One man and his lab

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Lawrence and His Laboratory. A History of the Lawrence Berkeley Laboratory. Vol. 1. By John L. Heilbron and Robert W. Seidel. *University of California Press: 1989. Pp.586. $29.95.*

AN UNDERSTANDING of just how high-energy physics reached its present state of apparently limitless demands on the world's physical and financial resources — as well as on the human resources of many physicists — can well begin with a close scrutiny of "the rise of Big Science as it was born in the Rad Lab" (Martin Kamen, *Radiant Science, Dark Politics*). Those of us who are not technological determinists want to get a sense of how the nuclear physicists of the 1930s, through cooperation and conflict with their fellows and with the rest of their social milieu, created the first generation of particle accelerators; and how the result in turn helped to shape the lives and deeds of succeeding generations of particle physicists. We want to get a sense of the alternatives that were faced, the crucial choices that were made — and why — and of potentialities left unexplored as a consequence of these decisions. Heilbron and Seidel have in large measure succeeded in fulfilling these hopes in the first volume of a projected trilogy, which carries the story to 1941, the year of America's entry into World War II.

We watch Lawrence himself pick up the basic idea for the cyclotron, which had previously occurred to many people, and develop it into a working machine, using his enthusiasm, energy and considerable skills as an organizer to build up a remarkable group of doctoral students and post-doctoral co-workers — his "boys" in the typical male-bonding language they all used. Heilbron and Seidel emphasize that, if Lawrence "himself had not uncovered much new about the nucleus", his "notable contribution" was "the cyclotron laboratory" (p. 489). As Livingston, one of the first and most notable of the boys — and one of the first to break free of Lawrence and his lab — put it: "His optimistic and inspirational attitude was what convinced me it was worth working on" (p. 486).

Yet Lawrence himself was changed by the course of his own success. The process of reaching for ever-higher energies and ever-bigger machines seems to have become an end in itself for him, an imperative only loosely coupled to uses to which the beams emerging from his machines could be put. "Lawrence sets goals expressible not in terms of progress in physics, but in terms of increases in decimals" (p. 480). While Lawrence and his brother John, a physician who worked on medical applications of the newly available particle beams, were undoubtedly sincere in their efforts to benefit humanity ("It means a great deal more to civilization . . . to find a new radiation or a new substance that will cure disease than it would to discover a new supernova", Ernest said in 1940), there was just as undoubtedly an element of manipulation in the way these prospects were dangled before prospective donors — and the general public — as a means of obtaining the financial support that became more and more necessary to the realization of Lawrence's ever more ambitious dreams. He was forced by the logic of his position as an experimentalist who had staked his whole career on the building of ever bigger and more elaborately instrumented cyclotrons to become the intimate of university administrators, foundation nabobs and influential industrialists. His induction into the Bohemian club, a retreat for the rich and powerful of San Francisco and their university confrères, fairly early in his career at Berkeley can be taken as an early indication of his success. The award of almost one-and-a-half million dollars by the Rockefeller Foundation and the trustees of the University of California in 1939 marked the culmination of his efforts: "The munificent grant represented many things: dollars to be sure, but also the affection, respect and confidence in which Lawrence's fellow physicists and prominent men of business held him" (p. 482).

For the first time, funding for nuclear physics began to rival that for an older American mania for the super in science, big telescopes; the parallel with the 200-inch telescope was explicit in the funding hype for the cyclotron — "the Palomar of the vanishing small". By this time, almost all the main ingredients for contemporary big science were in one place, except one: large-scale financial support from the federal government. As the authors indicate in the last chapter, World War II was to provide that ingredient.

The change in Lawrence was not without its costs to the laboratory and to the man. A veteran of the lab in the 1930s, Morton Kamen, reports that Lawrence "was almost always on the road by 1939. The early magic of the Rad Lab had largely vanished", to be replaced by "a new, less personal ambience, unpleasant in its demands for aggrandizement". Another ingredient had been added to the recipe for a modern high-energy physics facility. Kamen connects Lawrence's "untimely death at the age of fifty-seven of [chronic] ulcerative colitis" with the in-

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rence Berkeley Laboratory

Ernest O. Lawrence holding the first particle accelerator and right, the advanced light source (a synchrotron radiation facility) under construction at the Lawrence Berkeley Laboratory, completion date 1991.

flexible demands that he came to make on his family, his lab and himself. There are few hints of this darker side of the Lawrence story in the present volume, although we may anticipate more in the sequel.

Lawrence's ambitions were not only intensive — the biggest machine possible — but also extensive: "There should be a cyclotron lab in every university center" he said in 1938. He generously exported the know-how — and the people who knew how — to physics centres in the United States and abroad. By 1940, "there were 22 cyclotrons completed or under construction in the United States" (p. 308), hardly enough to satisfy Karl K. Darrow, the Polonius of American physics, who opined: "The country may need a thousand cyclotrons" (p. 311).

One gets a sense of lost potentialities for other modes of development of nuclear physics from the initial resistance to the spread of the cyclotron by the best of the British and finest of the French nuclear physicists. Lawrence was often reproached for careless work and unjustified claims in the early years of the lab, such as his notorious argument for the supposed instability of the deuteron. Heilbron and Seidel make a rather harsh assessment: "The frequency with which the laboratory had to retract published results had declined since Lawrence had gone full time into fund raising and administration" (p. 385). In any case, it is certainly a "disagreeable fact that no major discovery had yet been made [by 1940] in any cyclotron laboratory".

