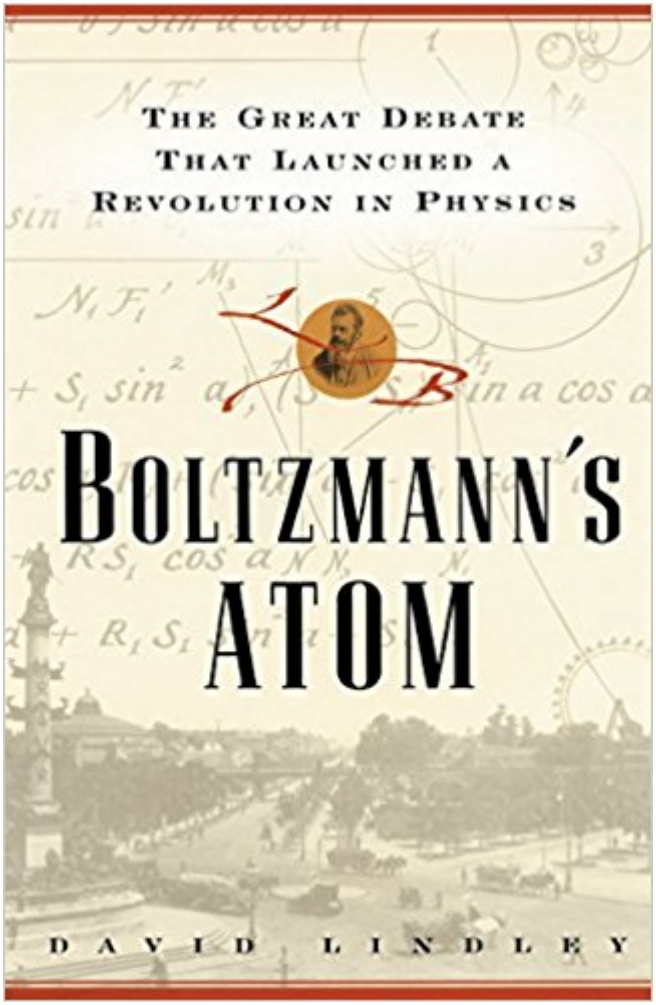
Boltzmanns Atom: The Great Debate That Launched A Revolution In Physics



Synopsis

In 1900 many eminent scientists did not believe atoms existed, yet within just a few years the atomic century launched into history with an astonishing string of breakthroughs in physics that began with Albert Einstein and continues to this day. Before this explosive growth into the modern age took place, an all-but-forgotten genius strove for forty years to win acceptance for the atomic theory of matter and an altogether new way of doing physics. Ludwig Boltz-mann battled with philosophers, the scientific establishment, and his own potent demons. His victory led the way to the greatest scientific achievements of the twentieth century. Now acclaimed science writer David Lindley portrays the dramatic story of Boltzmann and his embrace of the atom, while providing a window on the civilized world that gave birth to our scientific era. Boltzmann emerges as an endearingly quixotic character, passionately inspired by Beethoven, who muddled through the practical matters of life in a European gilded age. Boltzmann's story reaches from fin de siÃƒÂ¨cle Vienna, across Germany and Britain, to America. As the Habsburg Empire was crumbling, Germany's intellectual might was growing; Edinburgh in Scotland was one of the most intellectually fertile places on earth; and, in America, brilliant independent minds were beginning to draw on the best ideas of the bureaucratized old world. Boltzmann's nemesis in the field of theoretical physics at home in Austria was Ernst Mach, noted today in the term Mach I, the speed of sound. Mach believed physics should address only that which could be directly observed. How could we know that frisky atoms jiggling about corresponded to heat if we couldn't see them? Why should we bother with theories that only told us what would probably happen, rather than making an absolute prediction? Mach and Boltzmann both believed in the power of science, but their approaches to physics could not have been more opposed. Boltzmann sought to explain the real world, and cast aside any philosophical criteria. Mach, along with many nineteenth-century scientists, wanted to construct an empirical edifice of absolute truths that obeyed strict philosophical rules. Boltzmann did not get on well with authority in any form, and he did his best work at arm's length from it. When at the end of his career he engaged with the philosophical authorities in the Viennese academy, the results were personally disastrous and tragic. Yet Boltzmann's enduring legacy lives on in the new physics and technology of our wired world. Lindley's elegant telling of this tale combines the detailed breadth of the best history, the beauty of theoretical physics, and the psychological insight belonging to the finest of novels.

