

Remembering Thomas P. Hughes

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Whenever I receive inquiries about the effects of technological change on American society, my response is to steer students away from the hype and embellishment of today's tech writing, which has drained words like "innovation," "progress," and "advancement" of meaning. Instead, I ask them to read and reread the work of historian Thomas P. Hughes, who died in February 2014 at the age of ninety. Hughes helped to found two related disciplines: the history of technology and the sociology of technology (and its misunderstood sibling, science). He was revered by scholars but largely unknown outside academia; the *New York Times*, for instance, failed to run an obituary. Hughes's work exhibited a rare capacity to build meaningful bridges between academic silos and, although he never found a wide audience, to address the broader public without condescension, dumbing-down, or weakly tying his content to fleeting enthusiasms.

Thomas Parke Hughes was born in 1923 in Richmond, Virginia. He served in the U.S. Navy during the Second World War, then studied mechanical engineering at the University of Virginia, where he also earned a Ph.D. in modern European history in 1953. Over the next two decades, he received several fellowships and grants, including a postdoctoral Fulbright spent in Germany, and held positions at M.I.T., Johns Hopkins University, and Southern Methodist University. While at SMU, he wrote his first book, a biography of the inventor Elmer Sperry. He would go on to write four more books himself and to edit seven others, sometimes with his wife Agatha Chipley Hughes. He alighted upon the University of Pennsylvania in 1973 and remained there for more than two decades before becoming a professor emeritus in 1994. He was a founding member of the Society for the History of Technology, served as its president, and received its highest accolades—the Dexter Prize for outstanding books (twice) and the Leonardo da Vinci Medal for contributions to the history of technology—among his many other professional honors and awards.

I counted Professor Hughes as a mentor and a friend, although I was never his student—unlike many of today's important analysts of technology and society, such as Janet Abbate, author of *Inventing the Internet*

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SPRING 2014 ~ 103

(1999); Gabrielle Hecht, author of the award-winning book *The Radiance of France* (1998); Alex Soojung-Kim Pang, author of *The Distraction Addiction* (2013); and John M. Staudenmaier, for many years the editor of the journal *Technology and Culture*. My own relationship with Hughes was more idiosyncratic and one-sided: I asked him periodically for assistance in parsing the raw and cooked material of history, and he obliged with wisdom and good humor. We first met in the early 1990s, when I approached him for guidance on my biographical study of Vannevar Bush, the electrical engineer and author of the 1945 presidential report *Science, the Endless Frontier*. (Hughes generously reviewed my book when it was published.) On that first meeting, twenty years ago, Hughes displayed a gracious manner that seemed rooted in a bygone time—perhaps the genteel Virginia of his pre-war youth. Hughes nourished my own curiosity about the process of historical research, and the role of individuals in crafting the shape of emerging technological systems. We would later converse about information technology when I was a journalist covering Silicon Valley in the late 1990s, and he always evinced the levelheaded scholarly capacity to put the latest techno-mania into context.

The Social Construction of Technology

Professor Hughes saw American history as technologically centered. More than anyone else, he sought to reinterpret the American experience as one that aspires to a “second creation,” in the tradition of Francis Bacon—who, Hughes wrote, saw technical knowledge and ability “as a way to recover from the Edenic Fall and to regain a paradise characterized as within the reach of all men.” In the opening passage of his 1989 masterpiece *American Genesis: a Century of Invention and Technological Enthusiasm, 1870–1970*, Hughes writes:

By 1900 [Americans] had reached the promised land of the technological world, the world as artifact. In so doing they had acquired traits that have become characteristically American. A nation of machine makers and systems builders, they became imbued with a drive for order, system, and control. . . . Foreigners have made the second discovery of America, not nature’s nation but technology’s nation.

