

REFERENCES

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Out of Control

The New Biology of Machines, Social Systems, and the Economic World

Kevin Kelly (Perseus, 1994)

In *Out of Control*, Kevin Kelly delivers what one would expect from the executive editor of *Wired* magazine: a romp through some of the most intriguing territory at the boundary of technology and culture. The book is not science and, to Kelly's credit, does not purport to be. Nor is it a set of recommendations for managers, though thoughtful managers could surely deduce advice from it. Rather, *Out of Control* is an extended piece of science journalism. As journalism, the book belongs closer to the editorial page than the news page; strong opinions and a thesis that borders on an agenda bind the book together.

Kelly's central thesis is deceptively simple. The made and the born, he argues, are becoming indistinguishable. Human-made artifacts—from machines to economic systems—are increasingly biological in character, and organisms are increasingly engineered. As systems made by humans become more complicated, we must learn and rely on nature's tricks for managing such systems. Indeed, "managing" is probably a poor choice of a word. "Vivisystems," be they organisms, ecologies, economies, corporations, or computer networks, are better shepherded than managed. To be vital and successful, they must remain, at least to some degree, out of our control. In the future, Kelly suggests, we humans will evolve our complex systems rather than design them. This applies to our vaccines, our software programs, our appliances, and even our cartoon characters.

To marshal support for his thesis, Kelly patrols some of the oddest frontiers of science and technology. He reports from a robot battlefield in San Francisco, Biosphere2 in Arizona, Xerox's Palo Alto research lab, a manufactured prairie in Illinois, a computer hackers' conference, a war-simulation center near the Pentagon, the Santa Fe Institute, and

countless other venues. Conversations with scientists, lay descriptions of their work, and interpretation of the research make up the bulk of the book. While the scientists themselves certainly comprise an interesting rogues' gallery, Kelly focuses much less on their personalities and histories than, say, Mitchell Waldrop does in his widely read *Complexity* (Simon & Schuster, 1992). The emphasis, instead, is on building Kelly's argument. Anyone working at the intersection of the biological and the engineered is a candidate for inclusion in the book. Kelly does not focus on complexity *per se*, but the (regrettably) elastic definition of "complexity" makes it inevitable that most of the main characters are addressing complexity by someone's definition.

From his travels, Kelly pieces together a highly entertaining menagerie of examples. He writes vividly, often finding simple metaphors that illuminate complicated concepts. His comparison of evolution to a search through a vast library of all possible books, for instance, is especially effective. I laughed out loud at a number of Kelly's stories, including his attempt to resolve an old philosophy puzzle—what color is a chameleon on a mirror?—by an experiment with a real chameleon. His descriptions of scientific research seem simple but, by and large, accurate. I am familiar with the work of a number of the scientists he profiles, and, at least of their work, he provides a fair account. Kelly's failure to give detailed references left this academician very uneasy, but at least he supplies a useful annotated bibliography.

Simply as an accurate and entertaining depiction of cutting-edge research, *Out of Control* deserved a reader's attention when it was first published in 1994. Five years later, the cutting edge has moved a bit, and parts of the book feel dated. This is particularly true of the chapters concerning the economy. Predictions concerning the coming of the Internet, flexible manufacturing, mass customization, and knowledge-based competition are not as eye catching as they were in 1994. Now, the book must make some stronger claim for a reader's time.

The book would still command attention if its central thesis were absolutely compelling. On one hand, Kelly does make a convincing case that biological approaches such as artificial evolution are powerful ways to develop and manage complex systems. His proposition, however, is that only a biological approach can work. At times, his claims border on wild speculation. To wit: "Two hundred years from now, artificial adaptation—tamed, measured and piped into every type of mechanical appara-

tus we have—will become the central organizing force in our society” (p. 298). The human designer plays little role, then, in creating complex systems. He or she only designs the evolutionary process that develops the system or, better yet, designs the process that evolves the evolutionary process. Kelly does not provide enough evidence to convince me of such a distant vision.

The book would also deserve continued attention if it demonstrated how to write responsibly about complexity in the popular press. Relative to its peers, *Out of Control* earns high marks in this regard. Kelly does not rush headlong, as some authors do, to make managerial recommendations on the strength of metaphorical parallels between biological systems and human organizations. Modestly, he describes himself as a “science-groupie” (p. 457), not as a scientist, and he classifies his book along with other “armchair attempts to weave a coherent big picture together” (p. 454). Occasionally, Kelly makes a dizzying leap from the biological to the artificial, reasoning that something which works in nature must be best for human-made systems. In comparison to other writers in his genre, however, he does this rarely.

Beyond its responsible writing, however, *Out of Control* continues to deserve attention for two more substantial reasons. First, even when it does not compel, it does provoke. At many points in my reading, I found myself struggling, productively, to understand why I disagreed so vehemently with Kelly. Second, the book accurately captures the energy of complexity theory’s youth. Newcomers who wonder “What’s all the excitement about?” would do well to start with *Out of Control*, albeit with a skeptical eye. It truly conveys an appropriate sense of intellectual adventure and discovery.

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