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Historic Intrigue Through a Powerful but Imperfect Lens

Brotherhood of the Bomb: The Tangled Lives and Loyalties of Robert Oppenheimer, Ernest Lawrence, and Edward Teller

Gregg Herken
Henry Holt, New York, 2002. $30.00 (448 pp.). ISBN 0-8050-6588-1

Reviewed by Silvan Schweber

Stories about the making of nuclear weapons and about the lives of their creators have been told by a host of able authors. In particular, Richard Rhodes's *The Making of the Atomic Bomb* (Simon & Schuster, 1986) comes to mind. In *Brotherhood of the Bomb*, Smithsonian historian Gregg Herken tells the story through the lives of three men who were central in creating the nuclear age: Robert Oppenheimer, Ernest Lawrence, and Edward Teller. His book is the result of 10 years of intensive research, during which he scanned untold numbers of documents from the FBI, CIA, KGB, and other governmental agencies.

Herken interviewed scores of people, many of whom were never approached before, and ferreted out previously unknown but important manuscript collections. His account is rich in detail, full of new information and insights, and valuable in adding to our understanding. His book is much more than a narrative of the entangled lives of three men and of their projects before the end of World War II. It is also the best overview yet of American nuclear-weapon developments and their political context after the war: Lawrence and Teller's machinations to establish the Livermore Laboratory, the successes and failures of the Pacific nuclear tests, Lewis Strauss and J. Edgar Hoover's behind-the-scenes maneuvering at the Oppenheimer trial of 1954, Lawrence's role in the nuclear test ban treaty of 1958, and more. Notes to the various chapters fill 81 pages, and the bibliography, another 11. More extensive notes appear at http://www.brotherhoodofthebomb.com.

I have reservations, none of which diminishes the importance of the book. One stems from Herken's apparently being more prone than I am to accept as fact evaluations such as those found in the FBI and KGB files or in the private papers held by Haakon Chevalier (a close friend of Oppenheimer's before World War II who once inquired whether Oppenheimer would be willing to share secret information with the USSR). What becomes evident from reading the FBI reports is how the views from the top—that is, the views of Hoover and his associates—constrained and polarized the field agents' assessments.

It also seems to me that, at times, in his evaluations of statements in such private papers as Chevalier's, Herken has not taken into account his sources' possible motivations. Thus, in his narration of Oppenheimer's life at Berkeley during the 1930s, Herken strongly suggests that after meeting Jean Tatlock and Chevalier, Oppenheimer became a member of the Communist Party (CP). The circumstantial evidence Herken adduces seems compelling. But one must question the reliability of the most damning evidence—Chevalier's 1964 note attesting that Oppenheimer had been part of a secret communist cell. Chevalier surely held Oppenheimer responsible for ruining his life by reporting to security officers that Chevalier had solicited secrets. Herken dwells on Chevalier's note and some others, but devotes only a footnote to the fact that Oppenheimer wrote to Chevalier and denied that he ever had been a CP member. I believe Oppenheimer. Reports of Oppenheimer's political activities during the 1930s must take into account that, given its stand against Nazism and Fascism, and particularly given its support of the Loyalist cause in the Spanish Civil War, Communism had appeal within left-inclined intellectual circles. Only in the late 1930s, after the Stalinist excesses had become known and after the Molotov–von Ribbentrop nonaggression pact had been signed, did CP membership become questionable. Within certain circles during World War II, but much more generally and extensively thereafter, the question of CP membership became a critical and central issue equated with political disloyalty and untrustworthiness.

Those remarks should not be taken as minimizing the reality of extensive Soviet spying—often with the help of local party members—in the US, the UK, and Canada. Joe 1, the first atomic bomb exploded in the USSR, was a replica of the plutonium bomb that had been designed at Los Alamos, the details of that design having been supplied to the USSR by Klaus Fuchs. A valuable aspect of Herken's book is his extensive coverage of Soviet spying activities in the US and his detailed report of the counterespionage activities of Leslie Groves and of the security officers in the San Francisco Bay area and at Los Alamos.

It is impossible in a review to indicate all the new information that Herken has brought together. Here are a few salient examples. Herken gives a detailed account of the interaction between Groves and Oppenheimer in the aftermath of the Chevalier–Oppenheimer encounter. Oppenheimer eventually told Groves that it was Chevalier who had solicited the secrets from him. But Oppenheimer did not want Chevalier to be hurt, so Groves promised to respect the confidentiality of that information. Groves was true to his promise. But when the "prosecutors" at Oppenheimer's "trial" hinted that Groves's silence might be considered seditious, in that he had withheld vital information about an espionage contact during wartime, Groves gave much weaker testimony than he had initially intended in support of Oppenheimer.

Herken's account of the deliberations of the scientific advisory panel to the interim committee (comprising Oppenheimer, Lawrence, Arthur

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Compton, and Enrico Fermi) on how the bombs were to be used—whether in noncombat demonstration or against a Japanese target—is particularly thorough. Noting that it took place in July 1945, Herken corrects the date usually attributed to one of the meetings. That was before the Trinity test, when it was not clear whether the implosion mechanism would work. The new date casts a different light on Oppenheimer's recommendation that the atomic bomb be used against Japan.

