Einstein: His Life and Universe

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energy approach parameterizes the breaking in a general way using the "soft-breaking" Lagrangian. One can also study from a theoretical point of view how the supersymmetry might be broken and then predict patterns of the low-energy parameters that would allow recognition of a particular form of breaking. The books present good surveys of work on supersymmetry breaking and prepare readers to work on such questions. If supersymmetry were an unbroken theory, it would have no unpredicted parameters. All the parameters arise from the supersymmetry breaking, and measuring them will help researchers understand the breaking. The texts also contain major treatments of cosmology and important questions of physics beyond the standard model, including inflation, axions, the origin of the matter asymmetry in the universe, supersymmetry in the early universe, and connections to the string-theory moduli fields.

Binétruy has worked successfully at making his book pedagogically useful. He provides a roadmap of three paths through the book: one for researchers who want a theoretical introduction, the second for high-energy experimentalists, and the third for astrophysicists or cosmologists. The author often includes extra steps in derivations, which are helpful to a beginner or a reader coming from another field. He also provides useful hints to solving the exercises and includes a self-contained summary of basic notions of quantum field theory. His presentation of the general form of the supersymmetry soft-breaking Lagrangian is very pedagogical and physical. His 55 pages on string theory provide a good physical picture of compactifying to four dimensions and of phenomenological aspects of superstring models.

Dine's *Supersymmetry and String Theory* has more material on theoretical and nonperturbative aspects of the low-energy theory, with studies of anomalies, instantons, the strong *CP*-violation problem, monopoles, solitons, and alternative theories. His 170-page introduction to string theory covers a broad range of topics. Dine's book will be particularly attractive to theorists who want to be well informed about most of the theoretical issues related to physics beyond the standard model. A website to accompany the book (http://scipp.ucsc.edu/~dine/book/book.html) is under development, already has a useful set of errata, and is expected to have updates and solutions of selected problems.

If nature is described by a supersymmetric theory, windows are opened on early-universe cosmology and on physics at the Planck scale. Then we may be able to formulate a unified theory incorporating those fundamental areas, and we will be able to relate data from colliders to those topics, in both directions. The books by Binétruy and Dine indeed describe the state of the art and science today.

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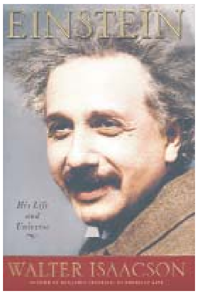
Einstein
His Life and Universe

Walter Isaacson
Simon & Schuster, New York, 2007. $32.00 (675 pp.). ISBN 978-0-7432-6473-0

When Walter Isaacson was managing editor of *Time* magazine in 1999, he canonized Albert Einstein as *Time*'s "Person of the Century"; the runners-up were Franklin D. Roosevelt and Mahatma Gandhi. Since then, much biographical material about the physicist has become accessible, and Isaacson makes good



use of it in *Einstein: His Life and Universe*. The author elaborates on two particularly interesting episodes in the historical record about Einstein's role in the atomic-bomb project: his attempts to warn Roosevelt of the Nazi nuclear threat and his later efforts to alert politicians about the consequences of building the bomb.

Before Einstein sent his first letter to Roosevelt alerting the president to the specter of a German bomb, he wrote to Charles Lindbergh in 1939, asking him to be the conduit to Roosevelt. The originator of that *Schnapsidee* (crazy idea) was the allegedly politically savvy Leo Szilard. Neither Szilard nor Einstein was aware that the famous aviator was Roosevelt's political enemy and had just been given a medal by Nazi leader Hermann Goering. Lindbergh did not respond. It was only after listening to Lindbergh in a nationwide radio address—with anti-Semitic undertones and pro-German sympathies, warning of involvement in European wars—that it dawned on the Jewish refugees that this was not their man. They then turned to Roosevelt's friend, economist Alexander Sachs, who eventually delivered the historic letter.

In December 1944 Einstein learned from his friend Otto Stern that a US atomic bomb would probably become a reality in the war. They felt that the policymakers had to be made aware of the immense consequences of that development. Hoping that Niels Bohr would support his appeal, Einstein wrote to him: "The politicians do not appreciate the possibilities and consequently do not know the extent of the menace" (page 483). Later, in 1957, Bohr stated, "It was terrible that no one over there," in the UK and the US, "had worked on the solution of the problems that would arise when it became possible to release nuclear energy; they were completely unprepared." (See "Memories of Niels Bohr," by J. Rud Nielson, in PHYSICS TODAY, October 1963, page 22). But in late December 1944, Bohr had rushed to Princeton, New Jersey, and assured Einstein that responsible statesmen were aware of the bomb, as well as "the unique opportunity for furthering a harmonious relationship between nations" (page 483), and he had persuaded Einstein to do nothing. A chance for Einstein to change history may have been lost. Bohr's own attempts to enlighten Winston Churchill and Roosevelt about the complementarity of the bomb—that it could be used for both war and peace—had been a disaster and led the two leaders to issue a joint order to their intelligence agencies to watch Bohr as a security risk.

