



Hydrogen: The Essential Element

By John S. Rigden

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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?

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Hydrogen: The Essential Element By John S. Rigden Bibliography

- Rank: #372993 in Books
- Brand: Brand: Harvard University Press
- Published on: 2003-11-30
- Released on: 2003-10-08
- Ingredients: Example Ingredients
- Original language: English
- Number of items: 1
- Dimensions: 8.12" h x .70" w x 5.50" l, .69 pounds
- Binding: Paperback
- 288 pages

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Editorial Review

From [Booklist](#)

Justly acclaimed for his lucid biography of physicist I. I. Rabi, Rigden here shifts his focus from person to problem, chronicling how one enduring conundrum--that of explaining the element hydrogen--has challenged two centuries of brilliant scientists. Beginning with the British chemist William Prout's pioneering hypothesis defining hydrogen as nature's fundamental building block, Rigden recounts episode after episode in which the mysteries of the simplest element--a bare proton and electron--have yielded their secrets to intellectually daring and resourceful researchers. In the process, he clarifies for general readers the nature of the scientific enterprise, in which elegant theories must meet the test of empirical verification. Nor does Rigden neglect the often-quirky personalities of the humans who frame the theories and conduct the experiments: we share, for example, in the frivolous musical ditties composed by Bloch and in the irreverent jokes circulated about Dirac. Readers will marvel that in its very first square, the periodic table holds so much science, so much history, so much humanity. *Bryce Christensen*

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Review

A prominent physicist once said, "to understand hydrogen is to understand all of physics." That is perhaps a bit of an overstatement; but it is no exaggeration to say that John Rigden's eminently readable book is a unique guide to the overwhelming role in science and technology of that simplest of all elements--from the origin of the universe itself to the most recently created lab sensation, the Bose-Einstein condensate. A book to be treasured by laypersons and experts alike. (Gerald Holton, author of *Einstein, History, and Other Passions*)

Using the leitmotif of the hydrogen atom, John Rigden gives us an elegant review of the development of modern physics. This simplest of all atoms provided the challenge to Bohr, Heisenberg, Dirac, Rabi, Ramsey, and the other founders of 20th century physics. As the leading character, it carries the plot gracefully even to the subtlest of corrections provided by the quantum field theory of the 1940's and the most recent breakthrough by Dan Kleppner and his students in the late 1990's which earned some of those students the 2001 Nobel Prize for the observation of Bose-Einstein condensates. The writing is lucid and accessible, and should be easy going for the lay reader who enjoys his science with a minimum of mathematics. It is quite astonishing that the story loses almost none of its drama and coverage when filtered through the efforts to really, really understand hydrogen. (Leon Lederman, Nobel Laureate of Physics, 1988)

John Rigden has chosen a great subject. Hydrogen truly has been the essential element in the evolution of our universe, in the development of the early quantum theory of atomic structure, quantum mechanics and quantum electrodynamics, nuclear magnetic resonance, and the creation of the atomic clock, and in many other discoveries and theoretical advances. In telling the story of this simplest of all atoms, Rigden gives us, in effect, a history of physics in the twentieth century. This fascinating book will captivate scientists and general readers alike. (Norman Ramsey, Nobel Laureate of Physics, 1989)

Justly acclaimed for his lucid biography of physicist I. I. Rabi, Rigden here shifts his focus from person to problem, chronicling how one enduring conundrum--that of explaining the element hydrogen--has challenged two centuries of brilliant scientists...Readers will marvel that in its very first square, the periodic table holds so much science, so much history, so much humanity. (Bryce Christensen *Booklist* 2002-03-15)

There can be no understanding of either the microscopic world or the cosmos at large without an

understanding of hydrogen. Rigden's book is, on one level, a history of this most basic element, from its discovery in the 18th century to today's cutting-edge experiments...But Rigden is also telling us the story of modern physics...If you love physics, you'll enjoy this book. It is thoughtful, clever and rich in detail. (Dan Falk *National Post* 2002-04-13)

There is almost magic eloquence in the practice and insights of science at its highest orders--which when transformed into the written word can produce splendid literature. A recent effort to do just that is *Hydrogen*...For many reasons, this book grabbed me from the start and held my attention to its finish...For its literary quality, its memorable parade of scientific superheroes and the richness of its material, this is a book I heartily recommend. (Michael Pakenham *Baltimore Sun* 2002-05-11)

Rigden's easy narrative style provides one of the most accessible descriptions of the importance of laboratory experimentation in developing our current understanding of fundamental physics that I know of. Also, he demonstrates how theorists have at times led the way, sometimes with jumps of intuition, sometimes with reliance on fundamental notions like symmetry and sometimes with sheer stubborn persistence. Finally, readers will particularly benefit from seeing extremely important practical technologies that the original experimenters may never have dreamed of. For a picture of how physics really progresses--with gritty details filled in, along with ingenious experiments and glimpses of physicists who push the forefronts of knowledge--Rigden's brief ode to hydrogen is a refreshing alternative to some of the speculative musings dominating the physics sections of bookstores. (Lawrence M. Krauss *New York Times Book Review* 2002-07-14)

Rigden is deeply enamored of physics, physicists and the historical anecdotes that bind them together. These passions are reflected in *Hydrogen's* format--short essays about different aspects of the hydrogen story, focusing on its physicist-heroes...Great stories, beautifully told...Rigden has done physicists a service with his touching love letters to their favorite atomic quarry. (Graham Farmelo *New Scientist* 2002-09-07)

John S. Rigden...has taken on the challenge and produced an accessible, congenial book for the general reader...His book deserves praise for introducing a wider audience to the rich story of hydrogen. (Peter Pesic *American Scientist* 2002-11-01)

Rigden writes well and admiringly of the characters involved and emphasises the benefits of pure research. (Steven Poole *The Guardian* 2004-01-24)

What this slim biography of 280 pages lacks in size, it more than makes up for in scientific revelations. Its subject, hydrogen, beneath a mask of simplicity, is clearly an element on the move. Such is the importance of this primordial element, that its biography mirrors that of the universe. As science--at least the modern physics part of it--is such an international enterprise, and is not carried out in a social vacuum, the book subtly provides a brief history of the world...If you are an admirer of progress in science, this book is for you. (Dozie Azubike *Materials World* 2005-01-01)

These chapters clearly demonstrate that hydrogen is an effective vehicle for presenting a good deal of modern physics...This book is part history of science and part primer on fundamental physical concepts. Moreover it includes interesting vignettes about the scientists involved in these various discoveries, especially I. I. Rabi, the subject of an earlier biography by the same author...The book is well written with clear explanations and good references. It should be accessible to an educated lay audience and of particular interest to chemists. (A. Truman Schwartz *Journal of Chemical Education* 2004-01-01)

Review

A prominent physicist once said, "to understand hydrogen is to understand all of physics." That is perhaps a bit of an overstatement; but it is no exaggeration to say that John Rigden's eminently readable book is a unique guide to the overwhelming role in science and technology of that simplest of all elements--from the origin of the universe itself to the most recently created lab sensation, the Bose-Einstein condensate. A book to be treasured by laypersons and experts alike. (Gerald Holton, author of *Einstein, History, and Other Passions*)

Users Review

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