Judging Edward Teller

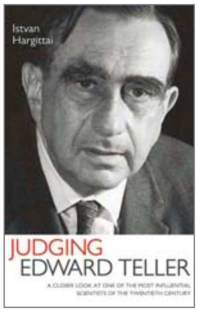
A Closer Look at One of the Most Influential Scientists of the Twentieth Century

Istvan Hargittai
Prometheus Books, New York, 2010. $32.00 (575 pp.). ISBN 978-1-61614-221-6

Much has been written about Edward Teller, but little of it is objective. Given, on the one hand, his position as one of the most inventive theoretical physicists of the 20th century and, on the other, his central role in the development and advocacy of thermonuclear weapons, one might imagine it impossible at this point in history to write a scholarly, impartial account of Teller's life and impact.

However, Istvan Hargittai, a prominent Hungarian physical chemist and historian of science, has written a balanced, thoughtful, and beautifully researched biography that comes closest—*Judging Edward Teller: A Closer Look at One of the Most Influential Scientists of the Twentieth Century*. Hargittai is uniquely qualified for this difficult task. Coming a generation and a half later from a similar background as a Hungarian Jew, Hargittai understands the influences and terrible events that shaped Teller. The advent of virulent, political anti-Semitism, first in Hungary and then in Germany, made Teller twice a refugee. Both he and Hargittai lost close family in the Holocaust; Hargittai was himself liberated from a Nazi concentration camp as a child. And although Teller was in the US by then, both his and Hargittai's surviving family members in Hungary suffered mistreatment at the hands of the postwar Hungarian Communist dictatorship. Hargittai's informed Eastern European perspective provides a fresh viewpoint to the cold war context of the second half of Teller's career. And furthermore, Hargittai's own scientific work in molecular structure clearly makes him appreciative of Teller's breakthroughs in that field in the 1930s.

Building on his fascinating interwoven personal portraits of Teller, Theodore von Kármán, John von Neumann, Leo Szilard, and Eugene Wigner presented in his earlier book, *The Martians of Science: Five Physicists Who Changed the Twentieth Century* (Oxford University Press, 2006), Hargittai now focuses more deeply on Teller. *Judging Edward Teller* is documented and annotated with more than 1200 references and notes, mostly new material from a range of sources, including the Hoover Institution Archives at Stanford University, the Special Collections Research Center of the University of Chicago Library, and the recently opened Historical Archives of the Hungarian State Security Services. Furthermore, Hargittai's portrait of Teller is well documented by hundreds of informative interviews he and his wife Magdolna Hargittai conducted in recent years with leading scientists whose paths intersected Teller's in diverse ways over many decades—those include Harold Agnew, Freeman Dyson, Richard Garwin, Vitaly Ginzburg, George Keyworth, Peter Lax, John Nuckolls, Laszlo Tisza, and John Wheeler.



Among the many gems that add warmth and dimension to this new biography are excerpts from Teller's touching, long correspondence with his close friend and collaborator, Maria Goeppert Mayer; George Gamow's 1954 cartoon illustrating Teller's unpublished idea for the protein-coding mechanism of DNA; Teller's principled 1950 defense of his former student Stephen Brunauer in the face of Senator Joseph McCarthy's accusations—ironic, given Teller's later testimony against J. Robert Oppenheimer; and Teller's prize-winning performance in the Hungarian National Physics and Mathematics Examinations.

Indeed, Teller's life and impact were quite remarkable: from his early, big successes applying the new quantum theory to molecular, nuclear, solid-state, and plasma physics, to his work on the Manhattan project, his post-war entry into public debate and his strong yet often stubborn and unpopular advocacy of nuclear weapons, the Teller–Ulam thermonuclear breakthrough invention, his disastrous testimony in the Oppenheimer hearings, cofounding of the Lawrence Livermore National Laboratory, his prescient interest in and ideas for nuclear reactor safety, his strong opposition to secrecy, his impact on scientific education, and his role in the Strategic Defense Initiative.

