Foreword to Living Control Systems II

Living Control Systems I & II
are collections of selected papers by
William T. Powers
published in 1989 and 1992, respectively

Foreword by W. Thomas Bourbon

In 1979, Bill Powers wrote a prophecy: "A scientific revolution is just around the corner, and anyone with a personal computer can participate in it.... [T]he particular subject matter is human nature and in a broader scope, the nature of all living systems. Some ancient and thoroughly accepted principles are going to be overturned, and the whole direction of scientific investigation of life processes will change." (William T. Powers, "The Nature of Robots: Part 1: Defining Behavior," *BYTE* 4(6), June, p. 132) Powers foresaw the overthrow of the idea that either stimuli from the environment, or commands from the mind or brain, are sole causes of behavior. In its place, he offered the concept that people (and in their own ways all other organisms) intend that they will experience certain perceptions and behave to cause the perceptions they intend. The social, behavioral, and life sciences had simply missed the fact that living things control many features of their environments. Powers acknowledged that fact, and he realized that to an organism the environment exists only as perceptions, hence his insight that organisms act to control their own perceptions. His formal statement of the new concept was control theory, and he said amateurs, working with personal computers on their tables at home, would be major players in the revolution. Thirteen years later, the revolution is not accomplished, but it is underway.

Powers' perceptual control theory is new, but he is not the first to describe many of the key ideas in the theory. Over 2200 years ago, Aristotle wrote about intention—"that for the sake of which," the desire or wish that causes actions that result in a particular end. Aristotle used many examples in which a person acts to produce an intended object, such as a bed, statue, tray, or house. The person's intention to create the object is the "final cause" of the actions that produce the object. Aristotle wrote that, depending on the condition of the world and the intention of the person, the same actions sometimes produce different ends, and different actions sometimes produce the same end. All of that sounds like good control theory, so why are those ideas considered revolutionary today?

For many centuries, Aristotle's ideas disappeared from Europe and were preserved by scholars in the Arab world. They returned, in altered form, to a Europe dominated by Christian theology. Theologians changed "final cause," which to Aristotle often meant only a person's intention to manufacture a bed out of wood, into God's original plan for the linear unfolding of history, from creation, to Calvary, to Apocalypse, to the end of time. Aristotle's original idea was unrecognizable.

Most early European scientists worked within Christian theology, embracing its notion of linear time and its implication of linear cause and effect. Many of these scientists mistakenly assumed that the original concept, that a final cause is a goal, implied that the future influences the present—a clear violation of the assumed linear flow of cause and effect. Eventually, potentates of The Church and potentates of Science came to a falling out over dogma. Those who established the canon for Science had yet another mistaken reason to reject final cause: they said it represented an appeal to the supernatural, in the form of God as agent. The idea that there is purpose or intention in the behavior of any living thing was pronounced "unscientific." Most aspiring behavioral and biological scientists still affirm that credo.

When William James wrote one hundred years ago, the ideas of purpose and intention were popular again. James said purposive behavior is the distinguishing feature of intelligence—of life. He said that in a variable world an organism's behavior necessarily varies to produce unvarying intended results. James wrote that people do not intend their specific actions; they intend to experience perceived consequences of their actions, then they vary their actions any way necessary to produce those perceptions. For a while, it looked as though the idea of intention might take hold, but once more the idea was purged from the sciences of behavior and life. Orthodox scientists asserted that intention implies final cause, which necessarily implies an appeal to supernatural forces and to a temporal reversal of causality. Purposive behavior was banished, on the one hand by behaviorists, environmentalists, and reflexologists who claimed that events in the environment determine behavior, and on the other by those who claimed that instincts acting as internal stimuli cause behavior. People on either extreme believed their positions were dramatically different, but they all portrayed behavior as the end result of a linear chain of cause and effect.

Powers writes at a time when purpose and intention remain unacceptable to most scientists. Behaviorists still believe environmental "stimuli" have the "power" to control behavior; and most cognitive scientists and neuroscientists say the mind-brain issues "commands" that cause muscles to produce appropriate behavior. Cognitive-neuroscientists frequently claim behaviorism is dead and a cognitive revolution has swept the behavioral and life sciences; in return, behaviorists pronounce themselves very much alive, and some portray cognitive theorists as "creation scientists," bent on keeping alive the concept of soul-as-mind. Once again, each camp believes its views differ markedly from those of the other, but both embrace the wearisome model of linear cause and effect—a model that was necessary a few hundred years ago to establish the physical sciences, but a model that mistakenly rejects what Powers recognizes as the defining properties of life. Neither wing of the cause-effect orthodoxy recognizes the abundant evidence that organisms control many parts of their world. But revolutions have a way of changing the minds of the orthodox.

