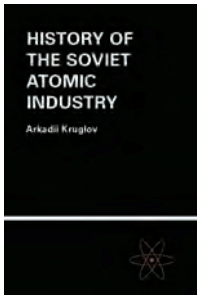
An Insider's View of Soviet Nuclear Research

History of the Soviet Atomic Industry

Arkadii Kruglov
(Translated from Russian by Andrei Lokhov)
Taylor & Francis, New York, 2002. $95.00 (282 pp.).
ISBN 0-415-26970-9

Reviewed by David Holloway

Arkadii Kruglov worked for many years in the Soviet nuclear industry. When his book *History of the Soviet Atomic Industry* was published in Russia in 1994, it provided the first detailed account of how the Soviet atomic industry had been set up.



Although Kruglov's book does touch on developments after 1950, most of it is devoted to the years leading up to the first Soviet atomic bomb test in August 1949. Unfortunately, the translation is rough, and the manuscript did not receive the careful editing it deserves; and one could certainly argue with some of Kruglov's judgments. But this is an essential work of reference on past decisions whose consequences we still live with, and it remains the single most comprehensive report on the Soviet atomic industry.

After providing brief introductory chapters on nuclear research in the Soviet Union before and during World War II, Kruglov's book describes the creation and early operation of the country's key nuclear facilities. There are chapters on the first experimental reactor, the first plutonium production reactor, the first reprocessing plant, and the first plant for producing nuclear explosives. In addition, the book covers the first Soviet atomic bomb test and the Semipalatinsk test site in Kazakhstan, the first uranium enrichment efforts, the first heavy-water reactors, the supply of uranium for the nuclear project, and the production of uranium metal and other materials for the atomic industry. The final chapter deals with nuclear and radiation safety, a topic Kruglov also discusses throughout the book.

In the 1930s, nuclear physics was a strong discipline in the Soviet Union, and Soviet physicists, like their colleagues elsewhere, greeted the discovery of nuclear fission with excitement. Nuclear research halted following the German invasion on 22 June 1941. In September 1942, Soviet leader Joseph Stalin authorized the renewal of nuclear research to see whether an atomic bomb was feasible. Soviet intelligence gathered remarkable information about the progress of research in Britain and, later, in the US. As a result, Igor Kurchatov, the scientific director of the Soviet atomic project, had a clear grasp of the progress the US was making.

Soviet nuclear research expanded during the war, but it was only after the atomic bomb was dropped on Hiroshima that Stalin made the decision to convert the project into a high-priority industrial effort. On 20 August 1945, Stalin established the Special Committee on the Atomic Bomb. Lavrentii Beria, who also oversaw the Soviet police apparatus, chaired the committee. Stalin was determined that the Soviet Union have the bomb as quickly as possible, and he put enormous pressure on the country's atomic industry to achieve results quickly.

In his book, Kruglov emphasizes the urgency with which the Soviet atomic industry was established and shows how resources were mobilized to build up the industry. The text provides figures on the numbers of people who worked at the different sites—hundreds of thousands in the late 1940s, if one includes building workers, many of whom were prisoners. The author discusses how Soviet intelligence contributed to different parts of the industry and writes about the role of German scientists and engineers, who were mainly involved in work on uranium enrichment. Kruglov also describes the urgency with which technological choices and design decisions had to be made.

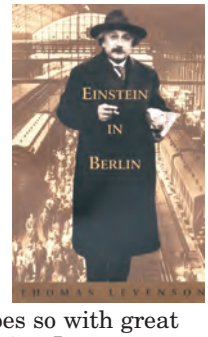
Kruglov does not question the need for urgency: He takes it as a given that the Soviet Union had to acquire the atomic bomb as quickly as possible. He does, however, make it clear that the urgency of the project carried a heavy cost. He describes in some detail the start-up problems with the plutonium production reactor and the gaseous diffusion uranium enrichment plant. More important, Kruglov shows how the determination to achieve results quickly led to damaging effects on the environment and neglect of the health and safety of workers.

David Holloway *is a professor of political science and history at Stanford University in California and author of* Stalin and the Bomb, *which was published by Yale U. Press in 1994.*

Einstein in Berlin

Thomas Levenson
Bantam Books, New York, 2003. $25.95 (486 pp.).
ISBN 0-553-10344-X

When Albert Einstein arrived in Berlin in the spring of 1914, he was at the height of his intellectual powers. Not yet a household name, he was already a force to be reckoned with in the European physics community. Five years would pass before he achieved true celebrity status with partial confirmation of the general theory of relativity in 1919, and almost 20 years would go by before his 1932 departure from the city with which his name has become inextricably linked. Thomas Levenson situates Einstein in that German metropolis, and he does so with great intimacy and sensitivity. In contrast to earlier biographies, *Einstein in Berlin* is the story of a man and a city. The book is a novel approach to Einstein historiography that, for the general reader, magnifies interest in the physicist's life.



Levenson begins with a brief prologue and first chapter on Einstein's life before he arrived in the city. For the most part, the account is straightforward and accurate. Some factual errors and misunderstandings, however, have crept in. The most significant error Levenson has made is perpetuating the myth that Einstein's work in 1905 arose completely out of the blue. Because of the rediscovery, almost two decades ago, of the letters to his classmate and future wife, Mileva Marić—

© 2004 American Institute of Physics, S-0031-9228-0402-240-9

correspondence on which much of our knowledge of the physicist's early years rests—we know that Einstein was working on what came to be known as the special theory of relativity since at least 1899.

