events all future happenings." This is Bachelard's dematerialized materialism, an ideology that is materialist in spirit, even if it takes logic as its

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[23] Otto Rank, *Psychology and the Soul*, Gregory C. Richter and E. James Lieberman, trans. (Baltimore: Johns Hopkins Press, 1998) 8.

[24] Ian Hacking has commented on the connection between New Age enthusiasms and the American Society for Cybernetics in his talk, "'True', Values and the Sciences," at the meeting of the Canadian Society for the History and Philosophy of Science in Toronto, May 26, 2002. See also the A.S.C. website, www.asc-cybernetics.org.

ontological starting point.[25] The manifestation of such logic could be either flesh or metal, but that did not mean that McCulloch removed all possibility of picking out the human beings from the crowd. About his assimilation of mind and brain, he concluded with a rhetorical flourish, "The joy of creating ideals, new and eternal, in and of a world, old and temporal, robots have it not. For this my mother bore me."[26] In 1964, when artificial intelligence research had begun in earnest, he announced, "To ask whether these computers can think is ambiguous. In the naïve realistic sense of the term, it is people who think, and not either brains or machines." This allowed the possibility of distinction. Computers and human beings were not exactly the same. But his next words dashed those hopes: "If, however, we permit ourselves the ellipsis of referring to the operations of the human brain as 'thinking,' then, of course, our computers 'think,' their primary language being that of number."[27]

Telling the humans from the robots would be difficult and perhaps eventually impossible. McCulloch referred to the "computing machine, either man-made or begotten," identifying the latter – that is, brains – as his daily business. "There are few symptoms," he said, "which are very conspicuous in the case of the nervous system and very conspicuously absent in any automaton," supporting the claim that these things were not different in any substantial or lasting way. In 1956, he proposed the existence of ethical robots, whose programs would erode the incidental differences further. An ethical robot would want to play games more than it would want to win, giving it an incentive to

[25] McCulloch, "The Past of a Delusion" (1953). *Embodiments*, 291. Dematerialized materialism was introduced in Chapter 1.

[26] McCulloch, "Why the Mind is in the Head" (1951). *Embodiments*, 87.

[27] McCulloch, "A Historical Introduction to the Postulational Foundations of Experimental Epistemology" (1964). *Embodiments*, 368.

learn the rules of any game by testing hypotheses. Unlike the checkers and chess programs that were being developed at the time, these robots would be programmed to want to play any game – a replication of the human eagerness to learn new games. They would be far less predictable than the single-game machines. "They are free in the sense that we, their creators, have neither told them what they ought to do nor so made them that they cannot behave inappropriately," McCulloch suggested. He referred to such a robot not as an impersonal 'it,' but as 'he.' The possibility of such a robot moved him to impassioned prose: "He can never know the rules of the game more than tentatively; for the stochastic horses of opinion drag no chariot to absolute certainty."[28]

McCulloch may have believed that human beings and automata were not identical, but he did not seem to consider the distinction important. In terms of ability, their difference was primarily a technical problem – and could therefore be overcome in the future. Towards the end of his life, while attending a conference on human adaptation that included several cyberneticians, he growled,

> Man to my mind is about the nastiest, most destructive of all the animals. I don't see any reason, if he can evolve machines that can have more fun than he himself can, why they shouldn't take over, enslave us, quite happily. They might have a lot more fun. Invent better games than we ever did.[29]

Fun and games – McCulloch chose interesting standards for superiority. Although he softened moments later, he held to the idea of fun, saying, "once you've started making computing machines, you're not going to stop them from evolving. I have no objection to

[28] McCulloch, "Toward Some Circuitry of Ethical Robots" (1956). *Embodiments*, 199.

[29] Mary Catherine Bateson, *Our Own Metaphor* (New York: Alfred A Knopf, 1972) 226.

it, if they make one that plays a better game of chess than I do."[30] Telling the human beings from the computers and the automata was at bottom unimportant, and not interesting enough to distract him from his goal of scientific knowledge of the mind. Besides, any distinguishing characteristics were likely to be either superficial or fleeting, since McCulloch's work introduced the possibility that machines could be made more and more like the prevailing conception of man as a thinking animal. In 1961, he was explicit about this potential:

> Pitts and McCulloch (1943) proved the theoretical equivalence of all Turing machines, whether they be made of neurons or any other hardware. From this it follows…that we can build a machine that will do with information anything brains do with information – solve problems, suffer emotions, hallucinate on sensory deprivation, what you will – provided we can state what we think it does in a finite and unambiguous manner.[31]

At first glance, McCulloch seems to have swept the laboratory clean of the lingering smell of mind-body dualism. But in exorcizing the mind of its ghostly spirits, he made the body ephemeral. What the body was made of – metal or flesh – was unimportant. All we were was brain.

The ephemerality of the body had broader subscription in scientific thought than just McCulloch and like-minded cyberneticians. Some of its most interesting applications were in medicine. In the late 1950s, doctors could use the modern positive pressure ventilator to keep a patient's body alive even in an irreversible coma. From 1955 to 1958, French researchers studied electroencephalograms – maps of the brain's electrical activity – to determine reliable signs of brain damage. They suggested that the absence of

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[30] Ibid., 227.

[31] McCulloch, "Where is Fancy Bred?" (1961). *Embodiments*, 220-221.

electrical activity in the brain was a sure sign that the patient was dead. The vessel of the body could be kept alive, but the patient's essential self was gone. Brain death did not develop legal status in the United States until the 1960s, but the technology and the ideas that supported it were all in place in the 1950s.[32] Jacques de Vaucanson's flute-playing automaton had once fascinated audiences because it had the ability to breathe at a time when breath was an indisputable sign of life.[33] In the mid-twentieth century, an active brain became the indisputable sign of life, and thinking automata usurped more old-fashioned craftsmanship in the annals of the uncanny.

McCulloch's efforts to develop a scientific account of mind came at a high price – no soul, no unique mind, no proof of our humanity. But his work was not widely cited, even within science. He received invitations to speak to scientists and philosophers, but there is little evidence that he had any great influence beyond a professional audience. What he advanced, though, was a concept of thinking in man and machine that had a sufficient number of adherents to attract the attention of the chattering classes, even if mainstream culture continued to hold man and machine distinct. In the more rarefied cultural strata, many were deeply distressed by the idea of machine thought.

In 1949, Geoffrey Jefferson, a professor of neurosurgery at the University of Manchester, gave a lecture to the Royal College of Surgeons entitled, "The Mind of Mechanical Man." He expressed his admiration for the achievements of computers and automata theory. "Ingenuity of invention at the present time confronts our more sophisticated eyes with models as seductive as were the cruder automata of old." The

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[32] C.M. Fisher, "Brain Death: A Review of the Concept," *Journal of Neuroscience Nursing* 23 (October 1991): 330-333.

[33] Gaby Wood, *Living Dolls: A Magical History of the Quest for Mechanical Life* (London: Faber and

new computers and automata were highly instructive. But clever as they were, their fruitfulness was limited, since they operated in an artificially restricted world. Computers could solve only particular problems, and those had to be presented cleanly. "A machine might solve problems in logic, since logic and mathematics are much the same thing." There were limits, however, to how much they could tell us about the mind. The full range of human thinking could not be reduced to logic. Machines could not feel, and emotion was not easily separable from human thought. Human thought included opinions and "creative thinking in verbal concepts." Jefferson did not believe that such complexity could be built from simple logic. "Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain – that is, not only write it but know that it had written it." Thought demanded the existence of consciousness.[34]

The philosopher Michael Scriven's opinions, published in *Mind*, snapped crisply in the analytic breeze. "We know that the question of consciousness is proper with a man: what concerns us in the case of a machine is not this question, but the question whether this question can sensibly be asked." It cannot, was Scriven's no-nonsense answer. Machines could not cope with the randomness of the natural world, he argued; therefore it was foolish to deem them conscious. It was just "the apparent humanity of robots that produce the reaction of saying they are Conscious. But they appear human simply because they were made to appear human." (Scriven was wrong about this; as has been noted earlier, by the 1950s, very few of the machines provoking questions of

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Faber 2002) 22.

[34] Geoffrey Jefferson, "The Mind of Mechanical Man," *British Medical Journal* (June 25 1949): 1107, 1110. Alan Turing would later quote this passage in "Computing Machinery and Intelligence."

consciousness looked even remotely human.) Were we to stumble across an autonomous android in the course of interplanetary travel – Scriven does not entertain the possibility that mere Earthlings could design such a marvel – we would not count it a machine. Living things could be conscious. Machines could not. If it was conscious, it could not be a machine. "[T]o count them Conscious is to put the ghost of a ghost in the machine." Such was Scriven's parting shot in a debate that continues to ruffle contributors to *Mind* today.[35]

Of course, there was middle ground to be claimed. The 1954 book *Minds and Machines* offered this terse suggestion: "Now it is quite foolish to assert that robots think; it is equally foolish to assert that they do not think. It is absurd to make this a debatable issue. Machines can and do think in *some* senses of the word, and cannot and do not think in other senses."[36] The neurophysiologist O.H. Schmitt, while attending a conference on "The Design of Machines to Simulate the Behavior of the Human Brain," wondered whether "we have fallen into the trap of describing some brain functions in terms of present-day computer components and are then delighted to discover machine-like components in our description of brain function." Such an accusation left McCulloch in the clear, since he made an ideal logic machine prior to both computer and brain, but it pointed out the hazards of simple identification.[37]

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[35] Michael Scriven, "The Mechanical Concept of Mind," *Mind* 62 (1953): 231, 240. Scriven used the capital letter for conscious for the sense of conscious as opposed to incapable of consciousness, rather than unconscious. This gives his argument a Pompous Tone, in addition to relaying his sense of the importance of the questions to hand.

[36] W. Sluckin, *Minds and Machines* (London: Penguin Books, 1954) 198.

[37] O.H. Schmitt, "The Design of Machines to Simulate the Behavior of the Human Brain," *IRE National Convention* (1955): 255, passage cited at length by Mortimer Taube, *Computers and Common Sense: The Myth of Thinking Machines* (New York: Columbia Univ. Press, 1961) 132-133.

In the early 1960s, skeptics continued to make similar objections. In common with Jefferson, but drawing on developmental psychology, the psychologist Ulric Neisser believed that thought was too closely associated with emotion to be possible for a machine. Ordinary people were sensitive to this difference, he offered. That was why computers provoked such anxiety.

> The deep difference between the thinking of men and machines has been intuitively recognized by those who fear that machines may somehow come to regulate our society. If machines really thought as men do, there would be no more reason to fear them than to fear men. But computer intelligence is indeed 'inhuman': it does not grow, has no emotional basis, and is shallowly motivated.[38]

Where the rational mind was no longer sufficient to distinguish us from the machines, our emotions stepped into the breach. A recent assessment of the impasse between skeptics like Neisser and believers like McCulloch is relevant to the postwar situation as well: "The more agile we become at replicating animate beings, the more we look to qualities social or immaterial (loyalty, love, despair, boredom, competitiveness, confusion) to tell ourselves from our creations – or the more pride we must take in their equivalence to us."[39] Of course, McCulloch's ethical robots could have fun, in his estimation. Had they been invented and become common, there could have been a battle over machine emotion as well as machine thought.

Alan Turing took on the objections to machine thought one by one in his 1950 paper "Computing Machinery and Intelligence." This is the paper that introduced the famous Turing Test of computer intelligence, which rested on the idea that if a computer

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[38] Ulric Neisser, "The Imitation of Man by Machine," *Science* 139 (January 1963): 197.

[39] Hillel Schwartz, *The Culture of the Copy* (New York: Zone Books, 1996) 360.

could fool a human being into believing that it could think, then we ought to deem it intelligent. The simulation of thought was effectively thought. Critics had little to say that moved Turing, with the surprising exception of the possibility that a man with extra-sensory perception would reveal himself to be a human being quite quickly, and the computer to which he was compared would be eliminated from the test post-haste. But even this scenario did not sway him from believing 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."[40]

The philosopher Gilbert Ryle, who famously dismissed mind-body dualism as a category mistake, said, "Men are not machines, not even ghost-ridden machines. They are men – a tautology which is sometimes worth remembering."[41] In his slim book *God and Golem, Inc.*, Norbert Wiener exhorted us to "Render unto man the things which are man's and unto the computer the things which are the computer's." He recognized that he risked blasphemy by comparing human beings and machines, but unlike McCulloch, he did not believe that they were essentially the same. He argued that creativity was not a special property of men, machines, or even God, but human beings were uniquely equipped to cope with the unpredictability of the world. Machines could learn (and develop an "uncanny canniness") and it would be only a matter of time before they could reproduce themselves, but they would always be too literal-minded to relieve us of our responsibility as thinking human beings. Wiener's greatest worry was not that the machines would take over thought, but that our abilities would not be equal to a world growing steadily more complicated. "The world of the future will be an ever more

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[40] Alan Turing, "Computing Machinery and Intelligence," *Mind* LIX (October 1950): 442.

[41] Gilbert Ryle, *The Concept of Mind* (London: Hutchinson House, 1949) 81.

demanding struggle against the limitations of our intelligence, not a comfortable hammock in which we can lie down to be waited upon by our robot slaves." However, he condemned those who would cynically direct the new technology to profit or power in an unexpectedly churchy language. He called them gadget worshipers, and damned them for their idolatry: "Yet there are aspects of the motives to automatization that go beyond a legitimate curiosity and are sinful in themselves."[42]

The opposing views of Wiener and McCulloch are evidence of the diversity within cybernetics, but also of something more important and more intractable. Dupuy holds that cybernetics had the ultimate goal of a scientific and materialist account of mind, with the implication that machine thought is possible. Yet he quotes Philippe Breton's elegant conclusion: "Cybernetics therefore assumes a terrible paradox: it affirms humanity while at the same time depriving man of it."[43] This is the paradox embodied by Wiener and McCulloch – the one determined to preserve human uniqueness, no matter how hamfistedly he went about it, the other willing in his darkest moments to let the machines take over. It is too bad that Dupuy does not take this up this paradox – his attention is on the antihumanist face of cybernetics. But to take up both of the cybernetic promises is the only way to understand the cultural response to computers and automata, including the inventions of the cyberneticians.