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Customer Reviews

Born in Austria and something of a bumpkin by nature, the 19th-century physicist Ludwig Boltzmann did not fit in easily in the highly cultured German universities at which he taught for many years. To add to his difficulties, Boltzmann stirred up controversy by proposing that scientists could make intelligent guesses about the behavior of atoms, which, though they moved randomly, could be described by certain probabilistic generalizations. His suggestion, hinging on novel interpretations of statistical theory, was not immediately acclaimed. "To an audience of physicists raised in the belief that scientific laws ought to encapsulate absolute certainties and unerring rules," writes scientist and journalist David Lindley, "these were profound and disturbing changes." Opposed by the then-influential physicist and philosopher Ernst Mach, who urged that scientists stick to classical thermodynamics, Boltzmann was hard-pressed to convince his colleagues that the behavior of atoms could be explained by laws thought to apply only to the gaming table. Mach objected, and with some cause, that "the fact that the theory worked was not enough to prove that the assumptions on which the theory rested were true." It would take the next generation of scientists, among them Albert Einstein, to provide more solid proof for Boltzmann’s hunches. And, while Mach’s contributions to physics have largely been superseded, Boltzmann’s endure in quantum mechanics and the Maxwell-Boltzmann distribution for the velocities of atoms in a gas. In this lively account, David Lindley tells the story of Boltzmann’s many failures, and of his eventual success. --Gregory McNamee --This text refers to an out of print or unavailable edition of this title.

In this well-researched study, Lindley (The End of Physics), a physicist and editor at Science News,

follows the career of Ludwig Boltzmann, who played a quiet yet crucial role in physics in the late 19th and early 20th centuries. In 1897, Boltzmann proposed the then-controversial premise that matter consisted of atoms and molecules. At the time, no proof of atomic theory yet existed, and many people considered it only a fiction. Boltzmann was the first to pursue the idea that molecules in gases move with varying velocities and that these variations could be evaluated using statistical methods. Lindley describes the controversy surrounding Boltzmann's scientific publications and his angst when his theories failed to gain wide acceptance. His search for academic acceptance led him to professorships in Vienna, Graz, Munich and finally back to Vienna, sometimes these settings blur as the author jumps backward and forward in time. But Lindley's precise detailing of the inception of modern atomic theory does not falter, and he leads the lay reader along with straightforward analogies. In 1905, toward the end of Boltzmann's life, Einstein applied Boltzmann's techniques, but his results were largely overshadowed by his papers on relativity, published the same year. Boltzmann, meanwhile, had sunk into a clinical depression. In the fall of 1906 he took his own life. Within a few years, his fundamental tools would enable the development of quantum theory. Lindley offers a well-crafted blend of biography and science; readers who sought out David Bodanis's E=mc2 will also enjoy this similar attempt to explain for laypeople the basis of modern physics. (Jan. 18) --This text refers to an out of print or unavailable edition of this title.

Lindley manages to convey the essence of Boltzmann's contributions and the controversies surrounding them correctly and with insight and grace. Especially interesting is Planck's and Einstein's adoption of Boltzmann's methods for different purposes. The controversy over the nature of entropy increase and the arrow of time continues unabated.

Brilliant book on Ludwig Boltzmann, the creator of our modern notions about statistical entropy. Lindley is particularly fascinating on Mach and Boltzmann and just how Boltzmann was marginalized in spite of his remarkable contributions to modern science.

It's a good and thorough read concerning the debate around 1900 between physicists who wanted to study the Atom, versus those who didn't believe in atoms, or thought physics should do without atoms. The central figure was the physicist Ludwig Boltzmann of Vienna.

I loved this book. I was very wrapped up in it throughout. I highly recommend it to any physics

students who are about to undertake a course in Thermo or Stat Mech. Amazingly, Lindley does a better job of explaining some things than many textbooks. I learned a lot from this book. I think seeing the historical development aides in learning the science.One downside is the lack of more in-depth science. Only one equation is written (S=klnw). It would be nice to see more of the physics being developled...possibly an idea for a new textbook...All in all, very fun. I would love to read more history of physics books that are written similarly.