The great discoveries in nuclear physics in the 1930s were made by small groups, getting the most out of small accelerators, careful chemical analyses and free-of-charge cosmic rays. No wonder Rutherford and Chadwick, Cockcroft and Joliot-Curie initially resisted the call from California. In another preview of post-war things to come, the first foreign converts to the Berkeley gospel were the Japanese, based on "a conviction on the part of government and industry that excellence in Western science was essential to Japan's place in the sun" (p. 317).

The need to move to higher energies than conventional methods could reach impressed itself on British, French and German savants in the late 1930s; by this time, the initial quirks that had made cyclotronics more of a dark art than a working technology had been resolved, and Lawrence's machine stood ready as the only technique able to meet the need. Something else went along with these exports: "The fascination with hardware and the subordination of the individual to the group that characterized Berkeley by the late 1930s were to spread from the accelerator laboratories to other parts of physics and from the United States to the rest of the world" (p. 351).

Heilbron and Seidel, with Bruce Wheaton, have elsewhere described the story of Lawrence and his laboratory as "a strong interaction between science and society" ("Lawrence Berkeley Laboratory 1931–81" *CERN Courier*, October 1981). Unfortunately, the social context they depict is limited largely to Lawrence's relationships with the powers-that-be. Theirs is a history from the top down, which is certainly an important part of the story. As Raymond Williams observed in another context: "A need which corresponds to the priorities of the real decision-making groups will, obviously, more quickly attract the investment of resources and the official permission, approval or encouragement on which a working technology . . . depends."

But if one is to understand the choices Lawrence made in the 1930s, as compared with those made by Berkeley's other rising physics superstar J. Robert Oppenheimer (the often-made contrast between the two is also made in this book), one must tell some of the history of the 1930s from the bottom up. It was a time of severe economic crisis in the United States, but also a time of great hope. President Roosevelt spoke of "one third of a nation ill-housed, ill-clad, ill-nourished", and of the need to curb the power of the trusts if the country was to be put back on its feet. A wave of protest by the unemployed and of trade-union organization by the employed swept the nation, cresting in California. To understand the California of the time one must evoke not only the Federal Telegraph Company and the Research Corporation, as do the authors, but also the general strike in San Francisco and the efforts to organize migrant farm workers, immortalized in John Steinbeck's *Grapes of Wrath*.

The impact of such events and struggles, which did not leave their own plight unaffected, moved a considerable number of US scientists into political action in broad sympathy with the growing movement to organize labour in factory and field — and laboratory. "Suddenly, prominent scientists were in the forefront of both the antifascist and social reform movements . . . A small though vocal and influential portion of the scientific community became radicalized", reports Peter Kuznick in his recent account of this movement (*Beyond the Laboratory*, University of Chicago Press, 1989). It will not do to say, as do the authors, "Lawrence trusted that the world would muddle through without requiring his attention", while "Oppenheimer did not allow the world to get on without his help" (p. 255). Theirs were political decisions, made in the context of national and international conflicts, the outcome of which were to decide the fate of a generation.

It must be added that the authors' aloof and ironic style, while adding considerably to the amusement of the reader, does not serve well the goal of a deeper understanding of the personalities of Lawrence or the other central figures in the drama. Instead of patronization, for example, one would have wanted more help in understanding what many of Oppenheimer's students — and students of his career — consider his finest hour as a human being and social figure. Lawrence also made his decisions. His biographer reports that: "He warned his people . . . 'If anyone wants to write letters to editors and that sort of thing, he should get out of science and get a job on a paper'" (H. Childs, *An American Genius*, p. 267). The authors discuss quite frankly Lawrence's anti-semitism, of the conventional mid-western variety typical of his generation, and its repercussions in the lab. They do not mention that: "Though he preferred not to have women in the laboratory at first", presumably because of similar conventional prejudices, "a few were eventually accepted" (Childs). Their own attitude towards women is not unobjectionable: in their text, Lawrence's wife is always "Molly", Lawrence is never "Ernest". Their account of the courtship of lab secretaries (all female) by lab scientists (all male) is reminiscent of anthropological accounts of the exchange of women as a means of male tribal bonding (p. 247).

This long book is not without its *longuers*: much of its length can be attributed to the tendency of the authors to follow their material, however far it leads them from Lawrence and his lab: in some measure, they have written a history of experimental nuclear physics in the 1930s. It would have been helpful if the authors had provided an introductory overview of the entire history of the lab; that they have not done so is surprising since they, together with their former collaborator, Bruce Wheaton, have written two such surveys that carry the story through the seventies (one is cited above; the other, published by the lab, has the same title as this book). Even more surprisingly, neither survey is cited in the extensive bibliography here.

The publisher must be commended for the unusually low price of the book, which certainly justifies its computer-driven look. But something has gone seriously wrong with the index, which is a disaster area. An hour's effort turned up nearly 100 missing page references, and about 40 missing names of people and institutions. A more systematic search of one entry (Szilard) turned up about as many missing references as there are in the index. □

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