sadie plant

DOUBLEDAY

NEW YORK LONDON TORONTO SYDNEY AUCKLAND

zeros + ones

DIGITAL WOMEN + THE NEW TECHNOCULTURE

1997

"Feedbacks of this general type are certainly found in human and animal reflexes," wrote Norbert Wiener. "When we go duck shooting, the error which we try to minimize is not that between the position of the gun and the actual position of the target but that between the position of the gun and the anticipated position of the target. Any system of anti-aircraft fire control must meet the same problem." The anticipated moment of impact is taken into account, fed back into the calculations which lead to the desired outcome. The end result is engineered in reverse.

cybernetics

When Wiener published his *Cybernetics: Communication and Control in Animal and Machine* in 1948, he announced the dawn of a new era of communication and control. The term cybernetics comes from the Greek word for steersman, the figure who guides the course of a ship. What it actually described in Wiener's terms was both the steersman and the ship, which together compose what became known as a cybernetic organism, or cyborg.

Cybernetic systems are machines which incorporate some device allowing them to govern or regulate themselves, and so run with a degree of autonomy. Cybernetic systems have little in common with "older machines, and in particular the older attempts to produce automata" such as Babbage's silver dancer. What sets "modern automatic machines such as the controlled missile, the proximity fuse, the automatic door opener, the control apparatus for a chemical factory, and the rest of the modern armoury of automatic machines which perform military or industrial functions" apart from clockwork machines is that they "possess sense organs; that is, receptors for messages coming from the outside." These are systems which receive, transmit, and measure sense data, and are "effectively coupled to the external world, not merely by their energy flow, their metabolism, but also by a flow of impressions, of incoming messages, and of the actions of outgoing messages."

While Wiener was among the first to name such processes, cybernetics has no neat source, no single point of origin. Cybernetic circuits and feedback loops could retrospectively be identified in a variety of modern contexts and theories, including those of Immanuel Kant, Adam Smith, Karl Marx, Alfred Wallace, Friedrich Nietzsche, and Sigmund Freud. Wiener's work picked up on many elements of these earlier researches. Energetic feedback loops are certainly at work in James Watt's steam engine, which is regulated by a governor which "keeps the engine from running wild when its load is removed. If it starts to run wild, the bars of the governor fly upward from centrifugal action, and in their upward flight they move a lever which partly cuts off the admission of steam. Thus the tendency to speed up produces a partly compensatory tendency to slow down." There are suggestions that "the first homeostatic machine in human history" came long before the steam engine with twelfth-century compasses. Sometimes Ktesibios's "regular," a water clock dating to the third century B.C., is given the honor of being "the first nonliving object to self-regulate, self-govern, and self-control . . . the first *self* to be born outside of biology . . . a true *auto* thing—directed from within."

As Wiener's work made clear, however, the old distinctions between autonomous activity within and outside biology could no longer be applied. As his reference to animal and machine suggested, cybernetic systems were composed at all scales and of any combination of materials, and the same patterns, processes, and functions could now be observed in technical and organic systems alike. Input and output devices allow them to connect and communicate with whatever composes their outside world; feedback loops and governors give them some measure of self-control. Prioritizing the processes common to lively systems of all varieties, rather than the essential qualities which had more recently distinguished them, Wiener argued that organisms—animals, humans, all kinds of beings—and things—nonorganic systems and machines—"are precisely parallel in their analogous attempts to control entropy through feedback." No matter how extreme, the differences between these systems were simply matters of degree. Human beings were no exception to these basic ways of life.

Cybernetic systems, it now seemed, had always been organizing themselves. Wiener's work was merely the occasion for them to become perceptible to a world which still thought that everything needed to be organized by some outside force. As "the theory of the message among men, machines, and in society as a sequence of events in time," cybernetics was conceived as an attempt to "hold back nature's tendency toward disorder by adjusting its parts to various purposive ends." This tendency toward disorder is entropy, defined by the Second Law of Thermodynamics as the inexorable tendency of any organization to drift into a state of increasing disorder. Wiener describes a world in which all living organisms are "local and temporary islands of decreasing entropy in a world in which the entropy as a whole tends to increase." Cybernetic systems, like organic lives, were conceived as instances of a struggle for order in a continually degenerating world which is always sliding towards chaos. "Life is an island here and now in a dying world. The process by which we living beings resist the general stream of

corruption and decay is known as *homeostasis.*" Wiener's cybernetic systems, be they living or machinic, natural or artificial, are always conservative, driven by the basic effort to stay the same.

