BOOK REVIEWS

How I Learned to Stop Worrying and Love the Bomb, the Nuclear Reactor, the Computer, Ham Radio, and Recombinant DNA

BY CYRUS C. M. MODY*

Atsushi Akera. *Calculating a Natural World: Scientists, Engineers, and Computers during the Rise of U.S. Cold War Research*. Cambridge, MA: MIT Press, 2007. ix + 427 pp., illus., index. ISBN 978-0262-01231-7. $40 (hardcover).

Mark D. Bowles. *Science in Flux: NASA's Nuclear Program at Plum Brook Station, 1955–2005*. Washington, DC: National Aeronautics and Space Administration, 2006. xxix + 335 pp., illus., index. NASA SP-2006-4317. $0 (digital) or $49 (hardcover).

Kristen Haring. *Ham Radio's Technical Culture*. Cambridge, MA: MIT Press, 2007. xvii + 220 pp., illus., index. ISBN 978-0262-08355-3. $27.95 (hardcover).

Scott Kirsch. *Proving Grounds: Project Plowshare and the Unrealized Dream of Nuclear Earthmoving*. New Brunswick: Rutgers University Press, 2005. xi + 257 pp., illus., index. ISBN 978-08135-3666-8. $39.95 (cloth).

Eric J. Vettel. *Biotech: The Countercultural Origins of an Industry*. Philadelphia: University of Pennsylvania Press, 2006. xv + 273 pp., illus., index. ISBN 978-08122-3947-8. $39.95 (hardcover).

Humans on the moon. An elevator to orbit. Digital computers. Intelligent electronic brains. Decoding the "book of life." Immortality. Splitting the atom. Energy "too cheap to meter." Space stations. Space colonies. Manipulating the weather. Manipulating climate. Check, check, and check.

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Wait a minute! As it turns out, only some of those things have come to pass. Yet during the Cold War, all of them seemed not merely possible but likely, given sufficient mobilization of people and resources. Evidence of mobilization was everywhere, from the Manhattan Project to the space race to the civil rights movement to the "wars" on poverty, drugs, and cancer. Mobilization was almost demanded by the logic of the Cold War: each superpower was acutely aware that *not* pursuing even the most outrageous visions could result in a victory for the other side.

The grandiose ambitions of the Cold War have long provided fodder for historians of science and technology. Indeed, "Big Science"—one blanket term for this era—refers to large-scale mobilization.[1] Everything in the Cold War was bigger: experiments, labs, budgets, academic departments. Grand plans for future projects were *much* bigger. If you could build a fission weapon, why not a fusion bomb? If Fermilab and CERN, why not the Superconducting Supercollider? If you could decipher one gene, why not the whole genome?

The breathtaking scope of Cold War ambitions continues to be uncovered by new studies—including, but not limited to, the ones reviewed here. What emerges from this research is the seemingly astonishing "otherness" of the Cold War. This was not the distant past. "Cold Warriors" still control the machinery of government (at least in Russia and the United States), and Cold War institutions still foster science the world over.[2] Yet much of what was common sense in that era only elicits nervous laughter and outrage today. When I explain nuclear earthmoving to my students, for instance, their jaws drop in disbelief. As Scott Kirsch shows in *Proving Grounds*, though, when Edward Teller offered to deploy a nuclear blast to create a harbor in Alaska "in the shape of a polar bear" (49), the response of the state government, academia, and Chamber of Commerce was an enthusiastic "How we can we help make this happen?" Similarly, today the idea that tens of thousands of people could be displaced and hundreds of nuclear devices detonated to clear a sea-level Panama Canal seems appalling and surreal. But for the Johnson administration, Teller's "geographical engineering" wasn't a pipe dream. It was an effective carrot and stick to persuade South American allies to fall in line.[3]

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1. Peter Galison and Bruce Hevly, ed., *Big Science: The Growth of Large Scale Research* (Palo Alto: Stanford University Press, 1992).

2. John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (Cambridge, MA: MIT Press, 2006), makes clear the lasting, intertwined effects of the Cold War on scientific institutions (e.g., CERN), European integration, and the transatlantic alliance.

3. Just to clarify: during renegotiation of the canal treaty in 1964, "Panama was offered veto power over the use of nuclear explosives if the new canal was excavated [in Panama] but not if it was blasted just across the border in Colombia" (150).