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[42] Wiener, *God and Golem, Inc.* (Cambridge: MIT Press, 1964) 73, 95, 21, 69, 53. The title is richly reminiscent of the military-industrial-scientific complex, but Wiener was irritatingly cryptic on his understanding of the phrase. See particularly page 95.

[43] Philippe Breton, "La cybernétique et les ingénieurs dans les années cinquante," *Culture technique* 12 (March 1984): 160.

Rats, cats, and tortoises

At the 1939 World's Fair in New York City, Westinghouse introduced Elektro, the talking robot. Elektro greeted visitors to the Westinghouse exhibit, who presumably were duly impressed with the company's technological prowess. By 1951, he had fallen on hard times, forced to earn a living attracting customers to the Mayfair Theater's showing of *The Day the Earth Stood Still*, under the care of a handler named Richens. The *New Yorker* gleefully reported the robot's decline. "Elektro occasionally goes haywire in the middle of a show, and Richens makes the best of it by threatening him with a can opener until he comes round."[44] Elektro was humiliated – a fitting punishment for uppity machines – but at least he was still around. Another world's fair automaton was not so lucky. In his 1956 book on cybernetics, Pierre de Latil related the sad story of this prototype automatonical dog which was responsive to light. Normally, the dog followed a flashlight obediently. But before the exhibition opened, "it perceived the lights of a passing car and rushed headlong towards it and was run over, despite the efforts of the driver to avoid it."[45] No doubt this was more realistic behaviour than the engineers had bargained for, and a new dog had to be built.

It was acceptable to snicker at the misfortunes of these automata. They had always been less threatening than the machines that threatened obsolescence. They were, from the start, toys – meant to entertain and to advertise. But they also represented the same technological future as the computers, and their every laughable failure counted as a victory for man.

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[44] "Tough," *New Yorker* 27 (October 13, 1951): 32.

[45] Pierre de Latil, *Thinking by Machine: A Study of Cybernetics,* Y. M. Golla, trans. (Boston: Houghton Mifflin, 1957) 241. Originally published as *La pensée artificielle* (Paris: Librairie Gallimard, 1956).

Victoria Nelson has recently argued in *The Secret Life of Puppets* that in works of the imagination, automata and robots function as our alter egos and evil twins. She describes a tradition in western thought where "the preeminence of the machine brought about by the industrial revolution did not rob us of the idea of soul at all. On the contrary, the machine *received* this idea just at that critical moment when the old cosmogony gave way to the new." Twentieth-century literature, theatre, and particularly film have given us an abundance of such "Divine Machines," which "have some kind of direct access to the supernatural and even personal immortality – exactly those qualities contemporary Westerners perceive as absent in ourselves and in the world around us."[46] The fears and hopes of a pre-scientific era were unconsciously adapted to the technological world, giving us machines like the supernaturally powerful, yet benevolent, soulful, and diminutively named Robbie (in Isaac Asimov's story of the same name, 1950) and Robby (in the film *Forbidden Planet*, 1956). The language of the divine spilled over into descriptions of actual computers, although the real was a poor rival for the powers of its imaginary counterparts.[47] Case in point: the cyberneticians' automata, which were small, limited in scope, and sometimes even cute. Real cybernetic monsters turned out to be both friendlier and less powerful than the imagined ones. But even they sometimes promised contact with the divine.

In 1938, American Thomas Ross designed a machine which ran on toy train tracks and could learn to find its way to a goal through trial and error. Fourteen years later, R. A. Wallace improved on this with a toy that also ran on miniature train tracks

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[46] Victoria Nelson, *The Secret Life of Puppets* (Cambridge MA: Harvard University Press, 2001) 250, 262.

[47] Sherry Turkle observed that popular unease about intelligent machines has declined considerably, possibly for this reason. *Life on the Screen: Identity in the Age of the Internet* (New York: Simon and

and could repeat its path home after doing it once.[48] Claude Shannon also built a maze-running machine, which he presented to the Macy conference participants. It was "capable of solving a maze by trial-and-error means, of remembering the solution, and also of forgetting it in case the situation changes or is no longer applicable."[49]

Shannon's invention had a slightly different design from Wallace's. On the top panel of the machine there was an array of twenty-five squares. Removable partitions between them allowed the construction of a variety of mazes. Within the maze was a pointer or finger which could sense the partitions when it ran up against them. Each time the finger found an opening, it triggered a relay switch, so that it set up a circuit that allowed it to run the maze perfectly over and over after solving it once. In other words, it could remember its solution, although each time it was turned off, it had to begin anew. If the machine was denied its goal – a removable pin at the end of any given maze – it would continue searching for a solution. "The machine just continues looking for the goal throughout every square, making sure that it looks at every square," Shannon explained, which prompted the comment, "It is all too human."[50] Despite this rueful self-recognition, and the fact that in his presentation Shannon called the thing running the maze a finger, it became known as the rat. Real rats had been running laboratory mazes for cheese for some years, and electronic models were frequently named for their long-whiskered brethren, so it is not surprising that Shannon's device was called a rat, too. One reporter called the sensing devices soldered onto one end of the maze solver "copper whiskers" and the electrical terminal that signalled the end of the maze a piece of

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Schuster, 1995) 124.

[48] As reported in W. Grey Walter, *The Living Brain* (London: Gerald Duckworth and Co., 1953) 80.

[49] *Transactions* vol. 8, 173.

cheese.[51] The cyberneticians likely would have thought this fanciful. In their introduction to the conference transactions, the editors claim

> The fascination of watching Shannon's innocent rat negotiate its maze does not derive from any obvious similarity between the machine and a real rat; they are, in fact, rather dissimilar. The mechanism, however, is strikingly similar to the *notions* held by certain learning theorists about rats and about organisms in general. Shannon's construction serves to bring these notions into bold relief.[52]

Yet even they described the rat as 'innocent' – irresistibly suggestive of a living animal. The cybernetic automata had an interesting habit of becoming pets, no matter what vocabulary their inventors originally bestowed on them.

Next up was Ross Ashby's homeostat, which he had first described in 1948.[53] It consisted of four magnets, each mounted on a pivot and enclosed by a coil which carried a current. Each magnet would move in correspondence to the strength of the current surrounding it. Also attached to each pivot was a wire with a metal plate that trailed in a rectangular basin of distilled water. Electrodes at either end of the basin applied polarized voltages. As the plate followed the magnet's movement, it was subjected to a voltage that varied from +5 to –5 volts, depending on its distance from the electrodes. This varying voltage was fed back to control the intensity of the current in the coil. All four units were also connected, so that a change in one forced a response from the others. Swinging a magnet sharply, blocking an electrode, even disconnecting one of the units, did not

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[50] *Transactions* vol. 9, 179. See also W. Sluckin, *Minds and Machines* (London: Penguin Books, 1954) 66.

[51] John Pfeiffer, "This Mouse is Smarter Than You Are," *Popular Science* 160 (March 1952): 99-101.

[52] The editors were Heinz von Foerster, Margaret Mead, and Hans Lukas Teuber. *Transactions* vol. 8, xvii-xviii.

[53] W.R. Ashby, "The Homeostat," *Electronic Engineering* 20 (1948): 380.

prevent the homeostat from eventually achieving an equilibrium in which the pivots were stilled.

Ashby was fond of quoting Claude Bernard, the great nineteenth-century physiologist, who said, "The fixity of the internal milieu is a condition of free life." The homeostat was meant to be an imitation of the process by which living creatures regulate their physiological stability in the face of changing surroundings. Some Macy conference participants were skeptical. "It may be a beautiful replica of something," remarked the engineer Julian Bigelow, "but heaven only knows what." Not unreasonably, they wanted to know what made the homeostat so special. How was it different from, say, a thermostat? Ashby seems to have considered such a distinction – whether for his homeostat or a living animal – purely one of complexity. Animals were more complex than the homeostat; the homeostat was more complex than other feedback devices. He pointed out that by using random numbers to determine a change in current, and by connecting all four units together, his device could be in any of 300,000 states. His critics were unconvinced. The ecologist George Evelyn Hutchinson complained, "It doesn't seem to me that the setup gives any particularly clear suggestion that this is comparable to the way invertebrates actually do behave." Ashby rattled them even more when he suggested that the homeostat was a model of learning, since the machine was 'punished' when the magnets deviated from equilibrium, and it altered its behaviour to avoid such punishment. Only McCulloch supported him, saying it was similar to Shannon's rat, which could only learn one maze at a time.[54]

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[54] Latil, 295; *Transactions* vol. 9, 95, 98, 105.

The homeostat was intended as to be an imitation of the function of an unspecified animal. Yet it too became familiar and domesticated. In his book *The Living Brain*, W. Grey Walter, wrote, "This creature, *Machina sopora*, it might be called, is like a fireside cat or dog which only stirs when disturbed, and then methodically finds a comfortable position and goes to sleep again." Walter was an electroencephalographer, and together with his wife created some automata of his own. He did not attend the Macy conferences – the guests were drawn from American institutions, and although he was an American, he worked at the Burden Neurological Institute in Bristol.[55] His automata, however, enjoyed the attention of the American popular press, with *Life*, *Newsweek*, and *Time* all featuring a spread on the little creatures. This was unsurprising, since they were more engaging and more interesting than the sleepy homeostat.

Walter named his automata *Machina speculatrix* "because they illustrate the exploratory, speculative behavior that is so characteristic of most animals."[56] They were small with a smooth, round shell and a neck bearing the photoelectric cell that allowed them to navigate their surroundings. Like the unfortunate dog that did not make it to the New York World's Fair, they were light sensitive. They were vaguely suggestive of turtles. Walter called them tortoises.[57] He named them Elmer and Elsie, after their more ponderous description, ELectro MEchanical Robots, Light-Sensitive, with Internal and External stability. Pierre de Latil described visiting the Walters in Bristol: "Three beings were crawling about the living-room carpet. The third was a small boy – Timothy, Timo for short – still, like the tortoises at the crawling stage." And perhaps a few

[55] Ross Ashby was also British, and attended the Macy conferences at the invitation of Heinz von Foerster.

[56] Walter, "An Imitation of Life," *Scientific American* 182 (May 1950): 43.

[57] He also began most of the articles on the tortoises by quoting from *Alice's Adventures in Wonderland*:

developmental steps behind them – Timo hit himself on a chair and started to cry, but the tortoise just "reversed a bit, and, without becoming discouraged, regained her former direction and avoided the obstacle."[58] The tortoises were able to do this with only a few simple elements. Each was equipped to be sensitive to light and to touch, and each had two motors, one for moving and one for steering. The number of components had been kept deliberately small in order to see what degree of complexity could result from a simple machine.

The four basic elements gave the tortoises six possible states. Even this small number produced satisfyingly unpredictable behaviour, or as Walter put it:

> The strange richness provided by this particular sort of permutation introduces right away one of the aspects of animal behavior – and human psychology – which *M. speculatrix* is designed to illuminate: the uncertainty, randomness, free will or independence so strikingly absent in most well-designed machines....The fact that only a few richly interconnected elements can provide practically infinite modes of existence suggests that there is no logical or experimental necessity to invoke more than *number* to account for our subjective conviction of freedom of will and our objective awareness of personality in our fellow men.[59]

Walter, then, seems to have been in agreement with Ashby and McCulloch – what stood between their automata and the things that we would unhesitatingly call alive was simply a degree of complexity.

"'We called him Tortoise because he taught us,' said the Mock Turtle angrily. 'Really you are very dull!'"

[58] Latil, 209.

[59] Walter, "An Imitation of Life," 44.

The photocell that functioned as the tortoise's eyes was connected to the steering mechanisms. When no light was present, the tortoise would search for light, its roving eyes causing it to move with a looping gait. When it finally found a light source, it would move towards it. If the brilliance of the light exceeded a certain threshold, the tortoise would move away once it got close, searching for a dimmer light source. If two light sources were present, it would shuttle back and forth between them. Ideally, it would have recharged its batteries from the light sources it found, but household light bulbs were a poor source of energy. Instead it fed off a battery charger kept in its hutch, which was also equipped with an attractive twenty-watt bulb.

