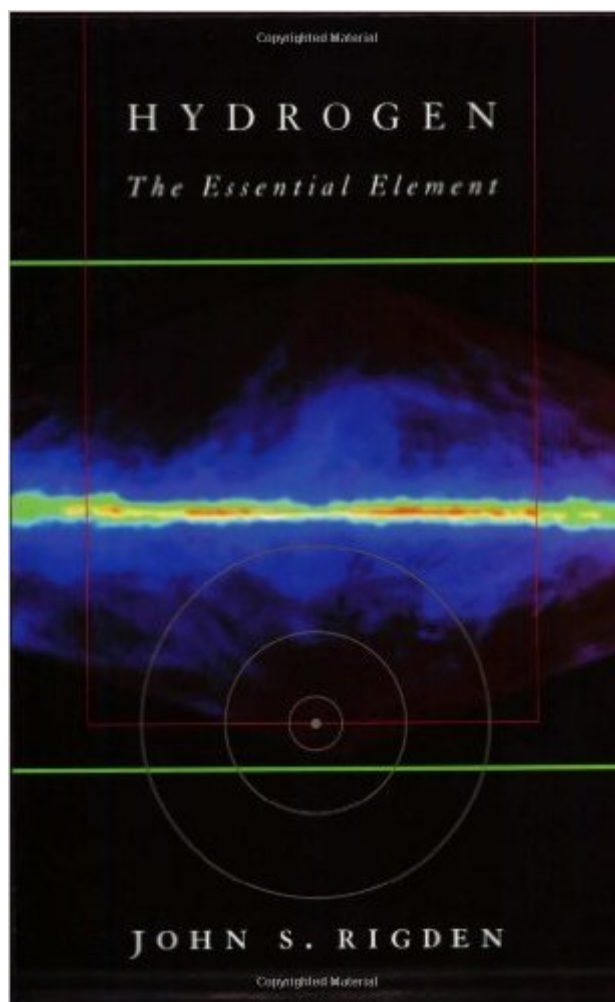


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# Hydrogen: The Essential Element



## Synopsis

Seduced by simplicity, physicists find themselves endlessly fascinated by hydrogen, the simplest of atoms. Hydrogen has shocked, it has surprised, it has embarrassed, it has humbled--and again and again it has guided physicists to the edge of new vistas where the promise of basic understanding and momentous insights beckoned. The allure of hydrogen, crucial to life and critical to scientific discovery, is at the center of this book, which tells a story that begins with the big bang and continues to unfold today. In this biography of hydrogen, John Rigden shows how this singular atom, the most abundant in the universe, has helped unify our understanding of the material world from the smallest scale, the elementary particles, to the largest, the universe itself. It is a tale of startling discoveries and dazzling practical benefits spanning more than one hundred years--from the first attempt to identify the basic building block of atoms in the mid-nineteenth century to the discovery of the Bose-Einstein condensate only a few years ago. With Rigden as an expert and engaging guide, we see how hydrogen captured the imagination of many great scientists--such as Heisenberg, Pauli, Schrödinger, Dirac, and Rabi--and how their theories and experiments with this simple atom led to such complex technical innovations as magnetic resonance imaging, the maser clock, and global positioning systems. Along the way, we witness the transformation of science from an endeavor of inspired individuals to a monumental enterprise often requiring the cooperation of hundreds of scientists around the world. Still, any biography of hydrogen has to end with a question: What new surprises await us?

## Book Information

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## Customer Reviews

It makes sense, if you are going to try to understand something, to go to the simplest instance of it and get all the information you can from the subject unimpeded by complications. Hydrogen is the simplest of all atoms. It is all around us; though hydrogen gas floats out of our atmosphere to join the hydrogen atoms that are in the "vacuum" of space, hydrogen makes up a large proportion of stars, water, and ourselves. John S. Rigden has written an admiring tribute to the simplest atom, Hydrogen: The Essential Element (Harvard University Press). It turns out that hydrogen has played an enormous role in our understanding of matter and energy, and that the simplest of atoms is so complicated and surprising that Rigden's book is a continual source of elemental wonder. Hydrogen is element number one, only a single electron orbiting a single proton. Repeatedly Rigden shows that this simplicity has been a boon to research. The lessons learned from this basic atom, in Rigden's story, form a history of physics in the twentieth century. The refinements to theory have largely been to explain the dark bands in the spectrum produce when hydrogen is made to glow. Niels Bohr produced the first modern picture of the atom, incorporating the experimental data from Rutherford and the hydrogen spectrum, but recklessly disregarding the historic laws of physics which he felt could not apply within the atom. He thus began the amazingly successful and fabulously strange quantum explanation for the behavior of matter. Rigden has not just included experimenters and theorizers, but also appealing stories about them, such as I. I. Rabi developing magnetic resonance in the 1930s to measure the nucleus, but then in 1988 being wheeled into a Magnetic Resonance Imaging machine. He said, "It was eerie..."

Written for the layman, the author takes you through the history of modern physics through a series of essays on the historical quest to understand the simplest atom. John Rigden was very clever in the layout. It was not until the third chapter or so that I realized he was doing this by writing short 7 - 10 page vignettes on those physicists most important in developing a model of hydrogen that explains its observed properties. Obviously, one could see that by looking at the chapter headings but for some reason I missed that the first time I read the book. By focusing on the one physicist at a time, and the specific question that physicist was trying to answer at a particular time, Rigden is able to walk you down a path that actually suggests you might understand quantum mechanics (QM) and the wave function, which united QM with Einstein's theory of relativity. Rigden uses almost no formulas in the book; the few that he does is simply to give the reader an example of how simple some of the concepts can be when placed in mathematical formulas. You won't understand the symbology, but you will be amazed at the elegance of the formulas. None is as good as Einstein's  $E = mc^2$  but they come close. It is very, very good. Along the way you will meet some very interesting

physicists, most who had very humble beginnings. As interesting as the physicists themselves are, the implications of their discoveries and the strangeness of the simplest atom will have you re-reading the book. This is a relatively compact book -- I have the hardback, which I see is now going for \$60 and more through resellers on -- perfect for your carry-on. The short essays allow for easy reading during even the shortest of flights.

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