"It seems almost as if progress itself and our fight against the increase of entropy intrinsically must end in the downhill path from which we are trying to escape," wrote Wiener in the 1950s. "It is highly probable that the whole universe around us will die the heat death, in which the world shall be reduced to one vast temperature equilibrium in which nothing really new ever happens. There will be nothing left but a drab uniformity out of which we can expect only minor and insignificant local fluctuations." Nevertheless, Wiener assures his readers that it may well be "a long time yet before our civilization and our human race perish." We are "not yet spectators at the last stages of the world's death," and a multiplication of cybernetic loops could ensure that this point was continually warded off.

The Sex Which Is Not One is not impressed. "Consider this principle of constancy which is so dear to you: what 'does it mean'? The avoidance of excessive inflow/outflow-excitement? Coming from the other? The search, at any price, for homeostasis? For self-regulation? The reduction, then, in the machine, of the effects of movements from/toward its outside? Which implies reversible transformations *in a closed circuit,* while discounting the variable of time, except in the mode of *repetition of a state of equilibrium.*" She is dying to run away.

Hunting for the abstract principles of organization and an organized life, cybernetics was supposed to be introducing unprecedented opportunities to regulate, anticipate, and feed all unwelcome effects back into its loops. It also exposed the weaknesses of all attempts to predict and control. Cybernetic systems enjoy a dynamic, interactive relation with their environment which allows them to feed into and respond to it. Feedback "involves sensory members which are actuated by motor members and perform the function of *tell-tales* or *monitors*—that is, of elements which indicate a performance. It is the function of these mechanisms to control the mechanical tendency toward disorganization; in other words, to produce a temporary and local reversal of the normal direction of entropy." It is also the inevitable function of these mechanisms to engage and interact with the volatile environments in which they find themselves. "No system is closed. The outside always seeps in . . ." Systems cannot stop interacting with the world which lies outside of themselves, otherwise they would not be dynamic or alive. By the same token, it is precisely these engagements which ensure that homeostasis, perfect balance, or equilibrium, is only ever an ideal. Neither animals nor machines work according to such principles.

Long before Wiener gave them a name, it was clear that cybernetic systems could run into "several possible sorts of behaviour considered undesirable by those in search of equilibrium. Some machines went into runaway, exponentially maximizing their speed until they broke or slowing down until they stopped. Others oscillated and seemed unable to settle to any mean. Others—still worse—embarked on sequences of behaviour in which the amplitude of their oscillation would itself oscillate or would become greater and greater," turning themselves into systems with "positive gain, variously called *escalating* or *vicious* circles." Unlike the negative feedback loop which turns everything to the advantage of the security of the whole, these runaway, schismogenetic processes take off on their own to the detriment of the stability of the whole.

Undermining distinctions between human, animal, and machine, Wiener also challenged orthodox conceptions of life,

death, and the boundary between the two. Were self-governing machines alive? If not, why not? After all, they were certainly not dead matter, impassive and inert. And, since many life-forms were less sophisticated than automatic machines, the status of being alive could not simply be a matter of complexity.

Only by reverting to some notion of essences was it possible to distinguish between the liveliness of an organism and that of a machine. In principle, neither was more or less dead or alive than the other. Life and death were no longer absolute conditions, but interactive tendencies and processes, both of which are at work in both automatic machines and organisms. Regardless of their scale, size, complexity, or material composition, things that work do so because they are both living and dying, organizing and disintegrating, growing and decaying, speeding up and slowing down. "Every intensity controls within its own life the experience of death, and envelops it." Either extreme can be fatal, and in this sense systems do die in a final and absolute and final sense. "Death, then, does actually happen." But it is not confined to the great event at the end of life. This is a death which is also "felt in every feeling," a death which "never ceases and never finishes happening in every becoming." All living systems are dying: this is the definition of life. Something that lives is something that will die, which is why "the hint of death is present in every biological circuit."

"And I am just the person to drop off some fine day when nobody knows anything about the matter or expects it . . .

