

# Nature, nurture, and the beginnings of a stellar career

## Nuclear Forces The Making of the Physicist Hans Bethe

Silvan S. Schweber  
Harvard U. Press, Cambridge, MA,  
2012. \$35.00 (579 pp.).  
ISBN 978-0-674-06587-1

Reviewed by Lillian Hoddeson

It is altogether fitting that the late Hans Bethe, among the most important physicists of the 20th century, has as his biographer Silvan Schweber, one of the world's leading historians of physics. *Nuclear Forces: The Making of the Physicist Hans Bethe* is an authoritative, thoroughly researched, and provocatively interpreted account of the first half of Bethe's life. A must-read for practicing physicists and historians of the past century's physics, the book may also interest general readers concerned with the nurturing of young scientists.

One of Schweber's goals was to offer a history in which Bethe comes to be "representative of the role played by physicists during the twentieth century." Thus Schweber humanizes his account of how quantum mechanics, applied to concrete problems in the middle of the century, yielded such modern subfields as nuclear physics, solid-state physics, and nuclear astrophysics, all of which benefited crucially from Bethe's fundamental contributions.

Even more compelling, if controversial, is the book's attempt to explain how the forces in young Bethe's life shaped him into the remarkably productive physicist that he was—for seven decades. Those "nuclear forces" include Bethe's high intelligence; his scientific and mathematical abilities; his superb memory; the influence of his parents, teachers, colleagues, and friends; and the social and political circumstances of the period. The result was Bethe's legendary personality, en-

ergy, passion, commitment, honesty, integrity, objectivity, thoroughness, and creativity in physics. (Additional insight on Bethe, from Schweber and others, can be found in PHYSICS TODAY's October 2005 special issue following Bethe's death in March of that year.)

Bethe's social, political, and religious views grew largely from those of his highly educated family and its culture of assimilated Jewishness. His father, Albrecht, a physiologist, helped shape Hans's unyielding belief in rationality and in science firmly based on observations. The two would discuss science, philosophy, and life during long walks in the mountains. Albrecht also modeled for Hans the importance of helping others. As a young historian in the mid 1980s, I benefited personally from that aspect of Bethe's character when the great man took several days to visit Los Alamos, New Mexico, and check my classified manuscript about the history of bomb-building during the Manhattan Project.

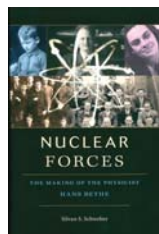
The intensity and passion that underpinned Bethe's creativity in physics, Schweber suggests, derived from the deep and at times smothering love between Hans and his mother, Anna, a musician and writer. While her overprotective hold was often a burden for Hans, Schweber speculates that it helped create his unusually high level of self-confidence, which made it possible for him to take on ambitious problems that others would not think to address.

One of Bethe's most important and influential teachers was his University of Munich professor Arnold Sommerfeld, in whose graduate seminar Bethe matured as a research physicist. Collaborating with Sommerfeld, Bethe would write most of the roughly 300-page review article "Electron Theory of Metals," which was published in 1933 in the *Handbuch der Physik* and which became the theoretical basis for the new subfield of solid-state physics.

Among the most pervasive features of Bethe's emerging style was his fundamental criterion that theory must be grounded in real-world observation—a view he shared with other young physi-

cists in his circle, including Edward Teller, Rudolf Peierls, Nevill Mott, Enrico Fermi, and later Richard Feynman. Bethe's physics would not be aimed at formulating radically new ideas, but rather at critically analyzing and extending theories and formulating models that could test their validity.

Through the example of Bethe, Schweber narrates other important physics stories, including the shift of the center of physics from Germany to



the US owing to the rise of Hitler. After his abrupt dismissal from his post at the University in Tübingen for being Jewish, Bethe, with Sommerfeld's help, found a series of new positions that ended at Cornell University. Bethe liked almost everything about the US, in-

cluding the pragmatic emphasis of American science and the American practice, then rare in Germany, of collaboration between theorists and experimentalists. Schweber gives masterful expositions of Bethe's physics at Cornell, often with collaborators, especially his work on nuclear reactions, on energy generation in stars, and on meson theory. Among his prewar publications were three lengthy review articles with Stanley Livingston and Robert Bacher published in *Reviews of Modern Physics*. This "Bethe Bible" accomplished for the field of nuclear physics what Bethe's earlier review with Sommerfeld had accomplished for solid-state physics.

