Science and Technology for Every Man, Woman, and Child

BY JACOB DARWIN HAMBLIN*

Zuoyue Wang. *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America.* Piscataway, NJ: Rutgers University Press, 2008. xiii + 454 pp., illus., index. ISBN 978-0-813-54331-4. $49.95 (cloth).

Lillian Hoddeson, Adrienne W. Kolb, and Catherine Westfall. *Fermilab: Physics, the Frontier, and Megascience*. Chicago: University of Chicago Press, 2008. xi + 497 pp., illus., index. ISBN 978-0-226-34623-6. $45 (cloth).

W. Patrick McCray. *Keep Watching the Skies! The Story of Operation Moonwatch and the Dawn of the Space Age*. Princeton: Princeton University Press, 2008. xiii + 308 pp., illus., index. ISBN 978-0-691-12854-2. $29.95 (cloth).

Michael D. Gordin. *Red Cloud at Dawn: Truman, Stalin, and the End of the Atomic Monopoly*. New York: Farrar, Straus and Giroux, 2009. 416 pp., illus., index. ISBN 978-0-374-25682-1. $28 (cloth).

Dolores L. Augustine. *Red Prometheus: Engineering and Dictatorship in East Germany, 1945–1990*. Cambridge, MA: MIT Press, 2007. xxvii + 381 pp., illus., index. ISBN 978-0-262-01236-2. $43 (cloth).

President Lyndon Johnson's science advisor Donald Hornig once pointed out that, had the post-Sputnik trends in funding continued, every man, woman, and child would be doing research. (Wang, 282) It was a humorous image that masked a serious question: why had science become so all-consuming, when there were plenty of other fruitful ways to spend government money? As we gain further historical distance from that half-century conflict known as the Cold War, quick answers to this question will become less persuasive. Fewer scholars will interest themselves in the specific give-and-take of the arms race or the space race, and more will step back and wonder about the aspirations of

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Historical Studies in the Natural Sciences, Vol. 40, Number 2, pps. 259–267. ISSN 1939-1811, electronic ISSN 1939-182X. DOI: 10.1525/hsns.2010.40.2.259.

scientifically oriented peoples, during the longest, tensest geopolitical crisis in modern history. The books under review already have begun to chart this path. Each shares the same backdrop—the Cold War—but the actors vary: presidential advisors, amateur scientists, high-energy physicists, bomb builders, and industrial engineers. Reading them together provides an absorbing portrait of what the relentless pursuit of scientific excellence and technological abundance meant for governments, for the practice of science, and for regular folks who just happened to grow up in the midst of it.

Zuoyue Wang's book on the U.S. President's Science Advisory Committee (PSAC, pronounced p-sack) is rich in thoughtful explorations of scientists' roles in government. Did scientists speak truth to power, with the courage to tell presidents what they didn't want to hear? Or was PSAC mainly a beachhead for scientists in the corridors of power? While tackling these questions, Wang provides a deeper message about the underlying tension between faith in technological solutions and an abiding skepticism toward technology for its own sake. After the Soviet Union's launch of Sputnik, the United States frantically tried to recover its technological edge. In short order, President Eisenhower created PSAC. But rather than act as mere boosters for science, these advisors tried to rein in what Wang calls "undisciplined hype" created by Americans' panic and the opportunism of scientists, engineers, and politicians.

Wang's catch-all term for this attitude is technological skepticism. As an analytical device, it explains why PSAC got along so well with Eisenhower, who was fiscally conservative and who later warned about the excesses of the military-industrial complex.[1] In Wang's telling, Eisenhower shifted his trust from hawkish technophiles, such as Edward Teller and Ernest Lawrence, to the moderate men in PSAC such as James Killian and Isidor Rabi. Over the years, PSAC stood up to some powerful entrenched interests, as when it issued a report endorsing Rachel Carson's book *Silent Spring*, which criticized the indiscriminate use of pesticides. (199–218) Technological skepticism also explains PSAC's demise, as its nay-saying routinely rocked the boat. Although President Nixon usually bears the brunt of scientists' resentment, *In Sputnik's Shadow* shows a steady erosion of PSAC's influence starting with President Kennedy and intensifying in the Johnson years. By second-guessing policy decisions, the

1. Eisenhower's views about the military-industrial complex, particularly in light of the role of scientists, is also documented in Richard V. Damms, "James Killian, the Technological Capabilities Panel, and the Emergence of President Eisenhower's 'Scientific-Technological Elite,'" *Diplomatic History* 24 (2000): 57–78.

advisors became thorns in each president's side. PSAC members thought Kennedy's commitment to manned space exploration was a colossal misuse of resources. They were deeply skeptical of Johnson's reliance upon technological superiority in Vietnam. And they opposed Nixon's development of anti-ballistic missile systems. After Nixon won his second term, he got rid of PSAC for good.