Befitting his "judging" theme, Hargittai doesn't simply trace those watershed events, which spanned nearly the entire 20th century. He also interleaves comparative illustrations of how Teller's peers in Hungary, Germany, the US, and the USSR responded to challenges similar to those Teller confronted. Key scientists discussed include the interviewees already mentioned, Teller's fellow "Martians," plus Hans Bethe, Werner Heisenberg, Lev Landau, Oppenheimer, Ernest Lawrence, Luis Alvarez, I. I. Rabi, Enrico Fermi, Gamow, Linus Pauling, Stanislaw Ulam, Yuli Khariton, and Andrei Sakharov. The descriptions of the parallel careers and historical viewpoints of Teller's mentors, friendly scientific peers, collaborators, and adversaries shed new light on his life and successfully give context to some of the enigmatic and ultimately tragic aspects of his career.

This book will be a significant resource for historians—it ably sets Teller's life in its broader, multiple contexts of Budapest in the period before World War I, the leading role of German science in the 1920s, the crucial contributions of émigrés to the rapid rise of American science and technology, the development of nuclear weapons and the cold war, and the ultimate dissolution of the Soviet Union. In that regard, Hargittai's book complements excellent scientific émigré biographies such as William Lanouette's biography of Szilard, *Genius in the Shadows* (Charles Scribner's Sons, 1992), Ruth Lewin Sime's *Lise Meitner: A Life in Physics* (University of California Press, 1996), and Hargittai's *The Martians of Science*.

Judging Edward Teller will be of great interest to anyone who wants to understand more about the impact on history of the 20th-century revolution in physics, and in particular about Teller, who was, in Hargittai's words, "an extraordinarily gifted physicist cutting a tragic figure."

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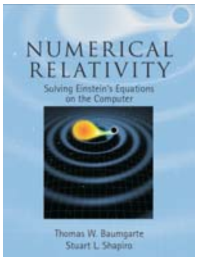
Numerical Relativity

Solving Einstein's Equations on the Computer

Thomas W. Baumgarte and Stuart L. Shapiro
Cambridge U. Press, New York, 2010. $90.00 (698 pp.). ISBN 978-0-521-51407-1

The application of numerical methods to relativity and gravitation has grown in intensity and scope in the past 20 years, thanks to a corresponding explosion in the power of computers and computational techniques. Those methods have perhaps had their greatest impact in simulations of binary systems of such compact objects as neutron stars and black holes and in models of the gravitational waves such systems produce as they spiral toward a collision.



Colliding binary systems are expected to be major sources of gravitational waves that could be detected and analyzed with ground-based interferometric detectors including LIGO in the US and VIRGO in Europe. Gravitational waves that result from the collision of supermassive black holes might be detected by the space-based LISA observatory, a joint proposal of NASA and the European Space Agency. Detailed models of the gravitational waveforms not only will aid in their initial detection but, perhaps more importantly, will be vital to establishing the field of gravitational-wave astronomy as wave detection becomes routine and wave detectors are used alongside ordinary telescopes to survey the sky.

A large community of researchers worldwide has been working in numerical relativity since the late 1980s. For a long time, it faced serious challenges in simulating stable evolutions of binary systems. That task is subtle because the binaries lose a very small fraction of energy in the emission of gravitational waves; as a result, their separation decreases on a time scale much greater than one orbital period. In 2005, however, a series of breakthroughs led to computer programs that have successfully evolved binary systems. And now that the field has matured, books on the subject are starting to appear.

Thomas Baumgarte and Stuart Shapiro have been collaborating on several frontline topics since 1996 and are major players in the field. Their book, *Numerical Relativity: Solving Einstein's Equations on the Computer*, is a well-written overview that includes a brief introduction to general relativity, a primer on setting up initial data from the theory, and tips on dealing with matter sources of a gravitational field. The authors also introduce the most commonly used numerical-relativity tools, including spectral methods and the mesh refinement techniques used to normalize the many scales involved in relativistic simulations. They particularly address the issue of how to cast the Einstein equations in manifestly hyperbolic form, which would make them treatable by well-established mathematical and numerical techniques.