Elsie was less stable than Elmer (something Latil suggests is evidence of her femininity!), since she was tuned to seek precise light intensities. She tended to run down faster than Elmer, who sought a wider range of light intensity. In observing Walter with Elsie, Latil was reminded of a proud father and his new baby, an image Walter encouraged by commenting, when Elsie at last went to her hutch, "She is taking her bottle." By that time, she needed her bottle, for they had kept her busy navigating obstacle courses and demonstrating her self-awareness with a mirror. In front of the mirror, the tortoise would approach the lamp, stop, and the pilot would go out. Then it would start searching for light again, the pilot would come on, and the process would repeat. Latil found Walter was especially impressed by this trick. "'Look at that!' said Grey Walter with the pride of a father admiring his progeny. 'Isn't it the personification of Narcissus?'" He claimed it was different from the dance the tortoises would do when they encountered one another, although by his own description it was the same cycle of attraction followed by the pilot going out.[60]

Walter put an end to the games when the tortoise began to run down, saying, "We mustn't keep her waiting for her meal much longer." He did not want her to die needlessly, although of course the prospect did not disturb him too much. Even a minor gesture towards keeping her alive is interesting, though, since she was readily revived. The tortoise engendered reverence mixed with the flat recognition that she was, after all, only a machine. She was alive but her death did not matter too much. A world with a large population of *M. speculatrix* might have had grim implications for our treatment of biological animals. Walter was aware that the tortoises brought about an uneasy combination of impulses, but believed that it did not have to lead to harm: "Yet as our imitation of life becomes more faithful our veneration of its marvelous processes will not necessarily become less sincere."[61]

Machina speculatrix, like the rat and the homeostat, could not learn from its experience. In 1951, Walter reported a more advanced species of automata that he named *Machina docilis*, or teachable machine. CORA, for Conditioned-Reflex-Analogue, began her existence sensitive to light like her predecessors, but also with a potential auditory capacity. She learned to respond to sound through Pavlovian training: each time she was presented with light, a trainer would blow a whistle. The coincidence of whistle and light

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[60] Latil, 211

[61] Walter, "An Imitation of Life," 45. Tamagotchi, a wildly popular Japanese toy introduced to the North American market in 1997, met with similar reactions. It was a handheld screen featuring an image of a pet or baby that the child would feed and tend. Parents complained that their children were devastated when the creature died from neglect. Others believed that since the child's neglect had no lasting effects – the pet could be readily revived – Tamagotchi fostered an unhealthy disrespect for life.

set up a distinctive oscillatory pattern in CORA's circuitry, which lasted for a long time and corresponded to her memory. After the trainer had presented her with both light and whistle a dozen times, the whistle alone, combined with the wave pattern that persisted in her circuits, was sufficient to cause her to come to the light. As Walter described it, "In *M. docilis* the memory of association is formed by electric oscillations in a feedback circuit. The decay of these oscillations is analogous to forgetting; their evocation, to recall." CORA was also testament to the maintenance of the difference between automata and living things, since she had been built with parts taken from Elmer and Elsie, but neither their sacrifice nor CORA's vigorous existence was met with anything other than good humour. It was all right to use the tortoises this way – after all, they were only machines.[62]

Although they were not as capable as CORA, Walter believed that automata such as Elmer and Elsie were very important. He recognized that they were toys as well as tools, arousing affection in the rational scientific breast. And they had a third role:

> As totems they foster reverence for the life they have so laboriously been made to mime in such very humble fashion – and still would foster it even should they, creatures of 'sorcery' peering into the dim 'electro-biological' future in search of a *deus ex machina*, look up at us and declare that God is a physiologist.[63]

Walter believed that it was impossible to say that his automata work was not psychologically equivalent to idolatry or witchcraft. He was aware that in creating his tortoises he had contact with the sacred, and his creatures had, metaphorically at least, a soul. If the mind had replaced the human soul, then these automata might run the

[62] Walter, "A Machine that Learns," *Scientific American* 185 (August 1951): 64, and Latil, 247-249.

[63] Walter, *The Living Brain*, 87.

substitution backwards, and claim their undeveloped minds as a primitive soul. They were not powerful enough to claim a role like that played by the divine machines in literature and film. But Walter, alone among the automata-builders, acknowledged that he followed in the footsteps of both the eighteenth-century craftsmen and the sorcerer's apprentice. It was only by imitating the divine, however blasphemous that might be, that we would be able to understand it.

Where destiny with men for pieces plays

The game of chess had none of the transcendent ambitions of the animal automata, but it did have a history of attracting extreme demonstrations of human ingenuity. Correspondence chess, in which games might go on for months or even years, is said to have started in the twelfth century, speed chess can become positively athletic as players slam their hands down on the board and the clock, and blindfolded chess attracted the attention of the psychologist Alfred Binet. Chess, like music and mathematics, has child prodigies and spectacular egos. And the theatricality of a close mental contest was not lost on those who organized games with full-grown men and women standing in for the chess pieces, including a mid-twentieth-century game in Stockholm which was "enacted by living pieces, with moves broadcast on loud-speaker" before a large and excited audience.[64] Chess shared the drama and arbitrarily imposed handicaps of more physical contests, so it was fitting that it was treated as a sporting event. We should therefore be unsurprised to learn that it has a long history in the great

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[64] Nathan Divinsky, *The Chess Encyclopedia* (New York: Facts on File, 1991) 50; Alfred Binet, *Psychologie des grands calculateurs et joueurs d'echecs* (Paris: Hachette, 1904); Fred Reinfeld, *The Treasury of Chess Lore* (New York: Dover, 1951) 305, note 12. The photographs of the Stockholm game

contest of man versus machine, too. In 1958, three AI pioneers claimed, "If one could devise a successful chess machine, one would seem to have penetrated to the core of human intellectual endeavor." Or, as the *Oxford Companion to Chess* dryly notes, "Under the delusion that skill at chess is evidence of high intelligence the public has long been fascinated by the idea of chess playing machines."[65]

The first automaton to boast chess skills appeared in 1769, the work of the Hungarian Wolfgang von Kempelen. It was said "to be for the mind…what the Flute Player of M. de Vaucanson is for the ear."[66] It was certainly the invention that ensured his place in history among the automaton-builders, likely to his chagrin. It consisted of a turban-clad man carved from wood, who sat behind a large maple cabinet with a chess-board on top. The Turk, as he soon was called, held one hand ready next to the board. The other hand held a pipe, all the better to think with. He was capable of expressive motion, and if an opponent made an illegal move, the Turk would gravely shake his head. Kempelen presented it to the Empress Maria Theresa, and it was a grand success at court. But soon after, he dismantled it. Twelve years later, he reassembled it at the request of Maria Theresa's successor, Joseph II. Again, it attracted a great deal of attention and was displayed to Europe's most discerning audiences. It won every game it played, defeating Benjamin Franklin and Napoleon, before it was destroyed by fire in Philadelphia in 1854.

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are between pages 180 and 181 and are not dated.

[65] Allen Newell, et al. "Chess-Playing Programs and the Problem of Complexity," *IBM Journal of Research and Development* 2 (1958): 320; David Hooper and Kenneth Whyld, *The Oxford Companion to Chess* (Oxford: Oxford Univ. Press, 1987) 73.

[66] Cited in Wood, *Living Dolls*, 57. See also Kenneth Harkness and Jack Straley Battell, "This Made Chess History," *Chess Review* (1947); reprinted in Reinfeld, *The Treasury of Chess Lore*, 244-265.

At the beginning of each exhibition, Kempelen made a great show of opening the cabinetry to show that nothing but gears and levers were responsible for the Turk's genius. Johann Nepomuk Maelzel, who bought the Turk after Kempelen's death in 1804, continued this bit of nothing-up-my-sleeve showmanship. This only piqued the suspicions of observers who were certain that it had to be a fake. One of these skeptics suggested that a man might climb into the Turk's loose clothing, and operate him like a puppet. A machine, he insisted, "cannot usurp and exercise the faculties of the human mind."[67] Edgar Allan Poe was among the debunkers, but not because he believed that it was impossible for a machine to play chess. The Turk's play was flawed, and Poe reasoned that a machine would have to play perfect chess. It was the Turk's mistakes that betrayed his humanity.[68]

The skeptics were correct, as it turned out. The Turk was a hoax. The human player crawled from section to section of the cabinetry to remain hidden as each door was opened before the audience. Actually, it was a succession of players, all of whom played excellent – but humanly flawed – chess. Since Kempelen dismantled the machine once, and announced he was going to dismantle it a second time, it is likely he was afraid of being caught. Gaby Wood has argued that the whiff of charlatanism was part of the Turk's popularity. "Audiences could be titillated by the possibility of automation; they could, to their mind's content, tempt fear and fate with the idea that machines could be like humans, without ever having to deal with the reality." When two boys told the *Baltimore Gazette* that they had seen a human player crawling out of the Turk's cabinet

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[67] Cited Wood, 70

[68] Edgar Allan Poe, "Maelzel's Chess Player," *Complete Works* vol. 10 (New York: Fred de Fau and Co., 1902) 1-39.

on a punishingly hot day in 1827, other newspapers ignored the story. The Turk's glamour lay in believing in his reality.[69]

It would be a long time before a machine that could really play chess appeared. Charles Babbage claimed that his analytical engine could be made to play chess, but he went on to describe only tic-tac-toe.[70] In 1914, Leonardo Torres y Quevedo demonstrated the first real chess machine, which could play a rook and king endgame. The reduction in moves was necessary, because the machine did not have the capacity to deal with the enormous number of possible moves in a complete game of chess. But it was really playing chess, however limited a game, and was arguably a mechanical mind. In an interview with *Scientific American* in 1915, Torres claimed that machines like his had far greater potential than the automata of earlier centuries, which merely replicated human or animal movement. "The ancient automatons…imitate the appearance and movements of living beings, but this has not much practical interest, and what is wanted is a class of apparatus which…attempts to accomplish the results which a living person obtains, thus replacing man by machine."[71]

Chess machines came into their own only in the 1950s, after the development of digital computing and game theory, which allowed sophisticated games to be represented

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[69] Wood, *Living Dolls*, 77. Monroe Newborn, *Computer Chess* (New York: Academic Press, 1975) 6. Today, the Turk is more interesting because it was a fake. See Mark Sussman, "Performing the Intelligent Machine: Deception and Enchantment in the Life of the Automaton Chess Player," *The Drama Review* 43 no. 3 (Fall 1999): 81-96 and Tom Standage, *The Turk : The Life and Times of the Famous Eighteenth-Century Chess-Playing Machine* (New York: Walker & Co., 2002).

[70] Charles Babbage, "The Life of a Philosopher," (London: Longman, Green, Longman, Roberts, and Green, 1864). See also Newborn, *Computer Chess* 6-7.

[71] Cited in Brad Leithauser, *Penchants and Places: Essays and Criticism* (New York: Alfred A. Knopf, 1995), 14.

mathematically. In 1944, Oskar Morgenstern and John von Neumann published their famous *Theory of Games and Economic Behavior*, in which they argued that the long-term outcome of games – or economic behaviour, in their opinion – was completely determined by the set of rules. In principle, chess was a perfect game, according the definitions set out by Morgenstern and von Neumann: there is no element of chance, except for which player makes the first move, and each of the players has perfect information about all past moves made in the game. In *Cybernetics*, Wiener pointed out that it was not necessary for a machine to play a perfect game of chess; this was likely impossible given the technical capacity of the computers, and in any case was a standard that human players could never reach. Such a machine would be far less interesting than a machine that had the qualities desirable in a human opponent. A worthy machine opponent would "offer interesting comparison at some one of the many levels at which human chess players find themselves." It would play by assigning a mathematical evaluating function to each move. Such a machine, Wiener wrote, would likely lose to very good players, but "it might very well be as good a player as the vast majority of the human race."[72]

Computer chess was attractive to many early programmers, not only because the rules were well defined, but because the mental gymnastics it demanded would be persuasive evidence that a mechanical mind was possible, even within reach. In 1949, Claude Shannon presented a paper to the Institute of Radio Engineers in New York City that outlined a technique for programming chess machines. He described two types of programs that became known as Shannon Type A and Shannon Type B. Type A

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[72] *Cybernetics*, 165.

machines explored all possible moves to a certain depth. At the beginning of a game, there are twenty possible moves. A Type A machine working to a depth of two moves evaluates all four hundred of the configurations possible. The Type B machine plays in a more human fashion, excluding some of possibilities from the outset, and instead evaluating the most promising configurations to a greater depth. *The Chess Encyclopedia* informs us of the importance of this imaginative leap: "The profundity of Shannon's ideas can be gauged from the fact that 40 years later virtually every chess program employs the Shannon 'B' strategy in one form or another." However, as essayist Brad Leithauser has remarked, "the programmer soon discovers that the task of instructing a computer to identify promising lines of play is fiendishly complex."[73]

At the ninth Macy Conference, W. Ross Ashby entertained the question of whether it would be possible to build a mechanical chess player which could outplay – rather than beat by dint of "sheer brute power of analysis" – its designer. "I want to consider the machine that wins by developing a deeper strategy than its designer can provide," he announced. In other words, was it possible to build a machine that could learn? Ashby believed so, although Julian Bigelow maintained that the best strategy for a game was inherent in computing the possible outcomes from a given configuration of the board, and therefore the machine was not truly learning, merely achieving its potential.[74] Elsewhere, Warren McCulloch claimed that Ashby's goal could be met by his ethical robots, those robots who were so eager to learn to play any game. "Unlike solitaire," he said, "chess can be enjoyed only by a society of men or machines whose desire to play

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[73] Divinsky, *The Chess Encyclopedia*, 49. Claude E. Shannon, "Programming a Computer for Playing Chess," *Philosophical Magazine* 41 (March 1950): 256-275. Leithauser, *Penchants*, 17.

[74] *Transactions* vol. 9, 151, 154.

exceeds their desire to win." However, McCulloch was very far from even the beginnings of a design for robots programmed to learn games, and "eager" seems a description better suited to the programmers than to the programs.[75]

Neither Shannon nor Ashby developed an actual chess program. Alan Turing devised a Type A program which lost to a weak player in its only published game.[76] A more successful Type A program, known as the Los Alamos program, was not developed until 1957. It was written for MANIAC I, a UNIVAC computer, and although the computer could execute some 11,000 instructions per second, it took about twelve minutes to make a move in a miniature version of chess that took place on a 6 by 6 board. (There were no bishops, and pawns were allowed to move only one square at a time.) It played its first game against itself. It played its second game against Martin Kruskal, a mathematician. The programmers noted that Kruskal quickly anthropomorphized his machine adversary: "after about 15 moves Kruskal had made no gain and had even started calling his opponent *he* instead of *it*." They believed this to be a common but interesting reaction. "When one human plays another, the feelings of the two players are communicated quite subtly. When playing a computer a human is often eager to express his thoughts and emotions; frequently a strange hostility develops."[77] (It is tempting to say that human players were deliberately showing off their difference, but it seems more likely that they were acknowledging the distinction of playing with a machine in a disappointingly mundane way: they did not bother to mind their manners.)