"Do not fancy me ill. I am apparently very well at present. But there are the seeds of destruction within me. This I know.

"Though it may only develop by hairs' breadths . . ."

Ada Lovelace, December 1842

Whether a system comes to an end as a consequence of too much or too little activity, its particular elements will be redistributed and rearranged within some new system which emerges in its wake. In this sense, Wiener also undermined the extent to which any working system can consider itself to be an individuated entity with some organizing essence of its own. It is not only at its demise that a system's components connect with others and reconfigure: they are always doing this. Just as the steersman was both an autonomous, self-regulating system, and also the governing element in a new autonomous, self-regulating system which he composed together with the ship, so Wiener's systems had no absolute identity. Continually interacting with each other, constituting new systems, collecting and connecting themselves to form additional assemblages, these systems were only individuated in the most contingent and temporary of senses.

Economies, societies, individual organisms, cells: At these and every other scale of organization, the stability of any system depends on its ability to regulate the speeds at which it runs, ensuring that nothing stops too soon, goes too slow, runs too fast, goes too far. And there is always something hunting, trying to break the speed limits necessary to its organized form, tipping over a horizon at which point, even though another, long-term stability may emerge on the other side, it can no longer be said that the system survives. Nothing can guarantee a system's immunity to these runaway effects. Invulnerability would be homeostasis, an absolute and fatal stability. This is what it has to seek, but also something it attains only at the price of its own demise.

"If the open system is determined by anything, it is determined by the goal of STAYING THE SAME." Systems com-

mitted to the maintenance of equilibrium are always holding back, and always in danger of running away. "Only when the system enters positive feedback does this determination change." At which point it also becomes clear that running away is what they were always trying to do: "Feedback tends to oppose what the system is already doing." It is this prior exploratory tendency which negative feedback tries to resist: "All growth is positive feedback and must be inhibited." It is only after the emergence of regulatory checks and balances that systems can then find themselves out of control, fueled by too much efficiency, overflowing with their own productivity, seeking only to break down or break through their own organization. And "once this exponential process has taken off, it becomes a necessary process, until such a time as second-order negative feedback—just as necessarily—brings the runaway processes to a halt so that the system as a whole may survive by qualitative change (revolution)." Positive feedback has to run its inexorable course, and every attempt to confine it will merely encourage its tendencies toward either destruction or qualitative change. "When the ecosystem is subjected to disturbances that go beyond a certain THRESHOLD, the stability of the ecosystem can no longer be maintained within the context of the norms available to it. At this point the oscillations of the ecosystem can be controlled only by second-order negative feedback: the destruction of the system or its emergence as a metasystem." Running toward the limits of its functioning, it will either collapse or exceed this threshold and reorganize on its other side. "Any system-environment relationship that goes outside the 'homeostatic plateau' results in the destruction of the system—unless, that is, it can adapt by changing structure in order to survive." Which may well amount to the same thing.

" 'The hour has come for you to live, Hadaly.'

" 'Ah, master, I do not wish to live,' murmured the soft voice through the hanging veil."

Villiers de l'Isle Adam, *L'eve future*

"I always feel in a manner as if I *had* died," wrote Ada, "as if I can conceive & know *something* of *what* the change is. That there is some remarkable tact & intuition about me on the subject I have not a doubt . . ." Hadaly, Ada, wrapped around each other . . . neither something nor nothing, dead nor alive. Missing in action. Absent without leave.

What gives a cyborg its autonomy and separates it off from its environment is not some ineffable quotient of soul or mind, or even fixed boundaries surrounding it. And while Wiener found it easy to consider each cybernetic system in relatively isolated terms, when cybernetics reemerged at the end of the twentieth century, it was not so easy to draw these lines. Blossoming into theories of chaos, complexity, connectionism, and emergent and self-organizing networks, Wiener's relatively simple and self-contained cybernetic systems could no longer be confined to circuits such as those connecting the pilot and the ship, but incorporated all and any of the elements which compose them, and those with which they come into contact: eyes, hands, skin, bones, decks, rails, wheels, rudders, maps, stars, currents, winds, and tides. It encompasses a literally endless list of components working together at an equally endless variety of interlocking and connecting scales. Systems such as these are not merely composed of one or two loops and a governor, but a myriad of interacting components too complex and numerous to name.