

## Foreword

Doug Hill

It tells you something about Norbert Wiener's qualifications as a prophet that *Cybernetics* has been republished twice since it first appeared in 1948, and that on each of those occasions his thoughts and predictions about the technologies he helped create have seemed more ingenious, more prescient, and, in some respects, more troubling.

The *New York Times* acknowledged as much in 1965 when it turned over the front page of its prestigious book review section to *Cybernetics'* first reissue—a rare editorial honor indeed for a book that was, at the time, seventeen years old.<sup>1</sup> (The decision to grant cover status may have been influenced by the fact that a month earlier Wiener had won, posthumously, a National Book Award for *God & Golem, Inc.*) The *Times'* reviewer, John Pfeiffer, called *Cybernetics* “one of the finest intellectual adventure stories ever written.” He also noted, however, that upon the book's initial publication, Wiener's warnings about the potential dangers of computer technology had created “something of a scandal.” Three years after Hiroshima and Nagasaki, Americans were worried that scientists might not be able to contain the powers they'd unleashed. Wiener didn't reassure them.

His introduction concludes by noting his distress that those who contributed to the development of cybernetics, including himself, “stand in a moral position which is, to say the least, not very comfortable.” The techniques emerging from their ideas, he said, could be used for evil as well as good, and it was obvious he expected they would be. True, he said, many of his colleagues held out hope that cybernetics could lead to “a better understanding of man and society.” Speaking for himself, Wiener said, “I am compelled to say that it is a very slight hope.”

This latest reissue of *Cybernetics* likewise makes its appearance at a time when people are wondering whether we have our technologies firmly in control. And it’s safe to say Wiener would not be surprised that those anxieties arise from just the sorts of technological power he wrote about in 1948.

The likely impact of automation on employment is an example. Over the past few years, a plethora of articles, books, studies, and conferences have warned, often alarmingly, that advances in artificial intelligence and robotics pose a significant threat to a significant number of jobs. Some of these postulate that half or more of all jobs could soon be replaced. “This will be the fastest transition humankind has experienced,” said Kai-Fu Lee, an AI expert who has held executive positions at Google, Microsoft, and Apple, “and we’re not ready for it.”<sup>2</sup>

Recent reports of thriving employment don’t disprove automation’s impact; the decisive factor is how many of those jobs offer meaningful employment at a living wage, especially for unskilled workers.<sup>3</sup> Two MIT economists, Erik Brynjolfsson and Andrew McAfee, say we’re witnessing the birth of the “Second Machine Age.” In an interview with the *Harvard Business Review*, McAfee noted that digital technologies are doing for human brainpower what the steam engine and related technologies did

for human muscle power during the Industrial Revolution (aka the First Machine Age).<sup>4</sup> If that doesn't sound familiar, it will after reading *Cybernetics*, where Wiener uses exactly the same comparison. Wiener notes in the book that he'd attempted to alert the labor unions of the threats posed by automation to their membership. With a few exceptions, he said, he found union leadership "totally unprepared to enter into the larger political, technical, sociological, and economic questions which concern the very existence of labor." Today we seem more willing to talk about those questions. Whether we're willing to do something about them is another question.

The potentially ruinous impact of communication technologies on democracy is another issue that Wiener anticipated with uncanny accuracy. The most fundamental conviction of cybernetic theory is that it all comes down to messages (i.e., information) sent and responded to (i.e., feedback). The functionality of a machine, organism, or society depends on the quality of those messages. Faithful exchanges of information allow the machine, organism, or society to maintain a state of homeostasis. Information corrupted by various forms of noise leads to the opposite.

In *Cybernetics*, Wiener calls the mass media of his day the single greatest anti-homeostatic influence in modern society. One wishes that the techno-utopians of Silicon Valley had heeded his point that genuine community extends only so far as the transmission of effective—meaning homeostatic—information. As the scale, scope, and speed of information technologies have increased, so has the potential for corruption. Certainly Mark Zuckerberg failed to appreciate that Facebook's "global community" of two billion users would inevitably produce countless messages that were antithetical to homeostasis, and thus to genuine community.