Hughes never sought to traffic in current affairs. He eschewed the practice of fetishizing personalities and individual inventors, even when he was studying individuals, instead concentrating on how larger social and technological patterns were structured and persisted. He and his fellow-

travelers, particularly the sociologists Wiebe E. Bijker and Trevor Pinch, sought to reconceive some of the core categories of technological change. Rather than just focusing on an inventor's idea for a new or improved technology and how it supplanted what preceded it, Hughes, Bijker, and Pinch urged scholars to think of invention, design, and the complex interplay between engineering and science as “socially constructed”—that is, as being shaped by, and in turn shaping, the wider social world of institutions, politics, economics, and culture.

A landmark 1987 collection of essays assembled by Hughes, Bijker, and Pinch, *The Social Construction of Technological Systems*, includes an important essay in which Hughes explores the crucial concept of technological systems—which were, for him, the primary means of understanding technological change, as well as history, politics, and culture. Technological systems, he wrote, of course include physical artifacts (which we normally associate with technology), but also can include organizations, “legislative artifacts,” and even natural resources. Hughes also argues that “radical inventions inaugurate new systems.” So, to choose a familiar example, the invention of the telephone resulted in the creation of major new businesses and the construction of a new kind of communications infrastructure, transformed commerce and public and private life, and created a host of issues that required political attention, with people and companies having countless complicated and competing interests. Some or all of this complex web could be considered the technological system arising from the telephone, depending on how narrowly or broadly a given historian wants to analyze the subject.

This “systems” thinking elevated the study of technological change, drawing the attention of leading sociologists in Europe. Hughes and other likeminded scholars combined the sociological and the historical studies of technology into a tasty, nourishing gumbo we today know as science and technology studies (STS).

The basic questions of STS arise from reflection on the human condition: Do machines drive men or do men drive machines? Does history shape technology or does technology shape history? Marx and Engels famously wove together capitalism, technological change, and historical determinism in the *Communist Manifesto*, presenting the forces of technology as unstoppable:

The bourgeoisie cannot exist without constantly revolutionizing the instruments of production, and thereby the relations of production, and with them the whole relations of society. Conservation of the old

modes of production in unaltered form, was, on the contrary, the first condition of existence for all earlier industrial classes. Constant revolutionizing of production, uninterrupted disturbance of all social conditions, everlasting uncertainty and agitation distinguish the bourgeois epoch from all earlier ones. All fixed, fast-frozen relations, with their train of ancient and venerable prejudices and opinions, are swept away, all new-formed ones become antiquated before they can ossify. All that is solid melts into air....

But Hughes saw Marx as only partially correct in his insistence that the modes of production dictated ways of living and thinking across all human realms. Hughes understood that change worked in the other direction as well—that ways of life could influence the means of production. Hughes reconceived the complex relationship between technology and culture, between machines and the humans who build them, and brought attention to the sometimes surprising ways in which technology and society shaped each other.

Technological innovations may destroy ways of life, but ways of life also impose constraints on both how we imagine potential new technological advancements, and how we receive those innovations when they in fact come to fruition. Societies alter and even reject technologies for an endless variety of reasons, including some that have nothing to do with the material nature of the technology itself. In short, the new does not always inevitably or fully overwhelm the old. On this point, Hughes applied the helpful term *momentum* to the well-documented persistence of older technologies, like the QWERTY (standard) keyboard or radio. “Mature systems,” Hughes wrote, “have a quality that is analogous...to inertia of motion. The large mass of a technological system arises especially from the organizations and people committed by various interests to the system.”

Postmodernity and Optimism

Though Hughes sympathetically captured the American zeal for innovation, he also sought to give full credence to informed critics of technology. According to Hughes, these twin poles—embrace of the new and wariness of where the new would take us—provided the foundation for what made, and makes, America exceptional in global terms. While Hughes was known especially for his work on technological systems, he was highly aware of how culture can work on technological change, altering its character and profoundly shaping the outcomes of seemingly

unstoppable progress. Systems come undone, and not only because of the “creative destruction” described by economists—the powerful interaction of capitalist and technical forces that assault the status quo. Culture both shapes and ratifies technological systems; but so can cultural resistance at times halt the forward motion of the machine.