Numerical Relativity starts with a review of general relativity and Einstein's field equations, including an introduction to gravitational waves and black holes, which both receive their own chapters later in the book. After a brief detour to discuss rotating stars and spherically and cylindrically symmetric collisionless clusters, the book moves on to discuss the central topics of binary black hole and neutron-star evolution. By including exercises, the authors aim to make *Numerical Relativity* useful as a graduate-level textbook and not just a reference. That feature, and the text's coverage of neutron stars, distinguishes it from the other comprehensive treatments of the subject, including *Introduction to 3 + 1 Numerical Relativity* (Oxford University Press, 2008) by Miguel Alcubierre and *Elements of Numerical Relativity and Relativistic Hydrodynamics: From Einstein's Equations to Astrophysical Simulations* (Springer, 2009) by Carles Bona, Carlos Palenzuela-Luque, and Carles Bona-Casas.

The text assumes that the reader has a solid understanding of general relativity, but in their preface, the authors wonder whether their book would also be useful to readers—mathematicians or computer scientists, for example—who might be interested in numerical relativity but who don't have a solid grounding in Einstein's theory. It is difficult to imagine that a book covering a field at the intersection of multiple disciplines could please all possible audiences. Nonetheless, *Numerical Relativity* hits the mark in its quite comprehensive coverage; it will be useful to practitioners in the field and especially to graduate students wishing to join them in this active and exciting area of research.

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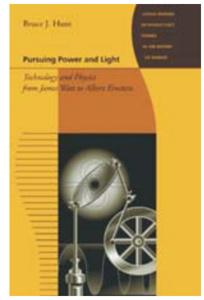
Pursuing Power and Light

Technology and Physics from James Watt to Albert Einstein

Bruce J. Hunt
Johns Hopkins U. Press, Baltimore, MD, 2010. $45.00 (182 pp.).
ISBN 978-0-8018-9358-2

Bruce Hunt's fine introduction to the history of physics in the 19th century is couched in a long tradition of studies linking science and technology. As is common in this tradition, science and scientists are more central to *Pursuing Power and Light: Technology and Physics from James Watt to Albert Einstein* than are technology, engineers, or inventors. The book's strong treatment of thermodynamics, kinetic theory, and electromagnetism befits the author of *The Maxwellians* (Cornell University Press, 1991) and one of the foremost authorities on James Clerk Maxwell and his followers.

For historians of science and technology, *Pursuing Power and Light* breaks no new ground. Hunt takes us through such familiar territory as the problems posed by steam engines and the search for increased fuel efficiency; the construction of new theories of heat and the emergence of the kinetic theory of gases; the successive formulations of what would become the first and second laws of thermodynamics; and the lengthy campaign to integrate new discoveries about magnetism and electricity into the classical worldview. Most of the usual suspects show up: Sadi Carnot, James P. Joule, Pierre Simon Laplace, Maxwell, William Thomson (Lord Kelvin), Hermann von Helmholtz, and others. The book is an excellent guide to this well-trodden terrain, particularly for students who will have heard the names in passing but have little sense of how they relate to one another or to the larger structure of physical theory.



Throughout the book, technology and engineering are used to stir the physicists to action, but are not examined or explained on their own merits. In that way, Hunt unfortunately follows many of the historians of physics before him. His attempts to highlight technology and engineering, with such chapters as "Steam and Work" and "Electric Power and Light," fall short. For example, sidebars embedded in the text serve to sketch out the workings of the three basic models of 18th-century steam engines, but readers are left with the impression that nothing important happens in steam-engine design after James Watt's condenser and Richard Trevithick's high-pressure engines. The reader never learns that, thanks in no small part to the thermodynamics that emerged from the efforts to improve them, the steam engines of the middle and late 19th century barely resembled those of earlier generations.

The situation gets a bit more complicated when Hunt links electrical theory