That the routine operation of computer technologies can lead to disaster was a point Wiener stressed repeatedly. Thinking machines are relentlessly literal-minded, he said. They mechanically perform the tasks we ask them to, even though their interpretation of those tasks may be diametrically opposed to what we had in mind. So it is that Facebook's algorithms have posted videos of murders as efficiently as they've posted videos of marriages.

Speed is another routine feature of automation that Wiener frequently warned could thwart our intentions. As he put it in a 1960 essay for *Science* magazine, "By the very slowness of our human actions, our effective control of our machines may be nullified. By the time we are able to react to information conveyed by our senses and stop the car we are driving, it may already have run head-on into a wall."<sup>5</sup> He was using the car image metaphorically, of course; the fatal accidents involving Tesla's and Uber's automated vehicles were still many decades in the future. Still, during those decades we've become ever more dependent on any number of complex computer systems that aren't as stable as we like to think. The failure of a relay switch in a power station in Niagara Falls, New York, on November 9, 1965, triggered a series of mechanical and electrical events that blacked out power to the entire northeastern United States and significant portions of Canada; now we're warned that Russian hackers may be as interested in disrupting America's power grid as they have been in disrupting its elections.<sup>6</sup> In 2010, computerized trading programs were blamed for a "flash crash" on Wall Street, when the Dow Jones Industrial Average plunged more than 900 points in a matter of minutes. "We have a market that responds in milliseconds," said a finance expert quoted by the *New York Times*, "but the humans monitoring respond

in minutes, and unfortunately billions of dollars of damage can occur in the meantime.” Stocks rebounded quickly on that occasion, but a 2018 report from J.P. Morgan warned that a more extensive crash spurred by electronic trading algorithms could lead to social chaos.<sup>7</sup>

Given the profits they engender, it’s unlikely we’ll stop using electronic trading programs anytime soon, which points to the driver of technological folly that most enraged Wiener: greed, for both money and power. He regularly railed against the “hucksters” in commerce and “gadget worshippers” in science whose cupidity leads irrevocably, he believed, to “no homeostasis whatever.” Readers will find piquant examples of Wiener’s disdain for the captains of capitalist industry in *Cybernetics*; here’s one from his follow-up book, *The Human Use of Human Beings*:

So long as anything remained of the rich endowment of nature with which we started, our national hero has been the exploiter who has done the most to turn this endowment into ready cash. In our theories of free enterprise, we have exalted him as if he had been the creator of the riches which he has stolen and squandered. We have lived for the day of our prosperity, and we have hoped that some benevolent heaven would forgive our excesses and make life possible for our impoverished grandchildren. This is what is known as the fifth freedom.

Under these conditions, the new resources given by invention have naturally been turned to the even more rapid exploitation of the resources of our soil. ... This game has another name than that of war. It is also called beggar-your-neighbor.<sup>8</sup>

Where did this willingness to so vehemently attack the powers that be come from? The same place, I suspect, that accounted for the magnificent originality of Wiener’s science, and also for the notorious difficulties of his personality. That place was his childhood.

Wiener showed signs of genius almost from infancy. According to *Dark Hero of the Information Age*, the superb biography by Flo Conway and Jim Siegelman, he was reading by the age of three and reciting in Greek and Latin by the age of five. As a child, he was consuming books of philosophy and literature that would enrich his writing as an adult. By the time he was ten, he was studying chemistry, geometry, physics, botany, and zoology; by the age of eleven, he'd entered college. He earned his undergraduate degree in mathematics from Tufts at fourteen, spent a year studying philosophy at Cornell, and earned his doctorate with a thesis on mathematical logic from Harvard at seventeen.<sup>9</sup> Wiener joined the faculty of MIT at the age of 23 and remained there until his death in 1964.