Powers turned the millennia-old idea that living systems act to produce intended perceptions into a formal theory of behavior: perceptual control theory. Perceptual control theory identifies behavior as the necessarily variable means by which organisms control their perceptions of the world. Working first on a build-it-yourself computer (the one he used when he wrote his prophecy), then on a first-generation IBM personal computer, Powers created elegant demonstrations in which the simple-idea-turned-formal-model generates remarkably accurate quantitative simulations and predictions of behavior and its consequences. He identified a first principle for behavioral, social, and life sciences and showed the way to a new foundation of theory and method.

For several years, only a few people followed Powers' lead, and even fewer gathered the data and performed the modeling that could establish control theory as an alternative to traditional science. But interest in the theory grew—a tribute to the dogged efforts of William and Mary Powers, over three decades, to maintain the visibility of the theory. During most of that time, Powers published only one book and a few papers. More recently, information about control theory burst into wider circulation through two functions of personal computers that no one predicted in 1979: desktop publishing and electronic-mail networks. Those applications freed perceptual control theory from the heavy hands of editors and reviewers who routinely rejected manuscripts on the theory. They were true defenders of cause-effect orthodoxy, rejecting control theory as uninteresting and unnecessary, or as merely another way to describe things that were already understood. The new media let many people see control theory, then judge it on its own merits. The once-small circle of people aware of the theory grew into a network spanning the world, including people from many disciplines, specialties, and professions. And the demand for Powers' writings grows.

In the Foreword to the first volume of Living Control Systems, Richard Marken wrote about the difficulty he experienced several years ago when he tried to locate published material by Powers. Volume I was a collection of Powers' published work But Powers has written far more than he has published. When he writes, Bill does not revise his drafts. If he encounters a block or is dissatisfied, he starts over. He has cast aside several beginnings of books and many drafts of chapters and papers that he never submitted, or that were rejected by editors and reviewers. Most of us would be happy if any of our publications equalled the quality of the work Bill put away in drawers and boxes and, more recently, on disks.

Over the years, only a few people have had a chance to read parts of Bill Powers' unpublished work. The opportunity to rummage about, looking for those gems, was at least part of "that for the sake of which" some of us travelled to his "laboratory" in the back room of his home in Northbrook, Illinois. When Mary and Bill decided to move to Colorado, Edward Ford, a counselor in Arizona, suggested that the mandatory gathering of possessions into boxes provided an excellent chance to select part of Bill's unpublished work for an edited volume. Greg Williams, a frequent visitor to Northbrook, journeyed there from Kentucky for the last time to gather the pages and disks and take them away so he could select the pieces in this volume.

This volume contains a small sample of the previously unpublished material from the years when Bill and Mary Powers were in Northbrook. If you want to rummage through the next accumulation, you must travel to the new site of The Laboratory of William T. Powers. That is the locus of many of today's clearest insights into purposive behavior. Over the millennia, that locus has moved from Aristotle's Lyceum, to James' Harvard, to Northbrook, and now to a house atop a ridge near Durango, with a view of the San Juan Mountains, located only a few miles away, across a broad valley—a view that, years ago in Illinois, Mary and Bill Powers said they intended to see out their back door. Stated intention, actions, and perceived consequences that match the intention. It looks like control to me!

W. Thomas Bourbon
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On the Phenomenon of Control. In the foreword above, I sketched a history of the often-rejected idea that living things act to control their own experiences. There is also a long history of devices that mimic control by a person. In classical times, observers of manufactured control devices often identified them as "mysterious" or "miraculous." There were lighted lamps in which the wicks and oil were never consumed, and vessels in which, no matter how much was consumed, the levels and flows of water or wine never changed, and statues that seemed to move of their own accord. The "miraculous" phenomenon of control was there for all to see, but the ingenious devices that actually controlled were hidden from view and the principles of control went unrecognized.

Centuries later, the metaphor of the machine was dominant in European thought. People were compared to lineal machines, embodying discrete, sequential cause and effect. The idea that people *resemble* machines soon gave way to the still-popular assertion that people *are* lineal cause-effect machines. Overextended metaphors aside, the design, and eventually the theory, of control devices moved on, from a variety of hydraulic and mechanical governors and regulators in the 1600s and 1700s, to electronic controllers in the 1920s and 1930s. Today, control devices are ubiquitous, yet most people who say a person is a machine (probably a computing machine), mean people *are* lineal cause-effect machines, not controllers or regulators.

To most people, the phenomenon of control typically goes unnoticed or unacknowledged, whether the controller is a living system, or an ingenious device. Control: it is everywhere, and everywhere it is denied.

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University of Texas Medical School-Houston