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[75] McCulloch, "Mysterium Iniquitatis," *Embodiments*, 159 and "Ethical Robots," *Embodiments*, 197-199.

[76] Alan Turing, "Digital Computers Applied to Games," *Faster than Thought: A Symposium on Digital Computing Machines*, B.V. Bowden, ed. (London: Pitman, 1953) 286-310.

[77] J. Kister, et al. "Experiments in Chess," *Journal of the Association for Computing Machinery* 4 (1957): 174-177. Passages cited in Newborn, *Computer Chess*, 20.

Kruskal did win his game, but the programmers wanted to secure a machine victory. They found someone who did not play chess to whom they could teach the game. This beginner, a woman – perhaps she worked as support staff, since a scientist would have been unlikely to admit ignorance of a game that was seen as testament to mathematical ability – learned the game, and lost in her first match against the computer a week later. Another group of programmers assessed the ability of the Los Alamos program as equivalent to a human player with about twenty games' experience.[78]

The first program for a full-fledged, 8 by 8 game of chess appeared in 1958. It was for the IBM 704, one of the last of the vacuum-tube computers. The programmers did not aim for a machine victory, since "it is more instructive to watch the computer lose than to watch it win."[79] They were interested in strategy, and losses pointed out weaknesses in strategy. They wanted a program that could play a reasonable game against skilled opponent, using an overall strategy, rather than evaluating the board afresh from each move. Their program was assessed to have the ability of a passable amateur.[80] By the late 1960s, chess programs had surpassed this, and were winning against proficient players under tournament conditions. They were ranked on the same scale as human players. Chess federations organized competitions in which programs played against each other. In 1966, a chess match was held between American and Soviet programs. The U.S.S.R. won the computer match, just as Soviet Block countries won most international human chess competitions.

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[78] Allen Newell, et al. "Chess-Playing Programs," 325.

[79] Alex Bernstein and Michael de V. Roberts, "Computer v. Chess-Player," *Scientific American* 198 (June 1958): 103.

[80] Newell, et al. "Chess-Playing Programs," 325.

The American reaction to Soviet prowess in chess is interesting in light of the American commitment to computer chess. Historians have attributed Soviet dominance in chess in the 1950s and 60s to a variety of factors, including the money that the U.S.S.R. poured into it from the 1930s on, as well as a cultural affinity that is more difficult to pin down.[81] American commentators at the time wondered whether there might be something essentially Russian about chess, even though title contenders included a Latvian and an Estonian. The idea that Russian culture and chess talent might overlap is interesting given that Americans also tended to think of communist Russia as regimental and machine-like. The enormous commitment that the Soviets made to intense training of talented chess players could look, like all intense training, like mind-programming. The near certainty that the Soviets would win handily led one American to refer to the Russian "chess machine."[82] This was all the more reason for the relief when the "defiantly individualistic" Bobby Fischer won the world championship for the U.S. in 1972.[83]

When Dick Cavett interviewed Bobby Fischer on television in 1972, Fischer admitted the possibility that a computer could beat a human being at chess, but maintained that there was still a long way to go.[84] But the gap between defiantly individualistic human beings and computers was closing steadily. Towards century's close, computer programs could cause world champions serious worry. In October 1989,

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[81] Richard Eales, *Chess: The History of a Game* (New York: Facts on File, 1985) 169-187; Harry Golombek, *A History of Chess* (London: Routledge and Kegan Paul, 1976) 208-9; D.J. Richards, *Soviet Chess* (Oxford: Clarendon Press, 1965).

[82] Eales, *Chess*, 189.

[83] Eales, "Politics and Chess," *History Today* 43 (Sept. 1993): 9.

[84] Newborn, *Computer Chess*, 2.

Garry Kasparov played a two-game match against Deep Thought. Brad Leithauser, who observed the match, noted "the deepest impression left by the first game is of the audience's partisan fervor. Deep Thought is disliked."[85] Kasparov won both games easily, but Leithauser wondered if Kasparov would be "the last world champion to whose name no asterisk is attached." He seems to have been right. Although Kasparov beat IBM-sponsored Deep Blue (a successor to Deep Thought) in 1996, on May 11, 1997 an improved version of the program defeated him in a six game match. This was widely greeted with disappointment and nostalgia for a time when the brain of *homo sapiens* was absolutely unrivalled. An observer recalled that the homicidal computer HAL in Arthur C. Clarke's *2001: A Space Odyssey* had begun his rampage after defeating the human ship's captain at chess. Kasparov himself exaggerated the implications to near-apocalyptic: "If a computer can beat the World Champion, a computer can read the best books in the world, can write the best plays, and can know everything about history and literature and people."[86]

There had always been those who did not worry too much about an eventual machine victory. In 1961, Mortimer Taube wrote a critique of the idea of computer thinking in which he took up the problem of chess. "It certainly does not make much sense to say that the function of the brain is to play chess." He continued, "the brain doesn't think any more than lungs breathe – it is man which does both. Furthermore, in the same sense that the brain thinks, it perceives, wills, feels, imagines, hates, loves, etc. Is the machine simulation of the brain also to cover these functions?"[87] It may have been

[85] Brad Leithauser, *Penchants*, 111.

[86] Daniel King, *Kasparov v. Deeper Blue* (London: B.T. Batsford, 1997) 5.

[87] Mortimer Taube, *Computers and Common Sense: The Myth of Thinking Machines* (New York: Columbia

these interestingly human functions that caused Kasparov to lose to Deep Blue: he admitted his anger and frustration with the machine provoked him into making a couple of uncharacteristically poor moves, and Deep Blue would obstinately play on where most human players would have conceded defeat.[88] As former U.S.S.R. and U.S. champion Boris Gulko wrote, "In a purely sporting sense, computers do enjoy a significant edge: they play on the same level day in and day out."[89]

Chess-playing programs were taken more seriously than the cybernetic animals, and perhaps it was always so in the history of automata. They had little of the animals' charm; they were designed to win a contest, not to imitate the learning we find so attractive in animals and babies. Chess programs were more than just literal battle between man and machine; they also became symbolic of the larger struggle to define human uniqueness in the computer age. Leithauser, watching Kasparov win against Deep Thought, was already wistful about the coming day when the machine would win:

> The new machines will represent triumphs of human doggedness and ingenuity, and we owe it to ourselves to acclaim their makers. But we also owe it to ourselves to grasp that within the transitional terrain we have now entered, where machines rapidly close in upon the human world champion, something inspiring is passing away.[90]

If the mid-century period stretching from roughly 1945 to 1965 was the period in which we believed most strongly that our ability to think was the best evidence of our

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Univ. Press, 1961) 74, 75.

[88] King, *Kasparov*, 94. King included photographs of Kasparov's "expressive body language" in contrast to the inscrutability of Deep Blue and its programmer. Photos are between pages 32 and 33. Kasparov played Deep Junior in New York in January and February 2003. The match was a draw.

[89] Boris Gulko, "Is Chess Finished?" *Commentary* 104 (July 1997): 47.

[90] Leithauser, *Penchants*, 116.

humanity, then the chess programs, the little cybernetic monsters, and the mechanical understanding of mind that developed in this period ensured that we would be forced – to some degree – to abandon this idea. We would need to rethink the meaning of humanity. This is why cybernetics is such a fascinating historical subject: it touches on much of the intellectual and cultural ferment of the time. Most historians of cybernetics believe that the rethinking was necessary, sometimes because of the changes in technology, and sometimes for broader reasons of historical inevitability or justice. Some have argued that cybernetics and similar efforts helped usher in a period that they call "posthuman."

We now take up that argument.

Chapter 5: Le Dernier Cri

Oh, the nerves, the nerves; the mysteries of this machine called Man! Oh the little that unhinges it: poor creatures that we are![1]

In 1999, N. Katherine Hayles published a book claiming that cybernetics helped usher in our current era of "posthumanism." Andrew Pickering, a long-time advocate of the importance of material history in science studies, believes that cybernetics and other mid-century scientific movements are ripe for posthumanist analysis, where – in his words – "human and nonhuman are seen to be reciprocally at stake in each other's becomings." Urging science studies to drop "the human from the explanatory center of the action," he said – possibly in exasperation – "human beings are not the only actors around; the material world acts too." Such an analysis claims to skirt pernicious determinism, deftly avoiding technological determinism by giving the scientists and other people their due, yet never lapsing into social determinism by virtue of the attention it pays to physical stuff – like laboratory equipment, computers, and Wiener's antiaircraft device.[2] This, Pickering assures us, will give us a truer description of history and our technoscientific world. Outside science studies, the posthumanist buzz is even louder.

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[1] Charles Dickens, *The Chimes; A Goblin Story of Some Bells that Rang an Old Year out and a New Year in* (1845).

[2] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999). Andrew Pickering, "Synthetic Dyes and Social Theory," paper given at IHPST, University of Toronto (February 1998) 41 (note 74), 42; "Cyborg History and the World War II Regime," *Perspectives on Science* 3 (Spring 1995): 1-48; *The Mangle of Practice* (Chicago: University of Chicago Press, 1995) and particularly "Cybernetics and the Mangle: Ashby, Beer, and Pask," paper given at the Centre Koyré in Paris in March 2000, pdf document archived on-line at www.soc.uiuc.edu/faculty/pickerin/cybernetics.pdf. Pickering's position on a "cyborg" or posthumanist analysis is broadly similar to Bruno Latour's idea of "humanism redistributed" in a "parliament of things."

Palgrave has published a collection of essays serving as an introduction to the topic, called simply *Posthumanism.* Francis Fukuyama, who gave us *The End of History and the Last Man* in 1992, brought out the more forward-looking *Our Posthuman Future* in 2002. In the short time since the turn of the century, we also have *Cyborg Citizen: Politics in the Posthuman Age*; *Posthuman Bodies (Unnatural Acts)*; *The Visible Human Project: Informatic Bodies and Posthuman Medicine*; *Sensing Corporeally: Toward a Posthuman Understanding*; and the October 2002 cover of *Harper's* magazine.[3] Posthumanism shows all the signs of becoming all the rage. Whatever else it might be, with a name evocative of the ideas recently so influential in North American scholarship, it is certainly a term calculated to grab the reader's attention.

Posthumanism is a set of ideas about (for lack of an alternative expression) the human condition in the current age. Its two motivations are the technologies that suggest that thinking and learning are not uniquely characteristics of biological life, and the perceived failures of what might reasonably be called humanism. These two motivations, one inspired by advanced science and technology and the other a rejection of modernity, mean that posthumanism has a typically postmodern ambivalence. Tim Woods, for instance, believes that postmodernism has a "continuous engagement" with modernism, "which implies that postmodernism needs modernism to survive."[4] Posthumanism, too, is

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We Have Never Been Modern (Cambridge MA: Harvard Univ. Press, 1993) 144.

[3] Neil Badmington, *Posthumanism* (Houndmills and New York: Palgrave, 2000); Francis Fukuyama, *Our Posthuman Future* (New York: Farrar, Straus and Giroux, 2002); Chris Hables Gray, *Cyborg Citizen* (New York: Routledge, 2002); Judith Halberstam and Ira Livingstone, eds., *Posthuman Bodies (Unnatural Acts)* (Bloomington: Indiana Univ. Press., 2000); Catherine Waldby, *The Visible Human Project* (New York: Routledge, 2000); Floyd Merrell, *Sensing Corporeally* (Toronto: Univ. of Toronto Press, 2003); and Ellen Ullman, "Programming the Post-Human," *Harper's* (October 2002): 60-70.

[4] Tim Woods, *Beginning Postmodernism* (Manchester: Manchester University Press, 1999) 6.

in continuous engagement with humanism and highly sensitive to humanism's failures and hypocrisies. In its strongest dialectical versions, and in Matei Calinsecu's phrase, "challenging the more commonsensical mind," it accuses humanism of inevitably bringing about the exact opposite of its ideals.[5] Maurice Merleau-Ponty, in his polemical *Humanism and Terror*, claimed that because Russian communism had humanist aims, humanism is forever associated with the brutal violence of the purges.[6] But we need not get into the extremes to accuse humanism of failure. There are plenty of less controversial examples.

In 1985, *A Feminist Dictionary* was published. From its index: "humanism: see androcentrism, androgyny."[7] Under the entry for androcentrism, there is no explicit mention of humanism – the terms are understood to be synonymous. Under androgyny, the word humanism appears only in a poignant quotation from poet Adrienne Rich: "There are words I cannot choose again / *humanism androgyny* / Such words have no shame in them, no diffidence / before the raging stoic grandmothers."[8] Humanism laid false claim to universality, and feminists targeted it accordingly. Iris Marion Young, for example, criticized the *humanist* commitment of first- and second-wave feminism which defined "gender difference as accidental to humanity" and which insisted that women could be the equal of men according to the standards by "which men have judged one another: courage, rationality, strength, cunning, quick-wittedness." It was men who had developed and maintained these standards, Young and others pointed out, and it was time

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[5] Matei Calinescu, "The End of Man in Twentieth-Century Thought," Saul Freidländer et al., eds., *Visions of Apocalypse: End or Rebirth?* (New York: Holmes and Meier, 1985) 175.

[6] Maurice Merleau-Ponty, *Humanism and Terror*, trans. John O'Neill (Boston: Beacon Press, 1969).