Although Wang does not suggest that PSAC was monolithic in its views, his focus on technological skepticism is an elegant way of capturing its ethos. It allows him to avoid the simplistic conclusion that obstinate politicians ignored sober scientific advice.[2] It seems clear that PSAC was a body suited mainly to Eisenhower. It reflected his sense of sufficiency in nuclear strategy and his skeptical attitudes toward big defense expenditures. PSAC fit Ike like a glove; it fit his successors far less well.[3] Wang clearly has sympathy for PSAC's attempts at moderation. In his conclusion he draws inferences about the Iraq War, in which the doctrine of Shock and Awe projected dominance and intimidation through overwhelming technological supremacy.[4] "We still need to move out of Sputnik's shadow," he writes. (324) And by that he means that we must bridle our technological enthusiasm with a healthy dose of PSAC-like skepticism.

Few sites exemplified the trend toward high technology and massive expenditures like the American national laboratories, particularly those housing instruments for high-energy physics.[5] After Sputnik, politicians and scientists justified funding expensive scientific projects by saying that these would help maintain American

2. Gregg Herken's history of PSAC received some criticism for oversimplifying scientists' roles as speaking truth to power. See Gregg Herken, *Cardinal Choices: Presidential Science Advising from the Atomic Bomb to SDI* (New York: Oxford University Press, 1992). See Bruce L. R. Smith, review of Gregg Herken, *Cardinal Choices*, in *Technology and Culture* 34 (1993): 462–64; and Michael Sherry, "Scientists in the Cold War: Masters or Servants?" *Diplomatic History* 18 (1994): 447–50.

3. Eisenhower's reasons for respecting scientific advice were myriad, dating back to his experience as the commander of Allied forces in Europe during World War II. Historians have begun to recognize the diverse roles scientists played during his administration in the formulation of national and international policy. See Allan Needell, *Science, Cold War, and the American State: Lloyd V. Berkner and the Balance of Professional Ideals* (Amsterdam: Harwood, 2000); John Krige, "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence," *Osiris* 21 (2006): 161–81; and Ronald E. Doel, "Scientists as Policymakers, Advisors, and Intelligence Agents: Linking Contemporary Diplomatic History with the History of Contemporary Science," in *The Historiography of Contemporary Science and Technology*, ed. Thomas Soderqvist (Amsterdam: Harwood, 1997), 215–44.

4. See Harlan K. Ullman and James P. Wade, Jr., *Shock and Awe: Achieving Rapid Dominance* (Washington, DC: National Defense University, 1996).

5. The national labs frequently are invoked as exemplars of the postwar concept of Big Science. See James H. Capshew and Karen A. Rader, "Big Science: Price to the Present," *Osiris* 7 (1992): 2–25; Peter Westwick, *The National Labs: Science in an American System, 1947–1974* (Cambridge, MA: Harvard University Press, 2003).

leadership vis-à-vis the Soviet Union. PSAC was instrumental in greasing the wheels of federal funding for universities, up from $127 million in 1957 to $564 million in 1964. (157) Others such as Fermilab director Robert Wilson took a more sanctimonious route, arguing that support for science on this scale had nothing to do with national defense, but rather it helped make America worth defending. Despite the sticker shock of such projects, Congress forked over the money and the "era of gigantism" (to use Wang's phrase) opened into full flower.

Fermilab (or NAL, the National Accelerator Laboratory) epitomized this gigantism. Lillian Hoddeson, Adrienne W. Kolb, and Catherine Westfall, in their institutional history of the laboratory, prefer the term "megascience" to the more conventional "Big Science."[6] They employ the word to encompass some key changes in the way high-energy physicists worked in the decades after the 1960s, for better or for worse. Reading this authoritative and detailed book, by historians who have published extensively about national laboratories and particle accelerators, it often seems for worse. Despite the laboratory's expansion in funding, its fantastic size, and its ever-growing teams of researchers, the authors point out a tendency toward very focused research projects, which may have discouraged new kinds of experiments. Physicists became "homesteaders" rather than "explorers." (280)