Bethe's fulfilling work and life at Cornell changed him so much that later, in 1947, when he was honored by Sommerfeld's offer of the prestigious Munich chair in theoretical physics, he turned it down. He explained, "For us who were expelled from our positions in Germany, it is not possible to forget." In any case, he added, "I am much more at home in America than I ever was in Germany."

*Nuclear Forces* includes some negative stories about Bethe—for example, how he deeply hurt physicist Hilde Levi by yielding to his mother's pressure to break his engagement to her just days before their planned wedding. Anna, although Jewish herself, opposed her son's marriage to a Jew. She later approved his marriage to Rose Ewald, and

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he and Rose would have a long and happy marriage, although Anna almost wrecked that marriage, too, when she came to live with them from October 1939 to January 1941.

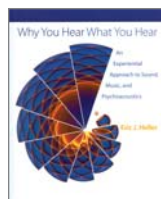
The book's main narrative ends in late 1939. By then the discovery of nuclear fission had opened the door to the atomic age, to which Bethe subsequently made crucial contributions at both Los Alamos and Cornell. It is urgent that Schweber arrange to complete a concluding volume of this biography; that promises to be as fascinating and as important as the first.

## Why You Hear What You Hear

### An Experiential Approach to Sound, Music, and Psychoacoustics

Eric J. Heller  
Princeton U. Press, Princeton, NJ, 2013.  
\$99.50 (624 pp.).  
ISBN 978-0-691-14859-5

There's a good reason Harvard University's Eric Heller titled his book *Why You Hear What You Hear: An Experiential Approach to Sound, Music, and Psychoacoustics*. He hopes the reader will learn



from doing. Much of those three areas of acoustics can be experienced via the ears or can be shown in animations, which can often make those topics accessible to students without much math or physics background. Consequently, the book frequently directs readers to its extensive supporting website, <http://www.whyyouhearwhatyouhear.com>. For several decades now, books on acoustics have been supplemented with sound recordings, and the use of the Web is an important next step. This book's website contains suggestions on using a variety of readily available software for sound analysis and synthesis and for creating wave-behavior animations. It also links to many other animations and sound media.

Heller's combined topic order is somewhat unusual. For that reason, *Why You Hear What You Hear* tells you "how to use this book": Because of the extensive cross-referencing, readers are encouraged to abandon the traditional linear approach and to navigate to chapters—and also to the website—according to interest and need.

The book grew from a course called

The Physics of Music and Sound that Heller taught at Harvard, first as a core curriculum course in physics, and later as a general education course. For non-physics majors taking music or any of the many other courses that involve sound, this book is a fresh alternative to some other texts. It's also deeper than most. However, for the nonspecialist audience, depth might not always be an advantage.

The first 15 of the book's 28 chapters develop the science of acoustics in logical and often novel ways. They're fol-

lowed by five chapters on musical instruments and the voice; six on psychoacoustics, with an emphasis on pitch perception and consonance; one on room acoustics; and another on outdoor sound. For some humanities students, the book's equations and some serious physics discussion may trigger an allergic reaction. However, derivations for equations relating to topics such as the exponential horn or Sabine's reverberation are often sequestered in colored boxes, an organization that indicates to readers with a distaste for

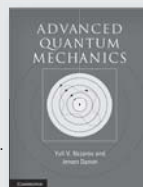
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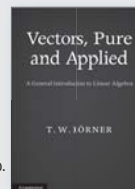
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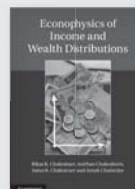
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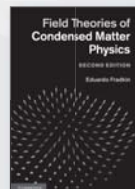
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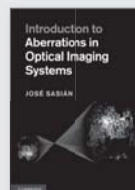
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