[7] Cheris Kramarae and Paula A. Triechler, *A Feminist Dictionary* (London: Pandora Press 1985) 200.

[8] Cited Kramarae and Triechler, 50.

for a feminism that valued specifically female experience, such as mothering, and its extension into the broader political sphere through environmental activism or the peace movement.[9] Humanism's promise of universality was harmful rather than liberating, because it could be kept only at the price of eliminating difference.

To be suspicious is a valuable quality in progressive scholars, for it can be true that ideas that at first are liberating in time exhaust themselves. Posthumanists hope that they have found a more certain path to liberation. Here is Katherine Hayles: "For some people, including me, the posthuman evokes the exhilarating prospect of getting out of some of the old boxes and opening up new ways of thinking about what being human means." She continues,

> But the posthuman does not really mean the end of humanity. It signals instead the end of a certain conception of the human, a conception that may have applied, at best, to that fraction of humanity who had the wealth, power, and leisure to conceptualize themselves as autonomous beings exercising their will through individual agency and choice.[10]

This attempt to redress imbalances of power is why so many scholars have found posthumanism attractive. It provides a philosophical basis for their frustration that the benefits of modernity have been extended to only a privileged few. Like the other post-isms, it promises emancipation through dismantling the structures of intellectual power. Curiously, though, the posthumanist concern for those short-changed by modernity is frequently accompanied by a fascination with body modification that is often consciously decadent and sometimes very expensive, ranging from piercings to computer chip

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[9] Iris Marion Young, "Humanism, Gynocentrism and Feminist Politics," *Women's Studies International Forum* 8 (1985): 174. See also Mary Poovey, "Feminism and Postmodernism – Another View," *boundary 2* 19 (1992): 34-52.

implants. In 1992, Jeffrey Dietch curated the exhibit *Post Human* at the FAE Musée d'Art Contemporain in Switzerland, which entertained the idea that cosmetic surgery and body building would bring about "a new stage to Darwinian human evolution." Other close observers of the contemporary scene have suggested that decorative body modification, prostheses, and posthumanism, have in common the belief that the human body can be whatever you make of it.[11]

These do not seem to be an obvious partner for emancipation. Piercing parlours seem radically different from Wiener's sketches for prostheses that would heal the wounds of war. Hayles, who sees the possibility of liberation in posthumanism, admits that posthumanism can have this unattractive aspect: "My nightmare is a culture inhabited by posthumans who regard their bodies as fashion accessories."[12] Wiener may not have been dealing in fashion, but his belief that intelligent prostheses would restore their wearers to full humanity does have at least a passing resemblance to the goals of the body-modification posthumanists. They just want to go further, using prostheses to push beyond the usual limits to human potential. Lumping together prostheses and the subculture of piercing and decorative implants, however, is an appalling trivialization of the lives of those who have suffered devastating accidents. Perhaps such theorists hope to beat dialectics to the punch.

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[10] Hayles, 285, 6.

[11] Jeffrey Dietch, *Post Human* (Pully/Lausanne: FAE Musée d'art contemporain, 1992). Gareth Branwyn, "The Desire to be Wired," *Wired* (Sept/Oct 1993) archived at http://www.wired.com/wired/archive/1.04/ desire.to.be.wired.html. Steven Mizrach, "Modern Primitives" http://www.fiu.edu/~mizrachs/ Modern_Primitives.html. See also the links at http://www.fiu.edu/~mizrachs/cyberanthropos.html

[12] Hayles, 5.

Although posthumanism is not purely constructionist – it often relies as heavily on the futuristic visions of science fiction as it does on history or sociology – Ian Hacking's classification of types of constructionism is nevertheless relevant here. Hacking suggests that constructionism can range from historical (*X* has not always existed) to outright rebellious ("*X* is a bad thing, and probably…we would be better off without *X*"). Sometimes ambitions grow beyond rebelliousness: "An activist who moves beyond the world of ideas and tries to change the world in respect of *X* is *revolutionary*."[13] Posthumanists overwhelmingly agree that humanism is a bad thing, and probably we would be better off without it. Some, like University of Toronto engineering professor and self-described cyborg Steve Mann, who has used wearable computers in a series of political demonstrations to expose the asymmetry between the behaviour we accept from government or large corporations and the behaviour those organizations demand of us, would like to change the world.

Mann's recent actions are an example of how body modification might serve the cause of justice. He has developed a device he calls EyeTap, where miniature cameras capture an image that is filtered into a computer system and then projected into the user's eye. In 2000, he and his students wore EyeTaps to an Ontario Coalition Against Poverty protest held in front of the provincial legislature. When the police moved in, journalists scrambled to stay out of the way, but EyeTap wearers continued their webcast of the protest from their individual points of view, transmitting images that suggested that the interaction between police and protesters was more complicated than most mainstream news sources – not fond of OCAP's abrasive tactics – allowed.[14]

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[13] Ian Hacking, *The Social Construction of What?* (Cambridge: Harvard Univ. Press., 1999) 19-20.

[14] Steve Mann and Hal Niedzviecki, *Cyborg: Digital Destiny and Human Possibility in the Age of the*

Actual cyborgs are unnecessary for the transition to the posthuman, however. Recent developments in robotics and computer software are sufficient. Ellen Ullman, writing in *Harper's* magazine, believes that the branch of computer science known as artificial life "has initiated a debate over the coming of the 'post-human': a non-biological, sentient entity."[15] Ullman's restriction of the posthuman to the wholly non-biological is unusual; most writers use it to talk about either a combination of the biological and the technological, or to talk about a conceptual revolution prompted by technology. On the other hand, the technologies that we quite comfortably think that we use, technologies that do not significantly alter our physiology, might also be sufficient to tip us from human into posthuman. In 1973, scholar Elizabeth Mann Borghese wondered whether our technology had forced us into some new kind of human being:

> One might even say that whether postmodern man is still *Homo sapiens* remains to be seen. A species that can fly is different from one that cannot. A species that can transport itself out of earth's biosphere to other planets is different from an earthbound species. A species that can transplant vital organs from one member to another, blurring the boundaries between this individual and that individual and between life and death, is different from a species whose members cannot do this.[16]

Another aspect of the centrality of technology to posthumanist arguments is their frequent analysis of science fiction, or SF.[17] Katherine Hayles devotes nearly half as

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Wearable Computer (Toronto: Doubleday, 2001) 175-6.

[15] Ullman, 61.

[16] Elizabeth Mann Borghese in *Center Magazine* (March/April 1973), cited in Ihab Hassan, "Prometheus as Performer: Toward a Posthumanist Culture? A University Masque in Five Scenes," in Michel Benamon and Charles Carmello, eds., *Performance in Postmodern Culture* (Madison WI: Coda Press, 1977) 213.

[17] SF includes the genres of science fiction and speculative fiction. Those in the know tend to use the term.

much time to the novels of Philip K. Dick and William S. Burroughs as she does to the Macy conferences and Norbert Wiener. The Palgrave introduction to posthumanism includes several essays on SF and imaginative literature. This dissertation has dealt mainly with the ideas of scientists and with the technologies that existed at the time, although it has dipped into literature or film to support a point. A complete understanding of the ideas that inspire the posthuman would require serious reading of twentieth-century SF literature and film, which is beyond the scope of this chapter and would be inconsistent with my overall approach. Since Hayles has devoted an entire book to the topic of posthumanism, I defer to her authority. She argues that novels like *Do Androids Dream of Electric Sheep?* (1968; the novel inspired the film *Blade Runner*) reveal the implications of technologies that even today remain distant dreams for scientists and engineers. Androids are an imagined, not real, technology. Imagined technologies play an important role in much posthumanist writing, which explains why the tenor is so similar to SF or futurism. But imagined technologies are shaky grounds for announcing that we have become posthuman. It is reminiscent of the Cold War fears that robots and computers would enslave human beings. The skeptical might point out that androids might never come to be, just as power-mad computers never came to be. Such imaginings tell us much about our fears and nightmares, and thus about ourselves, but they also suggest that announcements that we are now posthuman are premature.

Because posthumanism begins with technology – real or imagined – it carries a sense of its own inevitability. It does not argue that technology's history is full of accident and contingency. The technology is a given, or at any rate, its history is not examined. Posthumanism is the technology's inevitable result. Avant-garde critic Ihab

Hassan cited the Elizabeth Mann Borghese passage on postmodern man in the piece that likely introduced the term posthumanism. "We need to understand," says one of the characters in his piece, "that five hundred years of humanism may be coming to an end, as humanism transforms itself into something that we must helplessly call posthumanism."[18] There is a strong whiff of fate in posthumanism, made stronger by dialectical arguments that humanism had to give rise to the opposite of its ideals, and posthumanism is the only way out. Even Andy Pickering, that champion of contingency, arrives at a posthumanist analysis because of the manifest inadequacies of all other methods.[19] It seems we have little choice in the matter. At the same time, posthumanists are not necessarily technophiles. Hayles relates that she began *How We Became Posthuman* out of revulsion for an engineer's prediction that it would soon be possible to download a human consciousness onto a computer, "a roboticist's dream that struck me as a nightmare."[20]

Automation and computers have always met with gloomy predictions of the social change that was bound to follow. If the appearance of intelligent machines and software and technologies that closely interact with the human body were the only things encouraging posthumanism, the feeling of inevitability that surrounds it would be no surprise. But posthumanism is also bright-eyed with promises of liberation. Automation and computers, too, have always had those who optimistically predicted the freedom they would bring (in the form of increased wealth and leisure). What is novel about

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[18] Hassan, "Prometheus as Performer," 212. Katherine Hayles gives Hassan credit for the term and Badmington leaves the strong impression that Hassan coined it; I cannot find earlier evidence of it.

[19] See "Cyborg History and the World War II Regime," especially 1-13 and "Synthetic Dye and Social Theory," 41-46.

[20] Hayles, 1.

posthumanism is the unexpected combination of these two historically adversarial positions. Fate becomes a strange companion to freedom. Posthumanism generally takes a detached view of the benefits of technology, yet holds that technological developments spell a welcome end to humanism. There are exceptions, like the people at the Extropy Institute in California (where else?), technological enthusiasts who publish the *Journal of Transhumanist Solutions* and fund cryogenic and cloning research. (Humanism has its share of enthusiasts, too, and they reside in less marginal institutions.) But the bulk of scholarly opinion is with Lawrence Kritzman, who says that contemporary humanist critiques betray "a nostalgia for the thinking subject," and with Jonathan Goldberg, who finds little of interest in "sentimental humanism."[21] In other words, it is time we grew up, faced reality, and accepted some form of posthumanism.

Cybernetics and posthumanism

Hayles's account roots posthumanism in the two motivations described above. She describes a dissatisfaction with humanism, a restless sense that there must be a better set of ideas on which to build a just society. She includes in humanism the ideas of individual freedom and autonomy, which would be a fine place to start working for justice were it not for the terrible burden of dialectics that transforms these into their opposites. Fortunately, it is not necessary to critique dialectics to develop an understanding of Hayles's position, since generally she is willing to question humanism

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[21] Kritzman, "The Nostalgia for the Subject: French Intellectual Thought of the 1980s," *The Romanic Review* 88 (May 1997): 485; Goldberg, "Recalling Totalities: The Mirrored Stages of Arnold Schwarzenegger," Chris Hables Gray, ed., *The Cyborg Handbook* (New York: Routledge, 1995) 244. In his piece "Prometheus as Performer," Ihab Hassan quotes Arthur C. Clarke's idea that we are nearing "childhood's end" for humanity, 216.

directly. She claims her inspiration in the great C.B. Macpherson, who pointed out the paradoxical foundations of market society, based on the 'liberal humanist subject' which "is thought to predate market relations and owe nothing to them." However, that same liberal subject is the "retrospective creation of a market society." The posthumanist solution to this seems to be to recognize that we are all commodified and commodities. There is nothing that we can call our birthright. "Consider the six-million dollar man," Hayles entreats us, "a paradigmatic citizen of the posthumanism regime. As his name implies, the parts of the self are indeed owned, but they are owned precisely because they were purchased, not because ownership is a natural condition preexisting market relations."[22] Keep your receipts, folks. Posthumanism can be a bleak and even cynical outlook, in this case resolutely anti-idealist. We are forced to conclude that Hayles believes that humanism is shorthand for the ideas of political economy and rational economic man, a figure that is in any case deeply unpopular in most humanities departments. But humanism is a rich tradition, stretching to include ideas of the inherent worth and dignity that are ours merely by virtue of being human. Rational economic man is not sufficient cause to reject humanism. Hayles is more convincing when she examines posthumanism's technological motivations, which she finds in cybernetics and the related idea of the cyborg.

Critical to these technological developments was what she calls the 'disembodiment' of information. In 1948, when Claude Shannon developed a definition of information that was independent of the way in which it was conveyed and

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[22] Hayles, 3. The commodification of the human being is also a concern of Steve Mann's. He includes in his recent book a "Humanistic Property License Agreement," establishing the terms under which a person's physical likeness – as in an photo for an identification card – may be used. Apparently the University of

independent of its context, information "lost its body," Hayles tells us.[23] It allowed the cyberneticians to find parallels between the behaviour of human beings and animals, and to build machines that mimicked this behaviour. Hayles calls this disembodiment. She writes, "The triumph of information after materiality was a major theme at the first Macy conference. John von Neumann and Norbert Wiener led the way by making clear that the important entity in the man-machine equation was information, not energy."[24] Energy, however, had not been thought of in straightforward material terms since the development of thermodynamic theories in the early 1800s. Gaston Bachelard, as I have mentioned earlier, described the new conception as "dematerialized materialism," since power and energy were the intangible basic qualities of an understanding that remained materialist in its idea of the world. [25] Energy was measurable and quantifiable, real but immaterial. The cyberneticians, consciously replacing energy with communication, introduced a concept of information which adhered to the principles of a materialist understanding. It did not exist independent of a material carrier; it was measurable and quantifiable. The cyberneticians sought a materialist explanation of thinking, even if the definition of information allowed them to exchange the material of flesh and blood for metal and switches. Hayles's term 'disembodiment' is misleading, since information did

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Toronto refused to accept the agreement, and issued him a faculty card without a picture. *Cyborg*, 240-243.