In the 1960s and 1970s, culture also meant *counterculture*. To Hughes, the opposition to nuclear power and the advent of environmentalism marked the end in the United States of a century of technological enthusiasm, of nearly unqualified admiration for and acceptance of a staggering range of radical new machines and systems. The “jeremiads of the counterculture,” historian Arthur Molella has observed, led Hughes by the mid-1990s to ask, “what kind of world have we made in our Faustian bargain with technological power?”

In the latter part of his career, Hughes was increasingly persuaded that older, centralized, top-down styles of technological systems would not regain their momentum in American life. In *Rescuing Prometheus*, published in 1998, Hughes recounts the stories of four post-World War II U.S. mega-projects: the Semi-Automatic Ground Environment, a computerized radar and air defense network; Atlas, the first intercontinental ballistic missile; the Advanced Research Projects Agency Network (ARPANET), a precursor to the Internet; and, perhaps surprisingly, Boston’s Central Artery/Tunnel Project, better known as the “Big Dig.” His purpose was to chart the transition from the older, centralized, “modern” projects to what he considered “postmodern” technological systems, which demand public participation, decentralized and open decision-making, and smaller-scale subsystems that jibe better with the human scale. While the first two projects he focused on were essentially modern, the latter two, ARPANET and the Big Dig, were “in no small part” defined by “counterculture values that spread in the 1960s,” making them paradigmatic of a postmodern style. In the case of the Big Dig, the style of management and engineering were dictated not by technology and economics but by constant public input, making it “a messily complex embracing of contradictions.” And ARPANET, both as a project and an artifact, exemplified the postmodern characteristics of a horizontal and distributed structure rather than a vertical and centralized one.

The American belief that bigger means better had broken down, and Hughes found that putting restored confidence in the old model was not possible. Alienation from large technological systems, even when buffeted by contradictory attitudes, had become profound. Technical fixes to social problems, once viewed as the sure path to salvation by American

elites, were now seen to risk generating new problems that required new fixes. This attitude led to the impression, if not the reality, that the future required constant unsteady juggling and balancing of one “fix” after another. “This distrust of government and technology focused not only on military technology but also on large-scale technology in general,” Hughes concluded. “Hierarchy, bureaucracy, and governance by experts fell into disfavor.”

So might there be a way, as the book’s title suggests, to rescue Prometheus? Is there a way to revive wide acceptance among Americans of a future highly influenced, if not completely determined, by mega-systems and technoscientific advance? That question animated Hughes’s final years. His growing awareness of environmentalism and sustainability brought him to reconfigure his thinking in a manner that led Arthur Molella to note, “we are witnessing the greening of Thomas Hughes.” Basically optimistic about the capacity to restore science and technology to their rightful place in the sociopolitical pantheon, Hughes in his final book *The Human-Built World* (2004) advanced an approach he called “ecotechnological,” which consists of bringing together various parties to build and protect “intersecting and overlapping natural and human-built environments.”

Impressed with the culture arising from the Internet, Hughes imagined a spread of “technological literacy” that would restore vitality and coherence to mass-democratic efforts to tame technological systems. As technological literacy rose, postmodern systems would come to serve human ends and the public good, “allow[ing] the public to effectively monitor and exercise control directly, or through their political representatives, over scientific and technological developments, even complex ones.”

The democratic ideal remains elusive in the politics of technology and science—for very good reasons, some might insist, as our dependence on expertise has not diminished. But the American rendezvous with freedom ultimately led Hughes to align with the techno-utopians. In the face of staggeringly complex modern systems and mega-machines whose flaws were to be remedied by even larger-scale technological systems, Hughes found solace in the notion that, if technologies are “socially constructed” then “the public, through organizations and as individuals, can make choices about the characteristics of the technology they use and the effects that it will have upon them.” His call for “a change in values and an activist stance toward technological change” may seem unequal to the challenges at hand. But Hughes insisted that we not resign ourselves to determinism, to the belief that technoscience only acts upon us. We need not be its victims, though neither are we certain to become its masters.