Grandiose plans were certainly not peculiar to the Cold War. Nor did every lofty project come to fruition—Teller, alas, never built his canal. But at least three features of scientific ambition seem particularly distinctive of this era. First, even if a project never got very far, it could still receive millions (even billions) of dollars in funding, and leave behind institutions that could be retrofitted for the next big dream. Second, American scientists and engineers could always appeal for aid by pointing to even more (literally) earth-shattering plans in the Soviet bloc. Third, until the early 1970s the trajectory of science and engineering ambition was almost always forward, never back. If your project got canceled, the proper response was not to scale down, but to offer an even more grandiose and revolutionary vision in its place.

Mark D. Bowles highlights these three features in *Science in Flux*, his study of the National Aeronautics and Space Administration's nuclear reactors at Plum Brook, Ohio. The first proposals in 1952 for NASA's predecessor, the National Advisory Committee on Aeronautics (NACA), to build a research reactor centered on plans for a nuclear airplane. This would have been an astounding vehicle: weighing in at a million pounds, it would have been capable of continuous flight, without refueling, for at least four days at a time, able to accelerate to Mach 2.2 for a nuclear assault on any point on Earth. You and I might have second thoughts about such an undertaking—but as early as 1948 the *New York Times* was confident that the plane was "Ready 99% in Theory" (38).

Of course, many questioned whether such an airplane was feasible or necessary, but nay-sayers were shouted down with rumors that the U.S. was falling behind.[4] The Soviets, it was said, already had a 300,000-pound nuclear plane flying continuously for months at a time. Oddly, these rumors seemed to come from the Air Force, NACA, and "officials from companies who were receiving nuclear airplane contracts" (76). (Coincidence, surely.)

Still, after fifteen years and $1 billion, the nuclear airplane project was shut down in 1961. Why? By then, the Soviet rumors started to look less credible, the engineering difficulties more challenging, and the safety risks more alarming. But also, nuclear airplanes no longer seemed big and bold enough. A nuclear *rocket*, however . . . as President Kennedy put it, that would "provid[e] a means for even more exciting and ambitious exploration of space, perhaps beyond the Moon, perhaps to the very end of the solar system itself" (80). So,

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[4] Oppenheimer's opposition to nuclear aircraft was one reason the Air Force had its daggers out during his security clearance hearing. See Priscilla J. McMillan, *The Ruin of J. Robert Oppenheimer and the Birth of the Modern Arms Race* (New York: Viking, 2005).

many of the facilities built to develop a nuclear aircraft, including the Plum Brook reactors, found new support in NASA's nuclear rocket program.

Atsushi Akera's chapter in *Calculating a Natural World* on Project Whirlwind's bureaucratic travails emphasizes the same tropes. Jay Forrester initially set out to build a digital flight simulator, with the same "Ready 99% in Theory" optimism of the nuclear aircraft and earthmoving enterprises. Yet each attempt to put theory into practice caused Forrester to slip further behind deadline. Akera details the series of reviews used by an increasingly anxious Office of Naval Research (ONR) to pressure Forrester toward tighter budgets, timelines, and goals. Yet Forrester's response was almost never to retrench contritely. Instead, he continually redefined Whirlwind upward, proposing to make the project bigger, more expensive, more versatile, and more cutting-edge.

By 1950, ONR had washed its hands of Project Whirlwind, turning it over to the Air Force to fund. Forrester is often cast as "lucky" that the Air Force just then introduced a gargantuan new project—the Semi-Automatic Ground Environment (SAGE) air defense system—into which Whirlwind could be folded. Yet Forrester made his own luck. By constantly stretching Whirlwind to distance it from the Navy's original objectives, Forrester ensured that he could sell its relevance to a broader range of patrons. Had SAGE not come along, Forrester had plans to turn Whirlwind into an air traffic control system for the Air Force or an anti-submarine tactical command and control system for the Navy. A smooth salesman, Forrester leveraged panic over the first Soviet nuclear test to turn his inability to limit Whirlwind's scope into an attractive feature, not a bug.

