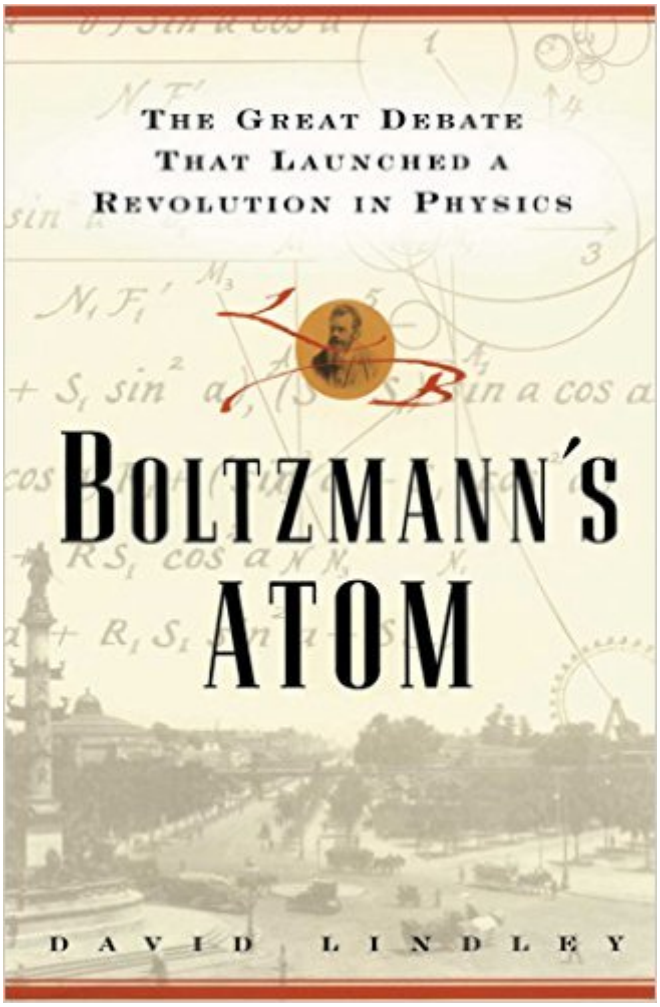
Boltzmanns Atom: The Great Debate That Launched A Revolution In Physics



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 siÃ¨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

A century ago, many physicists doubted the existence of atoms. Atoms were a lucky guess by the ancient Greeks, but ever since Lucretius, the belief in atoms has implied a mechanical and even godless universe. Atoms were seen, in the nineteenth century, as hypothetical, even imaginary, entities which might help in the bookkeeping of following chemistry experiments, but had only a theoretical rather than a physical existence. It was the Austrian physicist Ludwig Boltzmann who showed that atoms really were the teensy particles that made the formulas for heat and gases so consistent. It is a pleasure to read _Boltzmann’s Atom: The Great Debate that Launched a Revolution in Physics_ (The Free Press) by David Lindley, for it brings this important physicist to light and restores credit to a flawed but important thinker.What Boltzmann did was to take kinetic theory (the concepts of how gases flow, exert pressure, and exhibit temperature) into the uncharted waters of assuming that tiny atoms were responsible for the manifestations of the theory. He insisted that atoms behaved in orderly and predictable ways that could be understood. Furthermore, he realized that although we could never measure the uncountable trillions of atoms in a liter of gas, their behavior could be understood by approximation using the laws of probability. We could not know exactly what all those atoms were doing, but probability explained it to a reliable approximation. The idea of probability demonstrating what is real was anathema to many scientists

of the nineteenth century, and Lindley, in a cogent explanation of thermodynamics, tries to show both sides of the debate, which eventually, of course, Boltzmann was shown to have won.

Author Lindley admits that the definitive biography of Ludwig Boltzmann still hasn't been written, but that doesn't make him any less an important figure in the history and development of physics and science in general.Boltzmann is one of those rare figures that revolutionized the way scientists solve problems, choose problems -- indeed, the way they see the world. Einstein and Planck relied upon his work (and his conviction that the basic building blocks of matter were atoms) in their mathematical descriptions of Brownian motion and quantum theory (respectively).But Boltzmann stands out as an industrial-age tragic figure. Despite winning international accolades, his greatest contributions were the focus of acerbic and unrelenting derision at home. He suffered from depression and a paralyzing lack of interpersonal confidence at various times during his life until eventually, he hung himself out a window.That much we would know without this recent contribution to the story of his life. What makes this book remarkable is that it explains the cultural and social circumstances that might be described as the boundary conditions on Boltzmann's brain. Lindley explains the basic principles of all the major advances in physics in such a way that one can clearly make out the progression of thinking that evolved during the latter 19th century, the heyday of classical, Newtownian physics. He takes the mystery out of it. But he also makes it obvious that science does not operate in a cultural or political vacuum. It is not enough just to be right.This is not a fawning accout of our tragic hero. Where Boltzmann is childish or petulant, Lindley tells us so. Nor does this tale degenerate into impossible, soap opera, paperback romance novel prose.

Ludwig Boltzmann (1844-1906) was an Austrian theoretical physicist and made important contributions to the kinetic theory of gases and thermodynamics. His work was based on the hypothesis of the existence of atoms, and was not accepted by the majority of scientists in those days. In the undergraduate physics course, our teacher told us that Boltzmann committed suicide. I wanted to know why he ended his life so sadly, but did not have a chance to learn about it for many years. David Lindley's book gave me a clear answer to my question and much more. I was intrigued by the story about the romance between Boltzmann, a youth "whose energies and thoughts were rarely distracted from physics," and Henriette von Aigentler, a young student at a teacher training college.The author gives a readable account not only of Boltzmann's life and work but also of work and philosophy of those scientists who opposed his theory, developed a similar theory, or confirmed his hypothesis, James Clerk Maxwell, Wilhelm Ostwald, Ernst Mach, Josiah Willard Gibbs, Max

Planck and Albert Einstein among them. Thus readers can get good understanding about Boltzmann's depressive mood and the significance and greatness of his work. The conflict between Boltzmann's atomic hypothesis and Mach's philosophy that science should be based only on observable facts is discussed especially in detail in this book.Lindley teaches us that a similar conflict also exists nowadays. Namely, he writes in Chapter 7, ". . . now some physicists argue for the existence of superstrings and other curious entities that will never be seen directly.