Of the three men whose lives he recounts, Herken seems to understand Lawrence best and to admire him the most. With his strong advocacy and support of the nuclear test ban treaty, Lawrence broke with Teller and Strauss. Herken movingly narrates Lawrence's change of heart to test-ban advocacy before his death in August 1958. Herken finds it much more difficult, if not impossible, to make sense of Oppenheimer. And wisely, he lets Teller speak for himself. If only partially successful in making these men understandable, Herken has eminently succeeded in illuminating some defining events of the 20th century.

Nature's Flyers: Birds, Insects, and the Biomechanics of Flight

David E. Alexander
Johns Hopkins U. Press, Baltimore, Md., 2002. $49.95 (358 pp.). ISBN 0-8018-6756-8

Bound as we are to Earth, we find bird and insect flight endlessly fascinating. Most of us perhaps have wondered, at one time or another, just how birds and insects flap their wings, and how they manage to stay aloft. Scientific work inspired by biological flight dates back to the 1500s, when Leonardo da Vinci designed a number of birdlike flying machines (ornithopters). The quest to achieve aviation based on bird flight continued and reached a climax with Otto Lilienthal, who designed ingenious gliders and daringly flew them. Sadly, before he could test one of his powered-glider designs, Lilienthal was killed in a gliding accident in 1896. A few years later, the success of the Wright brothers changed our view of flight. Abandoning the often unstable ornithopter design, the Wright brothers adopted a fixed-wing design. As we know, the fixed wing works remarkably well at large scales and high speeds.

Although the fixed-wing design has engineering advantages, it cannot be simply scaled down to the size of insects, nor do devices built with fixed wings have the maneuverability that birds and insects have. Recently, scientists have used robotic, computational, and theoretical models to make important advances in the study of flapping flight. So now is an exciting time to seriously explore flapping flight at small scales and to take a closer look at birds and insects.

How do birds and insects maneuver, how do they stay on course, how do they navigate and migrate, and how did they evolve? These are the topics of *Nature's Flyers: Birds, Insects, and the Biomechanics of Flight*, by David E. Alexander. An assistant professor in the department of entomology at the University of Kansas, Alexander has been interested in biomechanics for more than 20 years.

The book is aimed at a popular audience that does not necessarily have a background in fluid mechanics or biology. Alexander achieves the difficult feat of explaining intrinsically complex phenomena without using mathematical or entomological jargon. As a result, the book is clear, beautifully written, and suitable for people at all levels.

Primarily, the book focuses on the physical aspects of flight. Its first half, devoted to the physics of how a wing works, reviews the canonical example of a classical airfoil moving in fluid. Alexander then discusses different flight styles seen in nature, such as gliding, soaring, and flapping. He explains the maneuvering and power requirements during flight. Although the book includes a brief summary of recent findings in insects' use of unsteady mechanisms, such as dynamic stall and wing and wake interactions, most of the discussions are based on the classical lift and drag of a fixed wing. Such a treatment is appropriate for the level of the book. But of course, it is risky to deduce results about flapping flight using analogies with airplanes. There is no telling when such analogies will go wrong. The old myth of bumblebee flight was an easy case in which anyone could see that the theorists had made an error. Other cases could be much more deceiving. For example, in low-Reynolds-number flapping flight, lift and drag no longer take their traditional role that lift is good and drag, bad. Flapping flight can make use of both.

The second half of the book moves beyond the detailed physics of flight to insect evolution, migration, and navigation, and to the global impact of animal flight. The discussions are brief and general, but introduce readers to some long-standing puzzles. For example, how do some insects manage to fly nonstop over hundreds of miles? How do migrating birds find their way?

It should be clear from reading *Nature's Flyers* that many of the questions it broaches are still open-ended. Perhaps the open-endedness will encourage some readers to take on the challenge of solving puzzles in this rich area of research. The book contains an extensive list of references up to 1999, thus providing a good starting point for further investigations. I recommend the book to anyone who is curious about flight.

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Computational Methods in Environmental Fluid Mechanics

Olaf Kolditz
Springer-Verlag, New York, 2002. $54.95 (378 pp.). ISBN 3-540-42895-X

Environmental fluid mechanics (EFM) is the study of natural fluid systems with emphasis on the transport and dispersion of environmental contamination. The diverse field includes fluid flows in the atmosphere; in surface waters such as wetlands, rivers, estuaries, and oceans; and in subsurface regions. A wide range of time and spatial scales and a multiplicity of interacting processes often make numerical simulation of such flows challenging and computationally intense. Continued increases in computer power allow modeling of larger, more detailed, and more complex problems; increase the accuracy and scope of flow and transport simulations; and create excitement among researchers.

Because of the diversity and complexity of EFM, it is not surprising that most texts limit their focus to specific areas. For example, Jacob Bear's excellent text *Dynamics of Fluids in Porous Media* (Dover, 1988) focuses on subsurface flows and transport. Benoit Cushman-Roisin's *Introduction to Geophysical Fluid Dynamics* (Prentice Hall, 1994) discusses oceanographic and atmospheric flows. However, a good text is long overdue on computational methods in EFM, tailored to the masters or beginning PhD level and addressing the many challenges of numerical-model design. I was therefore interested to read Olaf Kolditz's *Computational Methods in Environmental Fluid Mechanics*.

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