Like many, if not most, prodigies, Wiener emerged from childhood bearing psychological scars, many inflicted by his father. Unable to find a public or private school that could keep up with his son, Leo Wiener, an instructor in Slavic languages and literature at Harvard, began teaching him at home. The course of study was expansive in the subject areas it covered but brutal in its execution. In the first volume of his autobiography, *Ex-Prodigy: My Childhood and Youth* (like *Cybernetics*, a surprise best seller), Wiener recalls a regimen of “systematic belittling.” Mistakes were greeted by explosions of temper, his father progressing rapidly from demanding teacher to “avenger of blood.” This explains the title Wiener had originally chosen for his memoir: “The Bent Twig.”<sup>10</sup>

His academic precocity made Wiener a minor celebrity—a newspaper profile on the occasion of his entry into Tufts called him “The Most Remarkable Boy in the World”<sup>11</sup>—but did him no favors socially. His physical clumsiness, his poor eyesight, and his Jewishness further contributed to his profound and

permanent self-identification as an outsider. Wiener suffered, professionally as well as personally, from his uniqueness, but he also used it. As he put it in the second volume of his autobiography, *I Am a Mathematician*, "I knew very well that I was competitive beyond the run of younger mathematicians, and I knew equally that this was not a pretty attitude. However, it was not an attitude which I was free to assume or to reject. I was quite aware that I was an out among ins and that I would get no shred of recognition that I did not force. If I was not to be welcomed, well then, let me be too dangerous to be ignored."<sup>12</sup>

*Cybernetics* shows frequent evidence of Wiener's substantial ego, but just as often shows his willingness to share credit with his collaborators and other workers in the field. Claude Shannon, whose reputation as the father of information theory would come to overshadow Wiener's, receives several mentions. (Shannon earned his masters and doctorate degrees at MIT and, according to Conway and Siegelman, spent considerable time talking to Wiener about cybernetics there.) The text is also peppered with examples of Wiener's literary and philosophical chops; it's not often we encounter pages of mathematical formulae interspersed with name-dropping references to the likes of Balzac and Hume, Kipling and Carroll.

It's likely that the breadth of Wiener's erudition and ambition contributed to his eclipse by Shannon. As the subtitle of *Cybernetics* shows, Wiener set out to explain how information is the lingua franca of both animal and machine, a mission that consciously involved exploring, as he put it, "the boundary regions of science." Thus, cybernetics as Wiener conceived it is physically embodied—understanding the workings of the human brain and nervous system was a central goal, though at one point Wiener studied signal transmission in the nerve fibers

of cats—yet consciously holistic and theoretically unlimited. As the historian Steve J. Heims put it, cybernetics “leads to a more unified view of the world, including its human inhabitants, where everything is connected to everything else.”<sup>13</sup> Shannon’s information theory, by contrast, is both highly abstract and intensely practical, resolutely focused on moving electronic messages from point A to point B. For him, wrote the literary scholar N. Katherine Hayles, information is emphatically disembodied, “a probability function with no dimensions, no materiality, and no necessary connection with meaning.”<sup>14</sup>

With the advent of digital technology, Shannon’s more circumscribed approach paradoxically lent itself more readily to a host of real-life applications—they’re at work in the smartphones, fitness trackers, and countless other devices we use today. So it is that Shannon has typically received credit for jump-starting the computer revolution while Wiener’s legacy remained relatively obscure. Many scientists believe that is changing. In the burgeoning age of artificial intelligence, the line between human and machine is becoming increasingly blurred. Cybernetics was far ahead of its time in anticipating how fruitful those parallels could be.<sup>15</sup>

