HISTORY OF PHYSICS

Cult of the machine
A major player in 20th-century physics, Ernest Lawrence helped usher in an era of big-budget research projects

By Alex Wellerstein

high above the hills of the University of California, Berkeley, sits a physics laboratory that employs more than 3000 people, boasts an association with 13 Nobel Prizes, and has a budget of over $750 million dollars. The Lawrence Berkeley Laboratory is named after its founder, the famed American physicist Ernest Orlando Lawrence. Lawrence's name also adorns the Berkeley laboratory's weapons spill-off at Livermore, a career award issued by the U.S. Department of Energy, and an element (the actinide metal lawrencium) that he was a giant of American physics and, arguably, the architect of the late-20th-century approach to science that required big machines, big budgets, and big staffs, known fittingly as "Big Science" (1).

Michael Hiltzik, a Pulitzer Prize-winning journalist, has written a new biography of Lawrence, the only such monograph published since Herbert Childs's (family-sanctioned) book An American Genius was released in 1968 (2). Hiltzik takes a less hagiographical approach than did Childs, and the book reflects a shift in society's perception of Big Science, in particular its deep historical connections to military research.

What kind of scientist was Ernest Lawrence? He was less a discoverer than an inventor, more a tool builder than a tool user.

Lawrence's approach relied on the "re-morseless exploitation of cheap graduate-student labor," as Hiltzik aptly puts it. His first cyclotron, a small device a mere six inches in diameter, was apparently constructed entirely by a graduate student named Niels Edlefsen. Lawrence was singing its successes even before it was clear that it worked—which, it turned out, it didn't. The first functioning model was developed by his next student, M. Stanley Livingston, who debugged the earlier machine and fixed its numerous faults. Even before Livingston had put the cyclotron prototype through its paces, Lawrence was hot on the trail of the money needed to build a bigger model.

Lawrence's methods were viewed with justifiable skepticism among the scientific greats of Europe. For the first decade, they failed to produce real results. His first major scientific announcement—a theory of deuteron disintegration—proved to be an embarrassing flop. Instead of describing a new phenomenon that overturned the laws of physics, Lawrence instead broadcast to the world that the Radiation Laboratory couldn't keep its samples clean.

Lawrence's problem, as diagnosed by his contemporaries, was that he was more interested in the "cult of the machine" than the scientific results. A French visitor once ridiculed the laboratory for having "a mania for gadgets or a post-infantile fascination for scientific meccano [sic] games." The number of major discoveries that the Radiation Laboratory ought to have stumbled across, had it been watching for them, is a long one: The existence of the positron and the neutron were discovered during this time by using more modest tools and staffs, for example, as were the phenomena of induced radioactivity and nuclear fission.

Yet the funding continued to pour in, in part because of what Lawrence would at one point dub "the vaudeville"—his ability to project boundless enthusiasm and confidence to nonscientific audiences. In a rare moment of candor, he once admitted that he was making the cyclotrons bigger simply because he could get the money to do so, not because he had any idea about what the bigness would let him do.

To a large degree, Lawrence's strategy worked. The cyclotron went from being a crazy venture to a common tool, earning Lawrence the Nobel Prize in 1939. Part of the reason for this was that, in the right hands, it did yield important results. Ed McMillan, Luis Alvarez, and Glenn Seaborg—all future Nobel Laureates—cut their teeth and did some of their best work in the Radiation Laboratory, finding ways to make Lawrence's chaotic fiefdom work for them. Additionally, when it became clear that cyclotrons could produce radio-isotopes in quantity for other types of scientific research, Lawrence was happy to provide them to collaborators, knowing that he could only gain from their rising applicability.

The Second World War brought the ultimate patron to Lawrence's door: the U.S. military establishment. Lawrence's involvement in defense work began with radar but hit its stride with nuclear weapons. His relationship with the military would continue until the end of his life.

Ernest Lawrence poses in front of a domed building designed to house his 184-inch particle accelerator known as the cyclotron, c. 1950s.

Big Science
Ernest Lawrence and the Invention That Launched the Military-Industrial Complex
Michael Hiltzik

Published by AAAS
Lawrence was one of the loudest proponents of building the atomic bomb, largely because he claimed that he could practically pull it off single-handedly. In this, as with many things, he overpromised. The results-driven General Leslie Groves, head of the Manhattan Project, who did not accept the kinds of delays, excuses, and cost overruns that Lawrence had become accustomed to, proved a force to reckon with. Lawrence was ultimately able to generate enough highly enriched uranium for the Hiroshima bomb; however, his approach was scrapped in favor of a competitor’s technology in the early postwar.

Lawrence comes off as particularly shallow and unreflective in the immediate postwar period. He complained that the scientists who participated in the discussions about the domestic control of atomic energy were “frittering away so much time and energy on political problems, when they could be devoting themselves to scientific pursuits.” In response to his former colleague J. Robert Oppenheimer’s expressions of unease, Lawrence glibly remarked that, “I am a physicist and I have no knowledge of what genre the book is to belong: blushing or flattering at times, damningly critical or thoughtful and provocative,”

In the end, Hiltzik seems uncertain as to what genre the book is to belong: blushing or flattering at times, damningly critical or thoughtful and provocative, he never quite gets inside Lawrence’s head. What was it that drove the man: a true devotion to science or to ego? Is he a scientific hero or a cautionary tale?

REFERENCES AND NOTES

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