Whirlwind survived by becoming bigger and more abstract, unmoored from any particular application or patron. Eric J. Vettel tells a similar story for an entire discipline in *Biotech*, his study of the postwar life sciences at Stanford, Berkeley, and the University of California, San Francisco (UCSF). Vettel opens with a familiar theme of Cold War science: inflating largesse. "In 1946, the PHS [Public Health Service] granted forty-four extramural research contracts. In 1950, the NIH [National Institutes of Health, spun off from PHS] awarded 1,115 extramural grants" (24). The NIH pot for graduate fellowships went from "'a few tens of thousands of dollars' in 1948 to somewhere between $600,000 and $700,000 by 1952." And the number of NIH study sections grew from zero to twenty-one in 1946 to between 250 and 300 the next year.

Things only accelerated after Sputnik, as National Science Foundation support zoomed from $50 million to $133 million and NIH appropriations from $25 million to $135 million. Entrepreneurial academic administrators, such as

Stanford's Frederick Terman, knew from wartime experience of overhead contracts that these appropriations could be siphoned for institutional infrastructure. But this required faculty who banded together into research networks capable of applying for large grants to build gleaming new laboratories. Thus Terman schemed to do away with Stanford's older generation of biologists, such as Hubert Loring, and their "profoundly individualistic" (51) outlook and "parochial aversion to federal patronage for [and direction of] scientific research" (53). In their place, Terman recruited people like Arthur Kornberg by promising to airlift into Stanford all the faculty (most of them Kornberg protégés) in Kornberg's biochemistry department at Washington University in St. Louis, along with Kornberg's twenty-two-person staff, "including his administrative secretary, laboratory manager, sculptor, and instrument maker" (63). Such a ready-made conglomerate would "protect against the rise of another renegade individualist like Hubert Loring" (62). As a side benefit, this conglomerate could support itself on federal basic research grants and not have to worry about pesky students.

And if a university could do without students, why couldn't a hospital do without patients? Having transformed Stanford's biologists, Terman looked to apply his basic research grant–driven model to the university's medical school, moving it from San Francisco to Palo Alto and restructuring it to serve research interests rather than patients. As Terman's handpicked dean, Robert Alway, put it, "Medical progress now comes not from the bedside but from the laboratory" (58). Joshua Lederberg, begging Terman for a job, affirmed his belief that neither students nor patients should unduly encumber Medical School faculty: "clinical genetics is quite unimportant. . . . [A] medical genetics department is for the education of the faculty more than the students. . . . As for teaching genetics to medical students . . . frankly this is our least important function" (64).

One irony of the Cold War was the strange convergence of different kinds of research institutions. Numerous scholars have described the trend in the 1950s and 1960s of large corporations building research "campuses" for basic science and government labs and think tanks like RAND advertising themselves as "universities without students."[5] At the same time, traditional universities

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[5] Stephen G. Knowles and Stuart W. Leslie, "'Industrial Versailles'—Eero Saarinen's Corporate Campuses for GM, IBM, and AT&T," *Isis* 92 (2001): 1–33; Philip Mirowski and Esther Mirjam-Sent, "The Commercialization of Science and the Response of STS," in *The Handbook of Science and Technology Studies*, ed. Edward J. Hackett, Olga Amsterdamska, Michael Lynch, and Judy Wacjman (Cambridge, MA: MIT Press, 2008), 635–89; Bruce William Hevly, "Basic Research within a Military Context: The Naval Research Laboratory and the Foundations of

encouraged faculty members to get their slice of the research pie, even at the expense of their teaching mission. The flood of federal funding made basic research a sustainable business model for corporate, academic, and government labs. Thus all these organizations competed for basic research dollars, sometimes to the detriment of other organizational objectives.

Of course, universities never succeeded in ridding themselves entirely of students. One weakness of Vettel's analysis is that his focus on the funding bubble deflects attention from a different bubble, that of student enrollment. The Cold War obsession with technical "manpower" drove a leap in science and engineering student enrollment that triggered a qualitative change in academic research methods.[6] Akera does better on this point, showing how research interests and teaching requirements both competed and converged with each other at schools such as MIT and the University of Michigan.[7]

At some institutions, administrators such as Terman viewed a university's duty to provide undergraduate education as antagonistic to its ability to secure research dollars. As a result, even on a conservative campus like Stanford, by the late 1960s students were fed up with institutional neglect and made their voices heard. The story of Bay Area dissent and its relation to science has been told before.[8] Usually these protestors have been portrayed as aggrieved by military sponsorship of academic research. Vettel, though, lays bare a deeper tension. While the federal glut drove some academics toward military sponsors of

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Extreme Ultraviolet and X-ray Astronomy, 1923–1960" (PhD dissertation, Johns Hopkins, 1987); David Hounshell, "The Cold War, RAND, and the Generation of Knowledge, 1946–1962," *Historical Studies in the Physical and Biological Sciences* 27, no. 2 (1997): 237–67.

