

BOOKS

Boltzmann Bio: Solid, Readable, With Reservations

Boltzmann's Atom: The Great Debate that Launched a Revolution in Physics

▶ David Lindley
Free Press, New York, 2001.
\$24.00 (260 pp.).
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Reviewed by Clayton A. Gearhart

The Austrian theoretical physicist Ludwig Boltzmann shaped much of the physics of the 20th century. His influence was central to Max Planck's 1900–1901 papers on blackbody radiation, to Josiah Willard Gibbs's 1902 formulation of statistical mechanics, and to Albert Einstein's 1905 papers on the light quantum and on Brownian motion. Boltzmann was not only one of the most creative and influential physicists of the 19th century, but one of its most colorful personalities as well. His amusing account of his visit to California in 1905, "Journey of a German Professor to Eldorado," has been widely reprinted, and the number and variety of Boltzmann stories rival those told about Richard Feynman!

David Lindley's new popular biography is thus a welcome addition to the Boltzmann literature. Lindley is a physicist with wide experience as an editor and science writer. He gives a solid account of Boltzmann's life, one that makes good use of the collections of Boltzmann's correspondence that have appeared in recent years. There are also thumbnail sketches of such figures as Ernst Mach, James Clerk Maxwell, and Gibbs.

It is no easy matter to present Boltzmann's scientific achievements to general readers, and here the record is mixed: Lindley gives a good account of the 1877 paper that related entropy to probability—the principle that Planck later wrote down in the famous equation $S = k \log W$. The

section on the H -theorem is perhaps a little less successful (hardly a criticism in view of its difficulty). There is also a fine account of Boltzmann's visit to England for the 1894 British Association meeting, where he found the reception of the H -theorem and kinetic theory generally to be considerably more favorable than elsewhere in Europe. There is, however, only a brief mention of Boltzmann's papers of 1871 and later, in which he developed the formalism of equilibrium statistical mechanics that Gibbs later put to such good use.

Lindley does a good job of describing the uneven reception of kinetic theory in Germany. The criticisms of Josef Loschmidt and Ernst Zermelo, based respectively on the time-reversibility of Newton's laws and on Poincaré's recurrence theorem, forced Boltzmann to clarify the probabilistic nature of both the H -theorem and the second law of thermodynamics. Other objections from the energeticists and from Mach were less fruitful. Boltzmann found all of them discouraging.

These criticisms, along with failing eyesight and other health problems (including increasingly serious if intermittent depression), plagued his later years. Lindley shows how the controversy over kinetic theory, and more generally over the role and scope of theoretical physics, eventually led Boltzmann to write and lecture on the philosophy of science. Here again, however, the author's discussion is a little too brief to give a comprehensive picture. Readers looking for a more detailed and nuanced account of Boltzmann's scientific and philosophical writings may wish to consult the recent works of Carlo Cercignani (*Ludwig Boltzmann: The Man Who Trusted Atoms*, Oxford U. Press, 1998) and John Blackmore, editor, (*Ludwig Boltzmann, His Later Life and Philosophy, 1900–1906*, Kluwer, 1995).

There are some questionable statements and interpretations that readers should be aware of. For example, there were no "later editions" of Boltzmann's 1896–1898 *Lectures on Gas Theory*. The Franco-Prussian War of 1870–71 was considerably more than

a "skirmish." Lindley's account of Maxwell's religion and his statement that Maxwell "kept science and religion separate" struck me as dubious, as did his suggestion that Gibbs was in some sense neutral in the late 19th-century controversy over the existence of atoms and molecules. One could cite other examples. None is particularly serious—general readers will not be badly misled, and others will readily encounter corrections—but they are in sum unfortunate.

These problems should in no way discourage readers from a well-written and informative popular biography that fills a real gap in the Boltzmann literature. It serves as a fine account for general readers and a good starting point for those who want to go more deeply into Boltzmann's life and thought.

Atom: An Odyssey from the Big Bang to Life on Earth . . . and Beyond

▶ Lawrence M. Krauss
Little, Brown, New York, 2001.
\$26.95 (320 pp.).
ISBN 0-316-49946-3

Lawrence Krauss is a physicist who works on cosmological problems and who has been led by this interest to work on such astrophysical topics as the ages of globular clusters. He has written *Atom: An Odyssey from the Big Bang to Life on Earth . . . and Beyond* for the well-educated lay reader. It is the story of the universe from the distant past to the distant future, with many topics of interest to the human race in the middle. When I was asked to review this book, I thought I would seek an opinion from someone interested in science but with no training in physics. I quickly concluded however, that you really do need to understand physics at the level of a college course or two to appreciate the book. In other words, this is not a tutorial; it makes little attempt to describe the underlying

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