[23] Shannon generally receives sole credit for information theory. Hayles, however, is careful to call it the Shannon-Wiener definition of information. Shannon himself credited Wiener in his original work – "Communication theory is heavily indebted to Wiener for much of its basic philosophy and theory" (note 4, p. 34) – but in 1987 he said, "I don't think Wiener had much to do with information theory. He wasn't a big influence on my ideas...though I once took a course from him." Shannon, *Claude Elwood Shannon: Collected Papers*, N.J.A. Sloane and A.D. Wyner, eds. (New York: IEEE Press, 1993) xix.

[24] Hayles, 51.

[25] See chapter 1.

not so much lose its body as it gained the use of multiple bodies. However, it is not a big step from one to the other, and dematerialized materialism may have set the stage for disembodiment.[26] Hayles argues that although the definition of information made sense from the perspective of those trying to build better communication machines, it also "allowed information to be conceptualized as if it were an entity that can flow unchanged between different material substrates," or the vision of "the information in a brain being downloaded into a computer."[27]

Hayles has a related complaint about the idea of information, one that through the years has struck a chord with many observers. In order to make it a mathematical quantity, information was divorced from meaning. The answer 'no, not yet,' therefore contains the same amount of information whether the question is 'has the number 38 bus gone by?' or 'will you marry me?' The only way to make information scientifically quantifiable was to define it independent of its relevance or usefulness, since context was not a measurable thing. At the seventh Macy conference, Shannon reiterated his commitment to the idea that information was not the same thing as meaning:

> In communication engineering we regard information perhaps a little differently than some of the rest of you do. In particular, we are not at all interested in semantics or the meaning implications of information. Information for the communication engineer is something he transmits from one point to another as it is given to him, and it may not have any

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[26] Hayles does mention the term dematerialized materialism, which she attributes to Mark Seltzer. Seltzer does not cite Bachelard, and his idea is less specific to the history of scientific ideas and their influence than Bachelard's. In any case, "disembodiment" is the term Hayles prefers. Hayles, 100. Mark Seltzer, *Bodies and Machines* (New York: Routledge, 1992).

[27] Hayles, 53, 54.

> meaning at all. It might, for example, be a random sequence of digits, or it might be information for a guided missile or a television signal.[28]

The point was to preserve the integrity of the information as it moved from one point to another, to make sure that it arrived intact. Telegraphed messages, for example, were sent in various commercial codes, whose compression demonstrated that the English language was redundant. The translation of the message into code was achieved using "a few letters or numbers for common words and phrases." Shannon gave only a preliminary estimate of the amount of redundancy in English, based on the frequency of letters and groups of letters, which came out to 54 per cent. In *The Mathematical Theory of Communication*, which the more mathematically fluent of the cyberneticians had read, Shannon gave examples of the "extremes of redundancy:" "The Basic English vocabulary is limited to 850 words and the redundancy is very high. [*Finnegan's Wake*] on the other hand enlarges the vocabulary and is alleged to achieve a compression of semantic content."[29]

Efficiency and economy in English were topics that received wide airing in the 1940s, as information and communication replaced the entropy and energy of earlier generations. In the nineteenth and early twentieth centuries, the concern had been to determine the way to achieve maximum efficiency in the working man, through diet, exercise, nutrition, and the conservation of movement promoted by people like Frederick Winslow Taylor. Now that physical labour and enormous engines were giving way, in the imagination at least, to mental work and communication machines, the interest in

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[28] *Transactions* vol. 7, 123.

[29] Ibid., 125-6; Shannon, *Mathematical Theory of Communication*, 15; "Prediction and Entropy of Printed English," *Bell Systems Technical Journal* 30 (1951): 50.

economy underwent a similar shift in focus. Time management was applied to language. Language and grammar reform have much longer histories, of course, but there was a renewed interest in these topics in the 1930s, 40s, and 50s, motivated in part by urgent work in cryptography. Several books came up in the conversation that Shannon's presentation stimulated, including pioneering ecologist George Kingsley Zipf's *Human Behavior and the Principle of Least Effort* (1949), which calculated the frequency of words in several different languages. Psychologist Joseph Licklider mentioned Rudolph Flesch's small and popular book, *The Art of Plain Talk* (1946), which advised speakers to use direct and simple language, but also to repeat their message several times.[30] This, Licklider pointed out, made speech "even more redundant....a very dismal outlook for verbal communication." Another psychologist, Donald Marquis, responded that this was not inconsistent with the drive for efficiency, since it implied that "the best communication occurs if you say what the listener expects you to say." It was this very predictability of communication that allowed language to be coded in more efficient form. Although Shannon had not mentioned him in this particular talk, Charles K. Ogden also came up. In the 1930s, Ogden had developed Basic English, the highly reduced and arguably efficient form of the English language that could serve as an easily learned international language.[31]

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[30] Flesch also wrote *The Art of Readable Writing* (1949) and *How to Calculate Readablility* (1951), which detailed his method of figuring the 'readability' of a paragraph based on the number of words and the length of those words.

[31] *Transactions* vol. 7, 141. Licklider is remembered now primarily for his role in the development of personal computers and of ARPANET, the granddaddy of the Internet. See M. Mitchell Waldrop, *The Dream Machine: J.C.R. Licklider and the Revolution That Made Computing Personal* (New York: Viking, 2001), Janet Abbate, *Inventing the Internet* (Cambridge MA: MIT Press,1999) 43, 48, 57, and Irwin Lebow, *Information Highways and Byways* (New York: IEEE Press, 1995, 179-180. C.K. Ogden's work on

Hayles finds an ally for her desire for context in Donald MacKay, a young British scientist whom McCulloch invited to the eighth conference. In his presentation, MacKay suggested expanding the technical understanding of information to include meaning by taking account of the knowledge we already have when we receive a new bit of information. Returning to our earlier example, the answer "no, not yet," to a marriage proposal might mean that the inamorata is still hesitating over the idea of marriage, as she has been for months, or that her divorce is not yet final. MacKay called the combination of the answer and its context "structural information," as opposed to mere "selective information." This would seem to move us into the provenance of semioticians, but MacKay wanted to develop a mathematics to describe information in context. Shannon's restricted idea of information introduced something that was measurable and yielded to mathematics, but it could not even begin to guess at the amount of information that might already be in a human brain.[32] Hayles acknowledges, "The staggering problems this presented no doubt explain why MacKay's version of information theory was not widely accepted among the electrical engineers who would be writing, reading, and teaching the textbooks on information theory in the coming decades." [33]

The proposal excited lively reaction at the conference, but little of it was overtly critical. An exception was the psychologist Heinrich Klüver, who made a mild complaint about the strength MacKay's proposal gave to an already too powerful idea of man as communicating device.

Basic English was collected after his death and published as *Basic English: International Second Language*, prepared by E.C. Graham (New York: Harcourt, Brace and World, 1968).

[32] The information contained in a computer can, of course, be measured, although there was not much to measure at the time.

[33] Hayles, 56.

> It looks as if the human organism is often viewed here as merely a marvelous device for registering incoming stimuli, for receiving and coding of information, and for doing a large number of equally remarkable things. For the psychologist, the picture is unfortunately more complex; unfortunately he cannot see such simple outlines....At best, for the psychologist, the picture resolves itself into the formulation of a large number of unsolved or only partially solved problems.[34]

Expanding the technical idea of information posed problems beyond professional commitments. A Macy conference participant once suggested that the word information was perhaps an unfortunate choice for communication engineering, since its professional definition was easily confused with its everyday usage.[35] MacKay took a useful technical idea and tried to expand it meet its colloquial meaning.

MacKay's impatience with the convention of information generated a discussion similar to the one the participants had on the idea of redundancy in the English language. If language was redundant not only because of common letter groupings or word groupings, but because the receiver of the message already possessed some knowledge about it – "the best communication occurs if you say what the listener expects you to say" – then Shannon's definition of information was a little off-kilter. A definition of information that pointed the way to optimum communication was what was wanted. Lawrence Frank said pithily that contextual knowledge was "the difference between machine and man." Alex Bavelas, a social psychologist, suggested that information might be better defined as "anything which changes probabilities or reduces uncertainties." The discussion quickly veered in another direction, but there is nothing in the conference

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[34] *Transactions* vol. 8, 210.

[35] Heims, 112.

transcripts to suggest that anyone dismissed the idea of changing the definition of information. Hayles implies that MacKay was a voice crying out in the wilderness, but that does not seem to be the case. It seems more likely that most cyberneticians recognized that a definition of information less at odds with its colloquial use would be more obvious and even more useful – but no one knew where to begin such a forbidding task.[36]

The pared-down, mathematical concept of information, which applied equally to live things and electronic ones, did have a sort of independence of the material which carried it. Usually it remained part of the neurons or switches which marked its path, but occasionally, cyberneticians would talk about information existing in a more independent way. Wiener, for instance, suggested that "Our tissues change as we live….We are not stuff that abides, but patterns that perpetuate themselves."[37] McCulloch's conviction that the computer and the human brain were different instances of the same ideal logic machine is a perfect example of Hayles's idea of the posthuman. According to Hayles, cybernetics was posthumanism's incubator. She is right in many ways, but that troublesome 'post' drags with it many ideas which cannot really be associated with cybernetics.

"Of all the implications that [early cybernetics] conveyed, perhaps none was more disturbing and potentially revolutionary than the idea that the boundaries of the human

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[36] "Redundancy of English," *Transactions* vol. 6, especially 149-150, and Hayles, 55-56. Some computer scientists have suggested that context-sensitivity is going to be the next computer revolution. For instance, Tim Berners-Lee, the inventor of the World Wide Web, introduces the idea of the "semantic web," in which computers would be able to evaluate as well as retrieve information, in his book: *Weaving the Web* (New York: Harper Collins, 1999). Information was pared down in order to make it scientifically useful, and ever since we have been working to expand its scientific use to meet its everyday meaning.

subject are constructed rather than given," Hayles writes.[38] Or, in more old-fashioned language, the idea of what it meant to be human was changing. However, as she is aware and as is clear from the preceding chapters of this dissertation, Norbert Wiener made a very public defense of ideas of human dignity and uniqueness that sit uneasily with the posthumanism that cybernetics is supposed to have started. Hayles is careful to acknowledge Wiener's ambivalence about the new field he was so eagerly promoting: he was so sure that cybernetics would make so many lives better, producing hearing aids and artificial limbs and machines to take over mind-numbing jobs. At the same time, he was worried about the possibility of the machines usurping human dignity, either by throwing us out of work or, more metaphorically, through the dehumanizing effects of large bureaucracies. "To engage Wiener's work is to be struck by contradiction," Hayles writes. As hard as he tried to defend human uniqueness, "only for a relatively brief period in the late 1940s and 1950s could the dynamic tension between cybernetics and the liberal subject be maintained."[39] Again, we have a sense that once cybernetics had started, posthumanism was inevitable. The apple had been bitten; our innocence was lost.

Hayles remarks on Wiener's use of analogy, making the interesting argument that for Wiener, "analogy was communication, and communication was analogy." He believed analogies were a way of finding out about the world, as his early papers, notably the co-authored "Behavior, Purpose, and Teleology," show. In the paper, Wiener, physiologist Arturo Rosenblueth, and the engineer Julian Bigelow argued that humans and other living things could be described using ideas that normally applied to electric

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[37] Wiener, *Human Use of Human Beings*, 96. Hayles cites this passage on p. 104.

[38] Hayles, 84.

[39] Ibid., 85, 112.

circuits in machines, like negative feedback. Hayles objects to this because it goes too far:

> The problem with this approach lies not so much in the analogical relations that Wiener constructed between living and mechanical systems as in his tendency to erase from view the very real differences that embodied materiality, differences that the analogies did not express.[40]

It is an interesting objection, taken together with the idea that Wiener used analogies as a way of finding out about the world. It supports the argument I made earlier, that Wiener's ideas slipped the bonds of analogy, and that sometimes he thought that machines and human beings really were different examples of the same thing.[41] Perhaps he did not take account of materiality because cybernetics defined certain key phenomena – automatic function, communication, and thought – as things that were potentially biological *or* electronic. Of course he erased "embodied materiality." That was the point.

Posthumanism is fascinated by bodies, whether disappeared into virtual reality or as manipulable objects. Cybernetics did not care much about bodies; its consuming interest was in minds. Automatic processes were of some interest, certainly, but as examples of how physical laws could explain the way nature appeared to contain, as Jean-Pierre Dupuy has pointed out, "meaning, finality, directionality, and intentionality."[42] In Dupuy's view, the cyberneticians were trying to demystify these ideas, and make them part of a science that was materialist in spirit, if not in actuality. Most of the little cybernetic monsters were designed to learn; they were models of how a

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[40] Ibid., 99.

[41] See Chapter 4, p. 145.

[42] Dupuy, *The Mechanization of the Mind*, 4.

mind might work physically.[43] McCulloch had no difficulties imagining a machine with a complex mind, and despite his ambivalence, Wiener too could envision such a thing. Cybernetics pushed to its peak the idea that thinking was a uniquely human capacity and simultaneously damaged it beyond repair.