[6] David Kaiser, "Cold War Requisitions, Scientific Manpower, and the Production of American Physicists after World War II," *Historical Studies in the Physical and Biological Sciences* 33, no. 1 (2002): 131–59.

[7] Akera also shows how organizations, looking for new opportunities amid flux in the postwar "ecology of knowledge," sometimes consciously backgrounded their primary objectives. In the 1940s and 1950s, for instance, IBM and customers such as Lockheed allowed employees to work together on esoteric projects in programming and scientific computing that profited neither organization, but which (it was hoped) would give rise to a market for digital computers and a quasi-professional group of programmers to run them.

[8] Though usually treated as the end of a story, rather than the beginning. E.g., Stuart W. Leslie, *The Cold War and American Science: The Military-industrial-academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993), 241–56; Rebecca S. Lowen, *Creating the Cold War University: The Transformation of Stanford* (Berkeley: University of California Press, 1997), 224–38; David Kaiser, *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics* (Chicago: University of Chicago Press, 2005), 318–55.

research, it drove the rest of academic science away from any applications at all—even those benefiting the general welfare.

Thus, while campus protests often targeted engineers and physical scientists, Vettel contends that the wider, chronic unease about science disproportionately hit the life sciences. For instance, "between 1963 and 1967, virtually all bioscience departments at Berkeley experienced flat or declining enrollments—[up to] a 24 percent drop—while student enrollments in all other academic departments grew—including the physical sciences—generally by an average of 3 to 5 percent each year" (113). In 1967, Senator Walter Mondale, critical of the disparity between "enormously wealthy bioscience research laboratories and understaffed, underfunded, and underappreciated hospitals" (143), struck a stunned Arthur Kornberg with the new common sense: "the lack of public support for your kind of research . . . might stem from this reluctance to carry on a dialog about the real human implications . . . [and] the fact that you have avoided the public" (144).

Critiques of basic research flowed from the left (the ivory tower kept scientists from helping people) and the right (dependence on federal support kept academics from participating in the market). "Even the conservative Republican Barry Goldwater admitted to a stunned Stanford audience that he appreciated any attempt to rein in swollen federal budgets, even if it meant cutting fundamental research sponsored by military agencies" (138). From 1967 to 1975, new science-skeptical social movements and legislators like Mondale and his Senate colleague Mike Mansfield combined to deflate the postwar basic bioscience bubble. In turn, a new breed of charismatic venture capitalists and countercultural life scientists reassembled the discipline in the somewhat more socially responsive and significantly more commercial form we know today.

The story of interest in these books, then, is not so much that of postwar science and the engineering bubble, but the comprehensive deflation of that bubble around 1970, which created many of the dynamics that fuel today's research. The great deflation isn't news, but we still have a sadly inadequate picture of why it happened and what it wrought. Clearly, it had many causes. Economic woes reduced federal support, which led to a crash in employment opportunities for new science graduates and a scramble to secure research patronage from more diverse sources. Détente plus the oil embargo and the rise of the Japanese microelectronics industry shifted attention from military security to economic competitiveness. Thalidomide, *Silent Spring*, Agent Orange, and napalm left Americans unwilling to grant scientists the benefit of the doubt.

And nuclear strategies (and the technological systems that sustained them) became more settled, and the research trajectories underlying them less radical.[9]

In some cases, shifts in technology and commercial strategy prompted the bubble to burst. The early Cold War had seen well-funded crash programs to develop a variety of technologies (e.g., jet aircraft and silicon microelectronics) for military customers. By the late 1960s, firms such as Boeing and Intel had successfully adapted those technologies to civilian markets, thereby pushing aside older technologies that had not received a Cold War stimulus.[10] Communities invested in those older technologies experienced their own deflating bubbles. In Kristen Haring's *Ham Radio's Technical Culture*, for instance, the introduction of integrated circuits (ICs) imperiled ham radio by black-boxing components. In the vacuum tube and discrete transistor eras, new hams gained technical know-how by building and modifying their gear—and with that know-how they gained membership in the ham radio community. ICs, on the other hand, "gave no clues about how they worked or what they did" (148).