Such perspectives are sprinkled throughout *Fermilab*, as the authors return time and again to the notion of the "frontier." It comes from Fermilab's first director Robert Wilson, who routinely spoke of pushing back the frontiers of knowledge. He did not like what happened to Fermilab over the years, and he let people know it (including the authors). Although they are not uncritical of Wilson as a director, Hoddeson et al.'s analysis follows the contours of Wilson's own dissatisfaction with what happened to the lab. They appear to accept Wilson's self-image as a frugal, risk-taking cowboy, yet they also portray him as a sensitive Renaissance man who regarded science as an individual, creative activity. Wilson comes across as a visionary who saw his designs for accelerators as art, and who imagined Fermilab, with its giant accelerator ring, as a modern-day Gothic cathedral. The lab itself was to be a utopian place, expressing the aspirations and spirituality of the age. Wilson disliked team research, and he even opposed the expansion of computing capabilities because, as the authors note, "this violated his sense of what it meant to be a physicist." (239)

6. Although the authors prefer the term "megascience," the characteristics are similar to Big Science: teamwork, hierarchy, massive scale, and astronomical costs. See Peter Galison and Bruce Hevly, eds., *Big Science: The Growth of Large-Scale Research* (Palo Alto, CA: Stanford University Press, 1992).

Hoddeson, Kolb, and Westfall expertly convey the supreme irony of Wilson's worldview in light of what his lab actually turned out to be. By the time he stepped down as director in 1978, he had become a facilitator of large-scale, long-lasting, team-oriented experiments. This trend only continued under his successor, Leon Lederman, who favored "experiment strings." Instead of encouraging outside users to try something new, research needed to be embedded in a series of experiments, some of which might last more than a decade. Once Fermilab began experimenting with colliding particle beams, the experiments themselves became institutions. The two collider experiments, CDF (Colliding Detector at Fermilab) and DZero, consisted of hundreds of researchers and were "as large and long-lasting as many entire laboratories."[7] (282)

Hoddeson, Kolb, and Westfall end up wary (like Wang) of relying so heavily on technologies of ever-increasing sophistication. Despite the taxpayer expense, massive size of instruments, and high numbers of participants, *Fermilab* shows that "megascience" often made the community of science narrower, less flexible, and less open to outsiders. Scientists built wonderful machines to push the frontiers of science, but ultimately got saddled. Perhaps Wilson was right that megascience stood against what he thought of as good science: creative, individualistic, risky, and inclusive.

Team research did not always go hand in hand with sophisticated instrumentation. In the 1950s, astronomer Fred Whipple fought hard to get scientists to appreciate how a vast network of amateur eyes could provide data as reliably as expensive telescopes or radio receivers. Expecting to put up a satellite during the International Geophysical Year (1957–58), the U.S. Navy favored tracking satellites by radio, using the battery-powered signals emitted from the little piece of machinery in orbit. Those who favored optical tracking—after all, the battery would die eventually—built expensive room-sized Baker-Nunn cameras that could swivel and tilt. As it turned out, when the Soviets launched Sputnik, none of these sophisticated methods were ready. But Operation Moonwatch was, and its teams of amateurs were armed with cheap telescopes made from Radio Shack parts.

7. Large numbers of participants and overreliance on computer processing simply compounded the twin problems of credit and accountability in science. Particle physics in the era of Big Science is one of Mario Biagioli's key examples in his discussion of the evolving definition of scientific authorship. See Mario Biagioli, "Rights or Reward? Changing Frameworks of Scientific Authorship," in *Scientific Authorship: Credit and Intellectual Property in Science*, ed. Mario Biagioli and Peter Galison (New York: Routledge, 2003), 253–80.

In W. Patrick McCray's *Keep Watching the Skies!*, Operation Moonwatch is fleshed out with the stories of individuals, clubs, and communities who were delighted to help launch the space age. It is history from the bottom up, focused less on the twists and turns of policy and more on the cultural meaning of a large-scale movement of dedicated volunteers. The title is drawn from the parting warning in a science fiction movie, *The Thing from Another World* (1951), in which humans manage to beat back an alien invasion and must remain vigilant. McCray situates his story in the "climate of hyperawareness" created by all the ingredients in the Cold War stew: the arms race, the revelations of espionage, and the periodic accusations of internal enemies. People all over the country (and in some other countries) founded local troupes of Moonwatchers: the Twilight Observers, the Order of Lunartiks, the Spacehounds, and the Dawn Patrol were just a few. This was the heyday of amateur astronomy, when amateurs such as Clyde Tombaugh (who discovered Pluto) were still heroes and the average Joe seemed capable of making new discoveries.[8]