This is a very good book to learn about Boltzmann’s Constant, etc. Also get the one on Paul Dirac, "The Strangest Man" if you like science history.

Today we have little problem understanding that certain laws of physics are probabilistic. Statistical probabilities are an integral part of trying to understand the behavior of atoms. But in the late 1800ÃƒÂ¢Ã â ¬Ã â„¢s suggesting that we understand nature by statistics was anathema to most physicists. Nature had ÃƒÂ¢Ã â ¬Ã Å“lawsÃƒÂ¢Ã â ¬Ã Â• and those laws were either true or not true. If they were statistical probabilities they were not ÃƒÂ¢Ã â ¬Ã Å“laws.ÃƒÂ¢Ã â ¬Ã Â• It was Ludwig Boltzmann who revolutionized the way we think of atoms by showing, for example, that in the second law of thermodynamics the increase of entropy at any given moment in time is a very high probability but never an absolute certainty. It is not impossible that heat could flow to a hotter body; it is just enormously unlikely. This change in thinking about the way we understand nature led to so much more after BoltzmannÃƒÂ¢Ã â ¬Ã â„¢s death. He spent much of his life repeating his point again and again. Plagued by bad health, long periods of apathy and depression that he called ÃƒÂ¢Ã â ¬Ã Å“neurasthenia,ÃƒÂ¢Ã â ¬Ã Â• and a frequent sense that his work was not appreciated, Boltzmann committed suicide at age 62. Largely unknown to him, his work opened the door to a new way of understanding the very small in nature ÃƒÂ¢Ã â ¬Ã â œ a critical part of the foundation of physics.David Lindley is a fine writer and his descriptions of BoltzmannÃƒÂ¢Ã â ¬Ã â„¢s life and work are clear and easy to follow. My only problem with the book is with the digressions. Lindley also wrote the superb biography of Lord Kelvin published three years after this book. In the Kelvin biography he also digresses and talks for several pages about people that Kelvin worked with. I found those discussions interesting, relevant and well-written. But I did not feel that way about some of the digressions in this book. LindleyÃƒÂ¢Ã â ¬Ã â„¢s discussions of other historical figures are less directly relevant here at times. For example, he spends much of the second chapter talking about the atomic theories of Lucretius and Democritus. The idea is to give a thumbnail sketch of the history of atomic theory but to this reader it was much

more than I wanted to know in a book about the life of Boltzmann. His dozen page discussion of the background, life and work of the American Josiah Gibbs is much more directly relevant to BoltzmannÃƒÂ¢Ã â ¬Ã â„¢s work but seemed to include more than was necessary. Other digressions like the ones on Helmholtz and Maxwell I thought were better tied to the overall context. But this is really a minor problem. Perhaps it is because his book on Kelvin is so consistently strong that my disappointment rises because I am comparing LindleyÃƒÂ¢Ã â ¬Ã â„¢s work here against his own later book. In any case this work stands by itself as a worthwhile book on both Boltzmann and the state of physics in the late 1800's.Ludwig Boltzmann is not a household word, even among those with some background in science. But his place in the history of physics is critical in the development of the modern scientific worldview. LindleyÃƒÂ¢Ã â ¬Ã â„¢s book gives Boltzmann his due and fleshes out the life of a brilliant but often tortured person. I recommend the book.

This is a smoothly written biography of Boltzmann, focusing on whether atoms should be thought of as real because of their use in statistical mechanics. It does a superb job giving the reader a picture of the scientific community in 19th century Vienna. Loschmidt and Stefan (of the Stefan-Boltzmann law) now feel like people rather than merely names I have seen. Lindley is a good storyteller and gives drama to the story by making it a confrontation between Boltzmann and Ernst Mach (famous to the public for the Mach number in shock waves). Boltzmann turns out to be a miserable guy who sounds like he had something like manic-depression. Mach is made to seem less imaginative and more captious than we was: it is useful and intellectually healthy to examine how real the concepts one works with are, and to clarify what we get directly and unarguably from experience and what comes from intellectual structures that we build. For example, this project of Mach's was also pursued by Heinrich Hertz, who examined whether the notion of "force" is primitive in physics or derived from more fundamental things and merely is a useful way of organizing our thought.

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