In April 1945 Szilard again persuaded Einstein to write to Roosevelt. But his letter arrived too late: The president had died.

Isaacson's book is a sympathetic biography of Einstein as a mensch firmly embedded in the fabric of spacetime. It is well written and carefully researched with extensive notes. Although it perhaps presents the most readable account of Einstein's life, it fails to do as well in presenting Einstein's physics. In that area the book has to compete with Abraham Pais's magisterial Einstein biography *"Subtle Is the Lord...": The Science and the Life of Albert Einstein*, originally published in 1982 by Oxford University Press. Isaacson tries to describe Einstein's ideas selectively without sketching in a background of the contemporaneous physics. The result is that his representations are vague. The following is his flippant description of Erwin Schrödinger's great work: "But the world apparently already had enough Austrian philosophers, and he couldn't find work in that field. So he stuck with physics and, inspired by Einstein's praise of de Broglie, came up with a theory called 'wave mechanics.' It led to a set of equations that governed de Broglie's wavelike behavior of electrons, which Schrödinger (giving half credit where he thought it was due) called 'Einstein–de Broglie waves'" (page 330).

Isaacson rarely mentions quantitative confirmation of Einstein's physics, except for general relativity. The author's shunning of mathematical formulas, except $E = mc^2$ and a wrongly copied gravitational field equation, leaves the discussion of the physics mystifying and incoherent. It does not help that Isaacson says a tensor is "sort of a vector on steroids"(page 194). The author's intense focus on relativity and $E = mc^2$ in discussing Einstein's physics is particularly interesting. In *Einstein: The First Hundred Years* (Pergamon Press, 1980), an article titled "Assessing Einstein's Impact on Today's Science by Citation Analysis," by Tony Cawkell and Eugene Garfield, examined the 11 papers in the exact sciences from physics to physiology published before 1912 that were the most cited between 1961 and 1975. The four listed papers written by Einstein—the only author who had more than one paper cited—were his 1905 dissertation, published as "A New Determination of Molecular Dimensions," in 1906; his 1905 paper on Brownian motion; his 1911 correction of the 1906 paper; and his 1910 theory of critical opalescence. His papers on light quanta, special relativity, and L/V^2 = mass (later written as $E = mc^2$) are nowhere on the list.

Isaacson includes a few errors and misprints. For example, he mixes up Marcel Grossmann and Hermann Minkowski (page 33) and misspells Henry Siedentopf's name (page 106) and *kosmologische Glied* (page 255). In addition, contrary to what Isaacson writes, Armand Fizeau's measurement of the entrainment coefficient is not a null experiment (page 112); time dilation has an impact on our everyday life because it is responsible for cosmic rays near sea level and a functioning global positioning system (page 130); clocks run slower not in intense gravitational fields but in higher gravitational potentials (pages 148 and 349); the "fabric of spacetime" has to be credited to Minkowski (page 232); and Bohr escaped three years after, not during, the Nazi takeover of Denmark (page 482).

Despite the above errors, *Einstein* is a thoughtful, well-researched story about the physicist's life. But the wonderful book by Pais, which was republished by Oxford University Press in 2005, with a preface by Roger Penrose, is still the best introduction to Einstein's physics.

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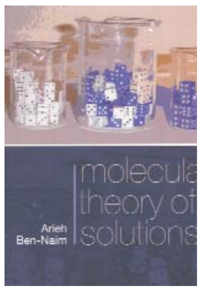
Molecular Theory of Solutions

Arieh Ben-Naim
Oxford U. Press, New York, 2006. $168.00, $64.50 paper (380 pp.). ISBN 978-0-19-929969-0, ISBN 978-0-19-929970-6 paper

The problem with solutions is that they are messy. In both a formal and a practical sense, liquids, especially concentrated aqueous solutions, pose complex problems. Many great scientists in the field of statistical mechanics, including Max Born, Peter Debye, John Kirkwood, Lars Onsager, Joseph Mayer, and Harold Friedman, have worked on those vexing problems in the last century. Progress has been in fits and starts for the most concentrated aqueous solutions. Neither analytical predictions since Debye and Erich Hückel's research on solutions at infinite dilution nor accurate ways to analyze the experimental data have been easy to come by.



In *Molecular Theory of Solutions*, Arieh Ben-Naim, a professor in the department of physical chemistry at the Hebrew University of Jerusalem, gives a cogent view of how we can begin to work solution thermodynamics problems of such complexity. Do not confuse Ben-Naim's book with Ilya Prigogine's *The Molecular Theory of Solutions* (Interscience, 1957), which focuses on cell and lattice models. Also, Ben-Naim's text is not about liquid-state theory and many-body approaches, as covered in Jean-Pierre Hansen and Ian R. McDonald's *Theory of Simple Liquids* (Academic Press, 1976) or Keith E. Gubbins and Christopher G. Gray's *Theory of Molecular Fluids: Fundamentals* (Oxford U. Press, 1984). Ben-Naim's is truly a book on multicomponent liquid solutions.

Although *Molecular Theory of Solutions* introduces pair distribution functions and their associated moments—concepts from modern liquid-state theory—that feature is but a prelude to