By the 1970s, Moonwatch had changed into a quasi-professional network that turned away enthusiastic laymen and worked hard to protect its scientific integrity. Its membership narrowed, not merely due to declining interest (although that happened, too), but because its members made it exclusive. Amateurs were no longer welcome. One could argue that the IGY was a perfect storm for amateurs in science, unlikely to repeat itself: dozens of nations took part, offering worthwhile activities to every man or woman willing to do it. But McCray denies that this golden opportunity for amateur science was a unique one. On the contrary, he lists many other international endeavors in which amateurs might play productive roles. He also shows that amateur astronomers are now treated as potential threats to national security. Amateur satellite spotters who put their data online are helping enemies avoid the watchful eye of American reconnaissance satellites. McCray is nostalgic for a time "when amateurs were encouraged and supported, not suspected." (241)

Spying, of course, is at the center of any technological account of the Cold War. The 1950 conviction of physicist Klaus Fuchs in Britain contributed to the hyper-vigilant anticommunism of American culture that McCray describes

8. Despite the existence of well-known amateurs such as Tombaugh, astronomy in the 1950s was highly specialized, resulting from a process of professionalization that was virtually complete by the early part of the century. See John Lankford, with Ricky L. Slavings, *American Astronomy: Community, Careers, and Power, 1859–1940* (Chicago: University of Chicago Press, 1997); and Marc Rothenberg, "Organization and Control: Professionals and Amateurs in American Astronomy, 1899–1918," *Social Studies of Science* 11 (1981): 305–25.

so well.[9] Revelations of espionage reinforced Americans' sense of superiority: the Soviet successes, it seemed, came from borrowing ideas or by outright theft of designs. Fuchs's spying, which apparently helped the Soviets to settle upon the plutonium-fueled implosion method, seemed to be the ultimate case in point.[10]

Michael D. Gordin's *Red Cloud at Dawn* investigates the problem of intelligence surrounding the first Soviet atomic bomb test in 1949 (who knew what, and when), but it also serves up a remarkable juxtaposition of how the two superpowers pursued their scientific and technological objectives. It has long been realized that the Soviet Union excelled at "human intelligence"—the kind of personal clandestine activity that makes for great spy novels and movies. The Soviets seemed to have spies everywhere. But as far as historians can tell, there were no atomic bomb spies working in the Soviet Union for the Americans. On the other hand, Americans were keen listeners, monitoring radio traffic and cracking codes (this is how Fuchs was discovered). "Signals intelligence" has been, and remains, America's crown jewel of spying. Gordin generalizes this beyond espionage, writing that the Americans preferred technological solutions for an array of strategic problems, whereas the Soviets tried to achieve political solutions. This is not to say that the Soviets were ambivalent about the need for technological parity with the United States. But Stalin got information from *people*, whereas Americans thought it "more prudent to trust cold circuitry." (297)

One of the compelling episodes is Gordin's account of how the Americans detected the first Soviet nuclear test using an innovative airborne radiological monitoring network. The subsequent confusion highlighted the cultural divide: why hadn't the Soviets mentioned it? Should the Americans say something? After some gnashing of teeth, President Truman did reveal the explosion to the public, because (as Gordin points out) being able to detect the bomb was a kind of technological superiority, showing that such secrets could not be kept.

To be fair, the Americans were not able to keep many secrets either. Gordin shows that on the question of whether it was wise to issue the Smyth Report—a discussion of the bomb project published shortly after the bombings of

9. On the effects of anticommunism upon scientists' activities in the late 1940s and early 1950s, see Jessica Wang, *American Science in an Age of Anxiety: Scientists, Anticommunism, and the Cold War* (Chapel Hill: University of North Carolina Press, 1998). On Fuchs, see Robert Chadwell Williams, *Klaus Fuchs, Atom Spy* (Cambridge, MA: Harvard University Press, 1987).

10. The most comprehensive book on the making of the Soviet atomic bomb, and its subsequent nuclear program, is David Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939–1956* (New Haven: Yale University Press, 1994).