At the same time, IC-enabled computers quickly dwarfed ham radio as an emblem of technological prowess. "Hackers replaced hams as the reigning amateur technical pioneers. As a result, the elite, manly reputation . . . of radio hobbyists as militaristic, innovative masters of technology began to crumble" (154). The near-exponential growth in ham licenses (from around 50,000 in 1935 to around 260,000 in 1964) suddenly leveled off from 1964 to 1975 with essentially zero growth. The small ham radio community that remained, retreated into nostalgia by rebuilding designs from the 1930s, trading the sterility

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[9] That is, where the 1940s–1960s period saw wild swings in nuclear strategy pushing (and being pushed by) the introduction of the hydrogen bomb, the air defense network, the ballistic missile, the spy satellite, and the nuclear-capable submarine, the 1970s saw much more incremental changes in both strategy and technology. "Weapons science became routinized . . . increasingly conservative and bureaucratized," says Hugh Gusterson, "A Pedagogy of Diminishing Returns: Scientific Involution across Three Generations of Nuclear Weapons Science," in *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, ed. David Kaiser (Cambridge, MA: MIT Press, 2005), 75–107. That lull would partially come to an end with proposals for space-based missile defense in the 1980s.

[10] For example, the founding of Amtrak in 1971 marks the eclipsing of passenger rail by the Cold War technologies of jet aviation and interstate highways. For the military-funded crash program in jet technology, see Philip Scranton, "Technology-led Innovation: The Non-linearity of U.S. Jet Propulsion Development," *History and Technology* 22, no. 4 (2006): 337–67. For the transition from military to civilian markets in the microelectronics industry, see Christophe Lécuyer, *Making Silicon Valley: Innovation and the Growth of High Tech, 1930–1970* (Cambridge, MA: MIT Press, 2006). Note that Lécuyer's study, like so many others, ends in the transitional year of 1970.

of the IC and the inanity of Citizens' Band (CB) radio for the warm glow (and technical challenge) of the vacuum tube.

By the mid-1970s, though, ham radio enthusiasts co-opted integrated circuitry as their entrée into the new amateur technical community of personal computing. "As employees of technical firms [some 40% of hams had careers in electronics], hams witnessed large-scale computers in operation years before the debut of personal computers and sometimes obtained access for after-hours experimentation. Their existing social-technical community provided a network for pooling ideas" (157). No wonder, then, that ham magazines like *CQ* provided the model (and personnel) for early computer magazines like *Byte* and *Kilobaud*, or that "members of the Homebrew Computer Club and others who advocated for the creation of understandable and interactive computing technology often referred to their background in ham radio" (158).

Not all technical communities transitioned from boom to bust. The bubble of the 1950s and 1960s fed on panic and speculation. New institutions spun out of that panic—but, as Mark Bowles argues in *Science in Flux*, there was little long-term planning for what would happen to them after the panic subsided. In the wake of the Soviets' startlingly quick acquisition of fission and fusion weapons (and later Sputnik), research reactors like Plum Brook were deemed indispensable.[11] But after the American moon landing and as nuclear arms treaties were being signed, the public mood changed—to boredom with the routine of spaceflight, fear of radiation, and annoyance at the largesse of research at the expense of social programs.

Under those conditions, there was little chance the Plum Brook reactors could survive. Indeed, the research reactor bubble popped nationwide: in one twenty-four-hour period in 1973 (June 30–July 1), nearly 3,000 employees at ten nuclear institutions (including Plum Brook) lost their jobs. Yet the irony, as Bowles tells it, is that the bubble's deflation was as wasteful and poorly planned as its inflation. Reactors were simply turned off in the middle of experimental runs. Worse yet, proposals to adapt reactors to the new public mood were written off. Plum Brook's supporters tried to retrofit the NASA reactors to aid the Cleveland Clinic's cancer therapy program or to perform neutron activation analysis for the EPA, yet they were told the facility "could not be saved . . . because it did not fit into the government's new budgetary policy of

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[11] Bowles says that 193 research reactors went critical in the U.S. between 1950 and 1969, compared to only thirty-four before or since. Though the U.S. has always eclipsed the USSR in the number of research reactors (227 to 97 at final count), there was an explicit, and competitive, superpower race to develop reactors with a higher and higher neutron flux.

supporting initiatives with short-term scientific returns" (233). Instead, the reactors were mothballed for twenty-five years (at an expense, by the late 1990s, of $1.4 million annually) and finally decommissioned during the early part of this century at a cost of approximately $160 million—when they could have been decommissioned in the 1970s for less than one tenth of that.