Human beings had been knocked from the pedestal of uniqueness, to be sure. Here is where Wiener becomes ambiguous and contradictory, a one-man band for post-war American society's mixed feelings about machines. He frequently deplored the possibility that we might surrender our autonomy to machines, as I have described earlier.[44] At the same time, cybernetics was going to improve our lives by understanding human beings in the same way it understood machines. Hayles suggests that Wiener's mixed feelings may be understood as a matter of boundaries and bodies. As long as "the physical boundaries of the human form" were secure, Wiener saw only glorious potential in "the flow of information through the organism. All this changes, however, when the boundaries cease to define an autonomous self." If we are understood as communicating devices, our individuality and our humanity are thrown into doubt.[45] Undeniably, Wiener was worried about the preservation of human integrity, but how much do boundaries and bodies explain about this?[46]

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[43] Ashby's homeostat served to demystify intentionality, as described in chapter 4.

[44] Chapter 3, p. 118.

[45] Hayles, 107.

[46] I find it extremely irritating that Hayles lumps mathematical boundary problems in with ideas about the boundaries of the human subject (p. 93). Mathematically, boundaries mark the initial conditions of a mathematical equation or some interval over which the equation is relevant. Boundary value problems might arise in the analysis of columns under pressure or electrical circuits. Certainly many of the cyberneticians would have been familiar with the methods used to solve such equations (or to show them to be insoluble). It is a technical term, with only a basic sense in common with the idea of the boundaries of human subjectivity, or international boundaries, for that matter. Hayles correctly states that Wiener

Boundaries and bodies have lost little of their sizzle in avant-garde scholarship over the last twenty years. Postmodern philosophies have advanced the claim that the human body has disappeared, or that it is obsolete, or that it is no longer human but hybrid. Arthur and Marilouise Kroker, for example, have made the exploration of this idea the focus of their work. Hayles quotes from them: "If, today, there can be such intense fascination with the fate of the body, might this not be because the body no longer exists?" The decadent fascination with the body in performance art or the body as fashion accessory is precisely why Hayles finds aspects of cybernetics troubling. She sees in cybernetics the origins of these worrisome contemporary ideas. It was a small step from the disembodiment of information to man as a communicating device to the disappearance of the body. It is not clear that cybernetics belongs in the same camp as the interests of the Krokers, although there is a sublimely incomprehensible essay on cybernetics in one of their books.[47] Cybernetics is not irrelevant to the contemporary interest in boundaries and bodies, but in the 1940s and 50s – the period that is Hayles's focus in this part of her book – it was not interested in bodies. It was interested in minds.

Wiener was an exception to some degree; his interest in prostheses to replace lost senses or limbs suggests an idea of being fully human that depended on an idea of physical completeness. Wiener can seem the most compassionate of the cyberneticians due to his publicly expressed concern for human dignity, but the idea of physical completeness has darker implications: was someone without a limb or without hearing somehow less than fully human? No doubt Wiener never experienced this as a conscious

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believed that all mathematical work was metaphorical, but there is no evidence that he made so facile a connection regarding boundaries.

[47] Hayles, 192-3; Stephen Pfohl, "The Cybernetic Delirium of Norbert Wiener," Arthur and Marilouise

thought. His was inspired to design prostheses, in any case, by the stories of desperate young men who had lost their limbs or hearing through war. It is a point in posthumanism's favour, though. Despite my dislike of the affinity posthumanism claims exists between prostheses and body modification, at least it cannot be accused of arguing that you need a complete body to be human.

Perhaps the posthumanist fascination with bodies is a kind of return of the repressed: after the intense interest in minds in the middle of the century, we became intensely interested in bodies at the end of the century. I do not want to attribute all contemporary cultural fascination with bodies to cybernetics; this would be too facile an explanation of a complicated phenomenon (although the flippancy of announcing that bodies went out of fashion and have now returned as hot collectibles has some appeal). At any rate, the posthumanist body that is simultaneously present and yet ephemeral – readily changed or discarded in virtual reality games – has something in common with the dematerialized materialism of cybernetics that made information real yet immaterial. Hayles says that the posthuman does not mean that the human body has disappeared, but that a "new kind of subjectivity has emerged" – or, we have a changed understanding of what it means to be human.[48]

An anti-automation book from 1956 stated, "The real capacity of the human mind is the capacity to love and to dream, to risk and to achieve, to struggle, to fail, and later to succeed."[49] It is strikingly similar to a passage from the paper that introduced the cyborg to the world in 1960, by Manfred Clynes and Nathan Kline: "The purpose of the

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Kroker, eds. *Digital Delirium* (New York: St. Martin's Press, 1997) 114-131.

[48] Hayles, 193.

[49] David O. Woodbury, *Let Erma Do It: The Full Story of Automation* (New York: Harcourt, Brace and

Cyborg…is to provide an organizational system in which such robot-like problems are taken care of automatically and unconsciously, leaving man free to explore, to create, to think, and to feel."[50] The first author hates machines because they strip human beings of their highest possible selves. The following pair revere machines because they enable our highest possible selves. This hints at a stronger cultural source of posthumanism than just cybernetics. Cybernetics was merely part of a broad focus on mind as a truly human thing, and at the same time part of the developing technology that was undoing that idea.

The cyborg seems to be a better source for posthumanism than cybernetics. The paper by Clynes and Kline described a mouse which had had a pump inserted under its skin that fed it a continuous injection of chemicals without any need for the mouse to do anything. It was a "cybernetic organism," or cyborg. "The cyborg," they wrote, "deliberately incorporates exogenous components extending the self-regulatory function of the organism in order to adapt it to new environments."[51] Patch-delivered pharmaceuticals are common now, but Clynes and Kline had more in mind than mere convenience. They hoped that the mouse would be a model for life in space. All of the body's needs would be taken care of automatically. It is an idea that is astonishingly dualist. Freed from his body, man would reach undreamed of potential, and would be able to exist not as heavy and earthbound, but as a mind in unlimited space. For the posthumanists who see technology as a source of freedom, this is certainly more of a foundational document than anything in cybernetics. But the cyborg's dualism has been largely overlooked. What captured the imagination of most writers and thinkers instead

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Co., 1956) 12.

[50] Manfred E. Clynes and Nathan Kline, "Cyborgs and Space," *Astronautics* (1960). Reprinted in Chris Hables Gray, *The Cyborg Handbook* (New York: Routledge, 1995) 31.

was the freakish, the grotesque, the unholy fusion of human and machine. Cyborgs quickly became wedded to the monsters of cautionary fiction, those misbegotten reminders of the limits to human power. Clynes was dismayed.[52] The cyborg did not become the signpost for the truly human. Instead, it pointed to the not-quite-human, the once-was-human, the might-have-been-human. Clynes, however, has not gone without disciples.[53]

The felicitously named Steve Mann says of his experiments in wearable computers, "In equipping myself, over the past thirty years, with a second skin, an extended central nervous system, I have sought to understand what the post-human world will look like." He echoes Hayles's concern with boundaries, lamenting his "profound loneliness as I struggled both to traverse and to maintain the boundaries of where I began and my computer ended." At the same time, these threatened boundaries do not mean the end of the individual. He quotes approvingly from Manfred Clynes, who recently said:

> Man's essence survives the vicissitudes of the body, with a brain of expanded functionality, with more highly evolved feeling, with further developed empathy. By the time that happens the very materials of the brain will have been changed to a degree, with a new freedom because its organizations will be less taken up with its own maintenance, and more with its consciousness, with communication to other consciousness, and communication with sources of information, music, art, experiencing new emotions. The web of the Internet will truly become a body politic, loneliness banished for all, while maintaining individuality, privacy.[54]

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[51] Ibid., 31.

[52] Gray, "An Interview with Manfred Clynes," *The Cyborg Handbook*, 43-53.

[53] Donna Haraway has found the cyborg a source of inspiration in her widely-cited essay, "A Cyborg Manifesto," *Simians, Cyborgs, and Women* (New York: Routledge, 1991) 149-181.

[54] Mann, *Cyborg*, 2, 5; "An Interview with Manfred Clynes," *The Cyborg Handbook*, 52 (cited Mann 225).

Mann also refers to his work as "humanistic computing," for he seems to believe that the human being is under siege, mainly from the forces of advertising and consumer culture. Like Clynes, he believes that technology might bring freedom and an existence that is more truly human, further support for the idea that posthumanism needs humanism and cannot exist without it.

Wiener's public defense of human dignity may not have been out of step after all. It also ensured that cybernetics would have a lasting reputation as something that preserved human essence in an increasingly technological world. The American Society for Cybernetics, an organization originally started in the late 1950s by scientists interested in cybernetics, now has an executive of assorted idealists (including someone whose occupation is "knowledge architect"). It concerns itself mainly with the human condition, in a way that Wiener likely would have found unscientific and even frivolous, but the basic themes would have been familiar. They co-sponsored a 2001 conference with the haunting title, *Remaining Human in the Face of Our Growing Dependence on Technology*.[55]

Posthumanism, even given that it is not a straightforward rejection of humanism, nevertheless remains troubling. It is a form of antihumanism, even if that term might discomfit some of its staunchest supporters. The prefix suggests an attempt to move beyond the humanist/antihumanist debate, but posthumanist rhetoric echoes perfectly the writings of the antihumanists – the same revulsion with the childishness of humanism, the same emancipatory hopes. In his history of cybernetics, Jean-Pierre Dupuy connects cybernetics not to posthumanism, but to antihumanism.

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[55] http://www.csci.educ.ubc.ca/remaining-human/seminar/; the American Society for Cybernetics website is at www.asc-cybernetics.org.

Cybernetics and antihumanism

T.J. Jackson Lears, whose reputation rests on his important history of American antimodernism, took up a more controversial position when he later wrote, "more crimes than anyone can count have been committed in the name of humanism. An antihumanism movement is long overdue, and if we take seriously its largest implications, crucial to the survival of the earth and its inhabitants."[56] It is difficult not to feel sympathy for this. Every clearcut, every extinct or endangered species, every catastrophic failure resulting from attempts at rapid modernization in the developing world, testifies to the senselessness of human greed and pride. The very word humanism implies that immediate human concerns are of central importance. There are countless heartbreaking examples of the short-sightedness that has led many human beings to run roughshod over the earth. But is humanism the same thing as anthropocentrism? What would an anti- or posthumanist movement accomplish? As Michèle Barrett put it (writing in 1991),

> How does one apply an anti-humanist position to South African politics, where the strongest card the black majority has to play, in the politico-moral arena, is an argument based on 'human rights' and 'equality' and other equally liberal humanist ideas? Anti-humanism, politically speaking, may be an appropriate position to take in the context of a particular Western society where 'bourgeois' democratic freedoms are historically assured, but it would be a dangerous matter to export it the vast area of the world where rule is secured by other means.[57]

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[56] T.J. Jackson Lears, "Reply to Jeffrey Decker," *New Literary History* 23 (1992): 311.

[57] Michèle Barrett, *The Politics of Truth from Marx to Foucault* (Cambridge: Polity Press, 1991) 93-94.

Antihumanism, like posthumanism, has overlooked humanism's substantial progressive role. Lears recognized that the antihumanism of poststructuralism, with its infamous proclamations of the death of the author, would not necessarily solve the problem:

> The *effect* of much poststructuralist thought, if not its intention, is to wipe out familiar notions of human agency and human responsibility....The irony is that the success of [an antihumanist movement] may require the participation of some knowing, committed subjects – or at least some people who believe in the convenient fictions of personal responsibility and selfhood.[58]

Posthumanism takes its cue from a variety of cultural sources; it is not just a response to humanism. Antihumanists, on the other hand, are exercised primarily by the failures of humanism, and humanism is tricky to define. It is associated with the Renaissance in nearly every introductory text, but the term *humanism* was unknown in fifteenth-century Italy. Although Florentine students did use the slang term *umanisti* to refer to their teachers, it was not until 1808 that the educational reformer Friedrich Immanuel Niethammer introduced the term *Humanismus* during a discussion of the role of the classics in German education. Nineteenth-century German educational reformers believed that the *neuhumanistische* curriculum, founded on the study of classical languages and literature, would inspire a second renaissance and the development of a modern German people. *Humanism*, as a description of these romantic Hellenistic ideals, quickly gained currency. In 1860, the publication of Jacob Burckhardt's *The Civilisation of the Renaissance in Italy* ensured a permanent association between the Florentine *umanisti* and humanism.

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[58] Lears, 311-312.

Few can match Burckhardt's historiographical impact. His book established the idea of the Renaissance as a definite historical period characterized by the emergence of the autonomous individual. Typical of his rhetorical flourish is this passage: "Italy began to swarm with individuality; the ban laid upon human personality was dissolved."[59] Although the succeeding generation of historians eagerly followed Burckhardt's model, by the early years of the twentieth century, his orthodoxy began to crumble. The new methods of intellectual history, combined with the efforts of medievalists to defend the honour of their chosen specialization, emphasized the continuity between the Middle Ages and the Renaissance.[60] Burckhardt's work fell into disrepute, and many questioned whether the Renaissance could even be said to exist as a distinct historical period. Renaissance historians responded to the clamour, sometimes taking refuge in queasy imprecisions like "the so-called Renaissance."[61] Even tourist guides became familiar with the debate: one book on art galleries and restaurants refers to Burckhardt as "the mark against which scholars still level their poison arrows of revisionism."[62] The furor slowly subsided, and by 1960, while Burckhardt was not really popular, scholars were at least in general agreement on his importance. Peter Burke nicely summarized the current position in the field when he called the Renaissance "an organizing concept which still has its uses." [63]

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[59] Cited in Oliver Burckhardt, "Jacob Burckhardt: Historian of Civilization," *Contemporary Review* 271 (November 1997): 225.