Hiroshima and Nagasaki—the critics were mostly right. The report held back technical details but gave away the bigger picture. It revealed the massive scale of the project and settled some big questions for the Soviets—such as whether to pursue the gaseous diffusion method of isotope separation. In addition, the Soviets could learn much of what they needed from any branch of an American public library. What they could not do, however, was create sources of uranium out of thin air. Indeed, one of Gordin's accomplishments is to clarify the calculus Americans used to predict (wrongly) the timing of the first Soviet bomb. Soviet scientific competence and industrial power, the usual suspects, were relatively minor considerations compared with the perceived shortfall of quality uranium that the Soviets faced. This was a material shortfall, not a technological one.

Lavrentii Beria and Igor Kurchatov, the political and scientific leaders of the Soviet project, were smart enough to realize that the Fuchs case would be nearly as demoralizing for Soviet scientists as for American and British ones. Consequently, few learned the extent of the espionage, and the Russians got to be proud of their home-grown bomb. In other countries of the Eastern Bloc, scientists and engineers could not live in this world of delusion. Dolores L. Augustine's study of East German engineers, *Red Prometheus*, shows how the government of the German Democratic Republic normalized technological espionage. Augustine relates a striking case in 1967, when a government minister came to a meeting with a cardboard box full of American-made integrated circuits. All other work was halted, and the process of copying began. This was innovation in what supposedly was one of the great technological success stories of the communist world.

Augustine goes to great lengths to show how the East Germans saw technology as part of their national identity, because it fit with communist goals and it extended preexisting German values. Like other scholars, she links the fate of technology to the economic decline of East Germany, and she does not shy from asking whether the communist system made failure inevitable.[11] But Augustine's approach is personalized, honing in on a few leading engineers, and her conclusions reflect their frustrations. The principal culprit was not communism, but the Stasi: the state security apparatus stultified research by clamping down on debate and discouraging independent thinking. Like the books under review, *Red Prometheus* reveals people with a strong faith that technological strength would fortify society in innumerable ways. But Augustine's book stands in sharp contrast to the others in its dismal tone. With

11. See Raymond G. Stokes, *Constructing Socialism: Technology and Change in East Germany, 1945–1990* (Baltimore: Johns Hopkins University Press, 2000).

Wang's presidential advisors, McCray's enthusiastic amateurs, Hoddeson et al.'s high-energy physicists, and Gordin's bomb builders, there is a sense of urgency, excitement, and deep meaning in the development of new technologies and new scientific ideas. But Augustine portrays pragmatic engineers beaten down by a political system that purported to embrace technology while tearing apart the very centers of innovation.[12] In contrast with the Soviet scientists under a socialist system, she writes, the East Germans had not an ounce of idealism left. They had struck a bargain under Hitler, and now served a new master whose totalitarian style was rather familiar.

Initially the East German scenario seemed promising, because the state had to woo scientists and engineers to keep them in the East. But over time, especially after the construction of the Berlin Wall in 1961, the centers of research were transformed by the inexorable power of the Party: it changed curricula, made new appointments, brought down bourgeois scholars who appeared to command too much personal loyalty, and crushed the autonomy of institutions. The Soviets were no help, viewing the East Germans as potential industrial competitors. So the East Germans had to go it alone. As Augustine reveals in abundant detail, the government shot itself in the foot. By copying technology, East German engineers infringed upon patents and could not develop markets outside their borders—making the country more isolated than ever, its technological success built upon an illusion.

For those who did not live through the Cold War, the near-worship of science and technology during that time may seem bizarre. Research loomed as a crucial element of national power. Those who participated in state-sponsored research followed, as Augustine puts it, "a process of constantly renegotiated power relations." (xv) Sometimes that renegotiation was *Godfather*-esque: offers that could not be refused. But some were true negotiations, reflecting the changing aspirations and hopes of scientists, politicians, enthusiasts, and government officials. Hoddeson et al. imagine archaeologists unearthing Fermilab in the year 9007 and asking, "Why did this earlier culture take from its own wants to support such curiosity about the universe?" (353) Saying "because of the Cold War" is probably too trite an answer. But if we think that public support of science is really just about "curiosity," then this question may indeed perplex us for the next seven thousand years.

12. In this, Augustine's work is in keeping with Jeffrey Kopstein's findings that despite the technocratic tendencies of East German politics, ideological factors trumped expertise. See Jeffrey Kopstein, *The Politics of Economic Decline in East Germany, 1945–1989* (Chapel Hill: University of North Carolina Press, 1997).