Less obvious but perhaps more troubling is the author's occasional misreading of the letters exchanged between Einstein and Marić. The 20-year-old Einstein's description of a growing estrangement with his mother and sister was not so much an indication of callowness or desperation, as Levenson writes, as it was an admittedly stilted attempt to stress his independence of family and thus ingratiate himself with a new girlfriend. Levenson also misses the point when referring to a passage in which Einstein mentions "our dark souls." That was no more than a playful allusion to a shared mischievousness, not a reproach about Marić's brooding nature—a trait that Einstein would criticize much later in their relationship.

The author really hits his stride when writing about Einstein's time in Berlin. The book is particularly masterful in its evocation of World War I and its importance as a crucible for the struggling democratic Weimar Republic that emerged in Germany in 1919. Clearly, Levenson feels very much at home discussing the strategy, battles, and personalities of that war; with great effect, he devotes considerable space to this topic.

By contrast, the author gives short shrift to Einstein's changing views on Zionism, a central thread that runs through the physicist's Berlin years. The importance of that theme is brought home even more powerfully when we consider that it may go to the heart of a significant mystery about Einstein: How did an individual so dedicated to the pursuit of scientific truth in his early years emerge with passionately held political interests after the war? And where did those political interests come from? We know that Einstein's indifference to political issues, as well as his "agnostic" views on religion and a Jewish cultural identity, changed in Berlin. Is it mere speculation that he forged a new sensibility and willingness to speak out on public issues by confronting what it meant to be a Jew? Such questions are open, but unfortunately Levenson does not pursue them in his book.

It seems the author is after bigger game. His goal, as he puts it, is to instrumentalize Einstein as "a kind of human Geiger counter tracing Berlin's state and fate at any moment for [the] eighteen crucial years" of the Weimar Republic. In addition to using the rather unfortunate metaphor, Levenson sets up for himself an impossible task. Einstein was the archetypal "outsider as insider," a man who remained aloof and is therefore not suitable to serve as a guide to Weimar Germany. The author could have more fruitfully juxtaposed Einstein's growing scientific isolation with an account of the burgeoning, interactive physics communities in Berlin and the rest of Europe.

Throughout the book, Levenson generally does a fine job in getting his German citations and translations correct. The book's index, however, is unfortunately riddled with egregious misspellings.

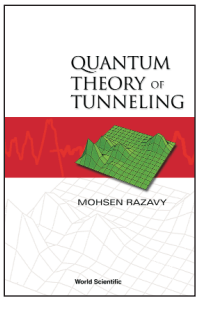
Einstein does not typify the period or the city of Berlin. He observed and partook of the city's singularity. And yet, even as an observer, he pales in comparison with German diplomat and man-about-town Harry Kessler, whose memoirs have recently been excellently translated into English. Still, there is no denying Einstein's symbolic importance. As Levenson accurately sums up toward the conclusion of his book, Einstein was a "tangible emblem of the city's drive to excel." Describing him in that manner is quite a different and far more acceptable proposition than viewing him as a human Geiger counter.

Robert Schulmann
California Institute of Technology
Pasadena

Quantum Theory of Tunneling

Mohsen Razavy
World Scientific, River Edge, N.J., 2003. $88.00, $48.00 paper (549 pp.). ISBN 981-238-018-3, ISBN 981-238-019-1 paper

Tunneling is one of the most striking of quantum phenomena. The term comprises a wealth of different effects having in common the possibility that a quantum system will be found in a classically forbidden region of space. Despite the multitude of tunneling processes, textbooks on quantum mechanics usually limit their discussions to the passage of a particle through a square potential barrier. Several more specialized books exist, but surprisingly, no comprehensive monograph on quantum tunneling had been published before this past year. That lacuna was filled by Mohsen Razavy's *Quantum Theory of Tunneling*. The book provides a good collection of examples of tunneling effects in atomic, molecular, condensed matter, and nuclear physics in the last three chapters; the rest of the book is essentially devoted to a rather impressive sweep of theoretical techniques.



Razavy has considerable experience in the field and has contributed to many of the topics included in his book. He pays a good deal of attention to semiclassical techniques, both in the simple case of a structureless particle in one dimension and in the more complicated multichannel and multidimensional cases. But he also discusses other techniques, such as the variable reflection amplitude method, inverse scattering methods, and techniques involving Feynman path integrals, Wigner functions, Heisenberg's equations of motion, complex scaling, and optical potentials. Other subjects covered include tunneling times, group and signal velocities, classical descriptions, time-dependent barriers, Gamow's theory, solvable models, motion in a space bounded by a surface of revolution, deviations from exponential decay, and decay widths calculated with scattering theory. One subject not addressed is dissipative tunneling, which is Razavy's main area of interest.

Each of the book's 26 short chapters has its own references. Razavy's style is quite laconic. He usually gives a very brief introduction immediately followed by formalism. He offers little or no discussion, but clearly explains the mathematics and works out calculations step by step.

The price paid for the broad scope is a certain lack of depth that, in some cases, can be misleading. I would like to have read an account of the limitations of the Wigner trajectory concept discussed in chapter 14. I also regard chapters 17–19 on tunneling times more as a sample of results than as a balanced review. They do not really do justice to the enormous number of publications on the topic. In particular, chapter 17 would benefit from a discussion going beyond the elementary but unsatisfactory treatment of Ken Stevens's work on evanescent waves. Chapter 19 considers Francis Low and Paul Mende's objections to the use of scattering theory for a Gaussian state that is initially close to a potential barrier, but does not adequately discuss work that has clarified how to handle those objections. Another example of the danger of brevity is the discussion of the time–energy uncertainty principle and tunneling given in chapter 2. I find the arguments