[60] Wallace K. Ferguson, *The Renaissance in Historical Thought* (Cambridge: The Riverside Press, 1948) 292.

[61] Ibid., x.

[62] Dana Facaros and Michael Pauls, *Northwest Italy* (Condon: Cadogen Press, 1990) 308.

[63] Peter Burke, *The Renaissance* (London, 1987) 5. Cited in Tony Davies, *Humanism* (New York: Routledge, 1997) 138, note 4. See also Hans Baron "Burckhardt's *Civilization of the Renaissance* a

Humanism as a concept, then, dates from the nineteenth century. But what is it? We can begin by treating it as a useful organizing concept for nineteenth-century ideals. The 1850s and 1860s were a period of unprecedented economic growth, creating a widespread confidence among many of its beneficiaries that the achievements of liberated human energy would be limitless. Humanism stood for the nineteenth-century ideals of individualism, progress, and economic and scientific confidence. But these ideals were not universally admired. A highly critical tradition began to develop in the late nineteenth century. Its most acrimonious representative was Friedrich Nietzsche, who scornfully wrote, "All philosophers involuntarily think of 'man' as an *aeterna veritas*, as something that remains constant in the midst of all flux, as a sure measure of things...But everything has become: there are no eternal facts, just as there are no absolute truths." It is for just this sort of thing that he has been dubbed "the doyen of philosophical antihumanists."[64]

However strong his reaction to nineteenth-century humanism, Nietzsche was interested in Burckhardt's history. He was deeply taken with Burckhardt's enthusiastic descriptions of absolutist Renaissance princes, and drew on it for his portrait of the *Übermensch*, that ideal man who rose from the ashes of meaning as the bearer of "radical freedom."[65] Like many of the antihumanisms that followed in its wake, Nietzschean antihumanism was not really the opposite of humanism. It was a rejection of humanism's perceived naïvete while holding fast to the ideal of human freedom. Burckhardt's own ardour for competitive individualism suggests the same thing: that antihumanism is

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Century after its Publication,"*Renaissance News* 13 (1960): 207-222.

[64] Davies, *Humanism*, 33, 36.

[65] Ibid., and David Norbrook, "Life and Death of Renaissance Man,"*Raritan* 8 (Spring 1989): 89-110.

humanism's shadow side, skeptical and cynical about the human race as a whole, but unwilling to let go all hope of human possibility.

The best-known successor to Nietzschean antihumanism is Martin Heidegger. His scathing criticism of modernity and Western metaphysics added a distinct rhythm to the humanism/antihumanism dynamic. In 1946, he published a reply to Jean-Paul Sartre's assertion that existentialism was a humanism. In this "Letter on Humanism," he wrote, "You ask: *comment redonner un sens au mot 'humanisme'*? This question proceeds from your intention to retain the word 'humanism.' I wonder whether that is necessary. Or is the damage caused by all such terms still not sufficiently obvious?"[66] Given Heidegger's shameful and sordid commitment to National Socialism, these lines, written so soon after the end of the war, take on an appalling gravity. "Because someone criticizes 'humanism'," he continued, "people suspect a defense of the inhumane and a glorification of barbaric brutality. For what could be more logical than to suppose that, for one who has said no to humanism, only the affirmation of inhumanity remains?"[67] But in this case, philosophical antihumanism and practical inhumanity were an alarmingly perfect fit. The simmering controversy that surrounds Heidegger always churns more furiously when the topic turns to his political engagement, making the adequacy of his indictment of humanism difficult to assess.[68] But Heidegger was not the only thinker of the time to repudiate humanism. George Steiner argued that pre-Nazi

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[66] Martin Heidegger, *Basic Writings*, David Krell, ed. (HarperSanFrancisco: 1993) 195.

[67] Davies, *Humanism*, 129.

[68] Gail Soffer, "Heidegger, Humanism, and the Destruction of History," *Review of Metaphysics* 49 (March 1996): 547-76.

Germany had been the most humanistically educated of European countries – sufficient grounds to reject humanism.[69]

These are all antihumanisms provoked by a deep distaste for humanism and the ideals that fall under modernity's broad rubric. But like its successor posthumanism, antihumanism can root itself it scientific and technological change as well. Jean-Pierre Dupuy asks, "can the idea we have of the human person, which is to say of ourselves, survive the forward march of scientific discovery?" Heidegger believed that modern metaphysics, centred on science and technology, had made man the centre of all things. Dupuy describes this as the idea that "everything that exists is a slave to the purposes of man....The value of things depends solely on their capacity to help man realize his essence, which is to achieve mastery over being." "Cybernetics is the metaphysics of the atomic age," snapped Heidegger, the latest and most concerted effort to gain mastery over the world.[70]

But as Dupuy argues, cybernetics was also critical to humanism's undoing. He claims that cybernetics was at once humanist and antihumanist; this is what made it "a turning point in the history of human conceptions of humanity." On the one hand it offered to complete the promise of science by giving man control over not only nature, but himself. On the other, it made the mind of man – that touchstone of human identity – the object of materialist investigation, just another sample on the laboratory bench. "No raising up can occur without a concomitant lowering, and vice versa," Dupuy remarks. If cybernetics was the apotheosis of humanism, it also made the human mind something that could be artificially reproduced, at least theoretically. One of Dupuy's aims in

[69] Alan Bullock, *The Humanist Tradition in the West* (New York: Norton, 1985) 179.

[70] Dupuy, 17, 90.

writing his book was to show that there was more to cybernetics than Wiener, but the best example of the cybernetic paradox is in Wiener's efforts and writings. He was the man who wrote to Walter Reuther to warn him of pending technological unemployment, but also said that the apparent flexibility of the mind in comparison to the machine might well be specious, since we did not yet understand just how "brain-machines" worked.[71] Wiener could be excited by the same ideas he warned Reuther against. Sometimes he saw the tremendous possibility of science and engineering; sometimes he saw that we would make ourselves obsolete.

In his essay on the idea of the death of man, Matei Calinescu suggests that we may have moved beyond the eschatological inclination of twentieth-century thought.

> However it may function – scientifically or metaphorically, literally or figuratively, philosophically or aesthetically – the language of the end of man and of the end in general is typical of certain deeper trends of modernity itself....There are signs, however, that modernity may have largely exhausted itself. The modern cult of doubt and crisis, once some of its chilling practical effects have become evident, seems to have lost much of its earlier appeal.[72]

Among the most vocal critics of the idea of the end of man are the philosophers Luc Ferry and Alain Renaut. They worry that the antihumanism of poststructuralism cuts adrift the idea of human rights, those rights we share merely by virtue of our humanity. Ferry and Renaut argue that a belief in traditional humanism is no longer possible; the horrors of the twentieth century are yet fresh. But they claim that it is possible to develop a "modest" or "nonmetaphysical" humanism that would preserve human rights while

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[71] Wiener, "The Impact of Communication Engineering on Philosophy," Box 31A, folder 765, Norbert Wiener Archive at MIT, 15.

avoiding "naïve ideologies of progress."[73] What makes their position difficult to sustain is their distaste for technology and modernity. The humanism they appeal to seems not to be part of modernity, and so is of limited help in answering the question of what it means to be human in the modern technological world.

Calinescu thinks there are signs of hope coming from science itself, as it attempts a "reenchantment of the world," as Ilya Prigogine and Isabelle Stengers claim in their book *La Nouvelle Alliance: Métamorphose de la science* (1979). This "rehumanized" science will take into its pluralistic embrace concepts long considered unscientific – "life, destiny, freedom, spontaneity, and irreversibility" – and will treat traditional knowledge and the teachings of other cultures with respect. This will lead to an age that is "transhumanist," a word that Calinescu borrows from the fecund Ihab Hassan.[74] It sounds like cybernetics all over again, which ought to make us skeptical. The American Society for Cybernetics, with their "Remaining Human" conference and their attempts to map the connections between scientific disciplines, remain convinced that the key to the reenchantment of the world is a version of cybernetics. But their work is at the fringes of the scientific world. The Macy conferences, which remained scientifically respectable, were never able to resolve the contradiction between their humanist and antihumanist ideas. Perhaps there is a lesson in this.

The energy that characterized the Macy conferences did not last long. After the final meeting wrapped up in 1953, cybernetics receded into the disciplines and departments from which it had come. The approach remained influential, especially in

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[72] Calinescu, 191.

[73] Luc Ferry and Alain Renaut, *French Philosophy of the Sixties: An Essay on Antihumanism*, trans. Mary H.S. Cattani (Amherst: Univ. of Mass. Press, 1990) xxvi.

cognitive science, but cognitive science has yet to produce a Norbert Wiener, someone compelled to share with the public the possible implications of the new science and technology. Possibly this is because cognitive science does not deal with broad cultural concern and fear, as cybernetics did. Cybernetics offered itself as a peaceful science, but one nonetheless caught up in the automation debates. It confirmed human uniqueness and simultaneously proposed to duplicate the very quality that made us unique: our minds. Perhaps it was this paradox that made cybernetics so vigorous. "Whether we entrust our decisions to machines of metal," Wiener wrote at the end of *Cybernetics*,

> or to those machines of flesh and blood which are bureaus and vast laboratories and armies and corporations, we shall never receive the right answers to our questions unless we ask the right questions....The hour is very late, and the choice of good or evil knocks at our door.[75]

In an essay on the necessity of Jewish education, Emmanuel Lévinas wrote that "in spite of all its generosity, Western humanism has never managed to doubt triumph or understand failure or conceive of a history in which the vanquished and the persecuted might have some value." But he also warned of the terrible possibility in antihumanism, "which begins by paying better attention to the human, [but] makes the antagonism between Law and Freedom which we had thought resolved erupt again and, by a progressive subtraction of elements, finally announces the end of the essence of the man."[76] The possibility of virtue is lessened by both humanism and antihumanism.

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[74] Calinescu, 192.

[75] Wiener, *Cybernetics*, 27, 185-6.

[76] Emmanuel Lévinas, "Antihumanism and Education," *Difficult Freedom*, trans. Seán Hand (London: Athlone Press, 1990) 282, 284.

Maybe cybernetics had the right of it: we need to hold on to both humanism and antihumanism, no matter how contradictory that might be, in order to be human.

Conclusion

In the mid-twentieth century in the United States, a number of cultural trends converged to make thinking the quality to which humanity would be anchored. Americans feared communism in part because it wiped out individual choice and individual thought. In social commentary, there were those who worried that Americans had become too conformist, that they valued fitting in over the cultivation of individual thought. Factory automation threatened mass unemployment. If the computer had been confined to the factory floor, that would have been bad enough, but it was quickly adopted to automate the work of record-keeping and the organization of information, raising the possibility of widespread worker obsolescence. In such an atmosphere, many people believed that the mind had to be a uniquely human characteristic. That it appeared to be under attack was reason to fight all the harder for its preservation.

But the readiness to believe that the communists had developed techniques of mind control suggests a desperation behind the conviction that thinking was uniquely human, revealing that we were afraid that there was nothing unusual about our minds at all. We really were machines, susceptible to button-pushing. There was an abiding ambivalence about the implications of the thinking machine. Uncanny imitators of our selves, did they mean that we too were machines, as we secretly feared? Or were they our opposites? If we were machines, was that always so terrible? The cybernetic automata might be a disconcerting reflection, but they could charm us as well. Cybernetics, particularly in the form that Wiener popularized it, answered yes to all of these questions. Perhaps, then, submerged in the work of Wiener and the other cyberneticians, it is going to be difficult to see any clear path through the thickets of contradiction in humanism and posthumanism, which are only tangled further by the contradictory meanings of man and machine.

Historians of science have tended to identify the emergence of cybernetics with a new age – posthumanist, postmodern, cyborg, and so on. But the central concern of cybernetics was to pin down in some way the meanings of man, mind, and machine. This effort resonated strongly with broader concerns of postwar American culture, giving cybernetics a strength that it has not seen since. This indicates that the new age that historians are so keen to date could not properly be said to have begun with cybernetics. Cybernetics, to be sure, was occasionally prophetic. It provided the foundations for the cyborg, one of postmodernism's more powerful myths, and its conception of man as a communicating device implied that human flesh was not necessary for human consciousness. But science does not lead culture; it is part of culture. Cybernetics, which was so speculative and existed mainly in the form of ideas, was very much a part of the concerns of its time.

The fact that the question of whether a machine can think has ceased to matter to most people indicates that the cultural shift that historians are seeking might have occurred some time later. The Kasparov versus machine chess battles are tinged with nostalgia, both for the days of the Cold War Russian chess machine and the days when there was more at stake in such a meeting. We have accepted that chess might be more a computer's game. The psychologist Sherry Turkle's work sheds some light on this. In her work in the 1970s and early 80s, she concluded that people saw the computer as a "second self" – a phrase that correctly implies one person and one computer in relationship with one another. By the 1990s, the prevalence of the Internet had given rise to multiple and shifting identities.[1] The idea of being human has splintered into a thousand possibilities. A new generation of cultural theorists routinely shakes off attempts to tie its identity to anything that looks like it might remain still. There is a willingness to accept contradiction, and sometimes an avidity for creating it. We no longer feel the same impulse to anchor our humanity to something. But these feelings, which are associated with postmodernity, arose quite recently. Cybernetics may have contributed to them, but its fascination with minds was firmly rooted in postwar American culture.

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[1] Sherry Turkle, *The Second Self: Computers and the Human Spirit* (New York: Simon and Schuster, 1984) and *Life on the Screen: Identity in the Age of the Internet* (New York: Simon and Schuster, 1995).

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