Still, even if the bursting of the bubble was chaotic and undignified, it took courage and determination to bring about. The public didn't suddenly change its mind about Cold War techno-science of its own accord. Rather, a dispersed band of scientists and non-scientists had to build coalitions to reverse the common sense of the early Cold War. Scott Kirsch narrates this process for Project Plowshare, following a rag-tag group of mathematicians, biologists, and geographers working from within the nuclear earthmoving program as they forged connections (with doctors, dairy ranchers, public health officials, First Nations communities, journalists, and scientist-skeptics like Linus Pauling and Barry Commoner) to impede the AEC's grand plans. They were rewarded with academic blacklisting, FBI surveillance, and excoriation in *Science* and *Life*. Yet everywhere Plowshare's supporters set their sights (Alaska, Nevada, Australia, Panama, Mississippi, Colorado), the coalition raised enough questions to transform initial local enthusiasm into opposition. Eventually, all those sites of local doubt joined up at national and international levels to help produce today's attitudes not just about nuclear earthmoving, but about scientific hubris and Cold War gigantism in general.

All of these studies, in fact, show that the early 1970s' decreases in funding and in new science and engineering jobs were co-produced with a dramatic qualitative shift in attitudes. The techno-optimism of the Apollo program yielded to a pessimism embodied by *Limits to Growth* and *The Population Bomb*.[12] Nuclear aircraft and earthmoving became, by consensus, grotesque. The crash of grandiose Cold War plans turned many researchers and counterculture technophiles toward individually transforming technologies such as the personal computer.[13] And academics' dabbling in the market went from an abomination to an oddity to a necessity in just a few years.

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[12] Donella H. Meadows et al., *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (New York: Universe Books, 1972); Paul R. Ehrlich, *The Population Bomb* (Rivercity, MA: Rivercity Press, 1971).

[13] As argued in Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: University of Chicago Press, 2006); and Timothy Moy, "Culture, Technology, and the Cult of Tech in the 1970s," in *America in the Seventies*, ed. David Farber and Beth Bailey (Lawrence: University Press of Kansas, 2004), 208–27.

Too often, historians of science have portrayed the 1970s as the end of the story of the Cold War, or else a hiccup between the High Cold War and the re-energized conflict of the 1980s. These studies show that the 1970s were much more—that the decade had its own logic that endures, in part, today. Historians of science and technology have a good grasp on the 1950s and 1960s, and even some aspects of the 1980s and 1990s are already well understood: biotech and the commercialization of academic research, the Strategic Defense Initiative, nanotechnology.[14] What we need now is a better picture of the intervening developments of the 1970s—of the ways scientists and engineers reined in their ambitions and adapted to stagflation, détente, environmentalism, and the oil embargo, and the ways those constraints engendered a new common sense.

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[14] Typical examples of scholarship on the 1980s and 1990s include: Rebecca Slayton, "Speaking as Scientists: Computer Professionals in the Star Wars Debate," *History and Technology* 19, no. 4 (2003): 335–64; Daniel Kevles, "Big Science and Big Politics in the United States: Reflections on the Death of the SSC and the Life of the Human Genome Project," *Historical Studies in the Physical and Biological Sciences* 27, no. 2 (1997): 269–98; W. Patrick McCray, "Will Small Be Beautiful? Making Policies for Our Nanotech Future," *History and Technology* 21, no. 2 (2005): 177–203; Cyrus C. M. Mody, "Corporations, Universities, and Instrumental Communities: Commercializing Probe Microscopy, 1981–1996," *Technology and Culture* 47, no. 1 (2006): 56–80. For the 1970s, things are a bit thinner, with the notable exception of work on computing and environmentalism in science. E.g., Michael Egan, *Barry Commoner and the Science of Survival: The Remaking of American Environmentalism* (Cambridge, MA: MIT Press, 2007); and Ross Knox Bassett, *To the Digital Age: Research Labs, Start-up Companies, and the Rise of MOS Technology* (Baltimore, MD: Johns Hopkins University Press, 2002).