There were personal as well as theoretical reasons for Wiener’s fading. His books made him a nationally recognized figure, but he used that fame to take principled public stands against the use of science—*his* science—to develop new ways to wage war, exploit labor, and destroy the environment. In these concerns he was, again, far ahead of his time, as well as uncommonly outspoken. In an article for the *Bulletin of Atomic Scientists*, he said that “the degradation of the position of the scientist as an independent worker and thinker to that of a morally irresponsible stooge in a science-factory has proceeded even more rapidly



and devastatingly than I had expected.”<sup>16</sup> Putting his money, and his career, where his mouth was, Wiener refused to take on research funded by the military, which effectively excluded him from much of the cutting-edge work in computers at a crucial moment in their history. (I can imagine Wiener smiling with approval of the Google engineers who insisted in 2018 that the company withdraw from its commitments to develop advanced AI capabilities for the Pentagon.<sup>17</sup>) Wiener also declined offers from corporations who sought his advice on automating their factories. “Those who suffer from a power complex,” he wrote in *The Human Use of Human Beings*, “find the mechanization of man a simple way to realize their ambitions.”<sup>18</sup>

The impact of Wiener’s ideas was also undermined by his own demons. According to Conway and Siegelman, he suffered from periods of severe depression during which he would lose control of his emotions, breaking into sobbing or shouting fits at the slightest provocation. More than once he threatened suicide. Wiener’s colleagues at MIT, although mostly unaware of those episodes, nonetheless at times found him imperious, temperamental, maddeningly absent-minded, and neurotically self-absorbed. Perhaps most important, Conway and Siegelman report that in 1951 Wiener abruptly abandoned leadership of a new neurophysiology laboratory at MIT—one that held immense promise for furthering the growth of cybernetics—after his wife convinced him, falsely, that more than one of his partners in the venture had seduced his nineteen-year-old daughter. Wiener’s fears that his colleagues were attempting to steal credit for cybernetics made him more likely to believe the story.<sup>19</sup>

Reviewers of *Ex-Prodigy* remarked that, despite his many successes, Wiener’s life story seemed imbued with sadness. His writings reveal a deep skepticism about human nature. Earlier,

I mentioned Wiener's comment that he used his outsider status to fuel his creative drive. Steve Heims noted a similar sentiment in a journal article Wiener cowrote, criticizing Rudyard Kipling for his "fear-based conformity." In a comment that could easily have reflected Wiener's view of himself, the piece added, "The marginal man is always relatively the more civilized human being."<sup>20</sup>

Throughout his life, Wiener harbored another conviction that in my view was equally important in fueling his genius, and that was his recognition of uncertainty. It's remarkable that at the age of ten he wrote a paper entitled "The Theory of Ignorance," in which he proclaimed "the impossibility of man's being certain of anything." He mentions the paper in the second volume of his autobiography. "Even at that time," he wrote, "I was struck by the impossibility of originating a perfectly tight theory with the aid of so loose a mechanism as the human mind." A key moment on his path to cybernetics came when he discovered the statistical mechanics theories of his scientific hero, Josiah Willard Gibbs, whose applications of probability demonstrated, Wiener said, that chance is part of the "warp and weft" of physics. This in turn affirmed his belief that it would be a mistake to view the world as purely rational.<sup>21</sup>

That Wiener's warnings about technology haven't been heeded in the long run isn't surprising; technological advance and enthusiasm for technological advance have been drowning out the warnings of skeptics for centuries. The surprise was that *Cybernetics* and his other books and articles received as much initial attention as they did. Nonetheless, the attitudes of the public do seem to have shifted in his direction. After years of enamored embrace of Google, Facebook, Amazon, YouTube, and any number of other internet attractions, a host of problems—loss of

privacy, tech addiction, and subverted elections among them—has, for many, provoked serious doubts. And it's not just the users who are having second thoughts.<sup>22</sup>

In several of his works, including this one, Wiener mentions Goethe's "The Sorcerer's Apprentice," "The Fisherman and the Genie" from *One Thousand and One Nights*, and W. W. Jacobs's short story, "The Monkey's Paw." In one way or another, the protagonists of all three tales end up asking themselves how the magic they thought would deliver them could have gone so horribly wrong. A series of scandals, beginning with revelations of social media's contributions to the election of Donald Trump, has caused many of Silicon Valley's would-be wizards to ask themselves, belatedly, the same question.

Doug Hill is the author of *Not So Fast: Thinking Twice About Technology*.

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# Cybernetics or Control and Communication in the Animal and the Machine

By: Norbert Wiener

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