

(Oxford U. Press, 1989).

Despite its use of specialized vocabulary, *Reduced Density Matrices* has the great advantage of bringing the subject up to the present. Its final section tells an exciting story: Coleman and Yukalov argue that the extreme practitioners of density functional theory, who aim to go beyond RDM theory and eliminate everything but the electron density as an input to their calculations, are whistling in the dark. They see the future presaged in the work of Carmela Valdemoro, Hiroshi Nakatsuji, Koji Yasuda, and David Mazziotti, who base their work on the demand that a recurrence relation between RDMs of orders p , $p + 1$, and $p + 2$ be self-consistent, thereby guaranteeing N -representability. Their results for the ground-state energies of light atoms like beryllium and neon and small molecules like H_2O , NH_3 , and CH_3F , are competitive with values obtained by traditional multi-configurational Hartree-Fock methods in which the wavefunction plays the central role.

The numerical comparisons are impressive: Agreements to four or five significant figures are common. However, to learn of these remarkable results, the reader is urged merely to turn to articles in the literature. The book would have gained from a detailed comparison of the two theoretical methods, but there is no doubt that the authors have achieved their goal of describing how Coulson's challenge can be met.

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Rutherford: Scientist Supreme

▶ John Campbell
*AAS Publications, Christchurch,
New Zealand, 1999. \$40.00
(516 pp.). ISBN 0-473-05700-X*

John Campbell's biography of Ernest Rutherford—who may surely be designated as New Zealand's greatest son—is unquestionably a labor of love, of steadfast devotion on the part of a loyal, energetic, and enterprising physicist who shares with Rutherford both New Zealand birth and Scottish descent. Campbell, has for many years been teaching physics at Canterbury College in Christchurch, New Zealand, the college at which Rutherford studied and worked from 1890 to 1895.

The purpose of this biography, as Campbell explains, is to redress "New Zealand's tremendous disservice to [Rutherford]" in its presentation of an incorrect and inadequate image of

him—one with which "no New Zealand children can identify." This lack is not surprising, because not one of the several dozen biographical works on Rutherford had been written by a New Zealander. Campbell has now corrected this lapse—and also, he hopes, other errors of both omission and commission in the Rutherford legacy.

In this context, it is not surprising to find about half of Campbell's book devoted to the first 24 years of Rutherford's life (1871–95), which were spent in New Zealand. The remaining half covers 40-plus years of his great scientific career in Cambridge, England; Montreal, Canada; Manchester, England; and Cambridge (again). Campbell invariably relates even this latter part to a New Zealand context; indeed, few of the 400 or so textual pages lack *some* reference or relationship to New Zealand.

Campbell's biography is the result of more than two decades of assiduous research: collecting and recovering records, interviewing relatives or descendants of relatives, and scrutinizing hearsay and legends. All is fully and faithfully displayed and recorded, with a wealth of illustrations of people, laboratories, artifacts, tokens, and medals.

The geographical, social, and economic background of a relatively raw and far-distant colony in the 19th century and, more specifically, the background of Rutherford's forebears, family, childhood, and early education all emerge vividly in this biography. They heighten the great drama of a youth from a remote frontier transposed to the opposite part of the globe, to emerge with astonishing speed as one of the world's greatest scientists. As a fellow student observed soon after Rutherford's arrival at Cambridge: "We've got a rabbit here from the Antipodes, and he's burrowing mighty deeply."

Despite the very limited resources of Canterbury College, it was in New Zealand that Rutherford first demonstrated his ability to make the most of any and every opportunity. So when he arrived in the scientific world of Cambridge—Trinity College and the Cavendish Laboratory—he already had considerable experience and accomplishment in the newly opened field of the production and detection of "Hertzian" waves. Rutherford's work on this topic, more demonstrative of scientific enthusiasm, insight, and perseverance than of precocity, is the essential bridge linking two major phases of Rutherford's life. It is fully presented in Campbell's account, but in personal rather than scientific terms.

To remind us that we are dealing

close-up with one whose childhood was shared with 11 siblings and many dozen first cousins, whose most devoted, lifelong relationship was with his mother (of little formal education), and who became a scientist of unique eminence, Campbell invariably refers to Rutherford as "Ern." He does not use Rutherford's formal title Lord Rutherford of Nelson; or Sir Ernest (he was knighted in 1911); or "the Prof," as he was known to countless disciples and students at Montreal, Manchester, and Cambridge; or simply as Rutherford, as his name appeared in the scientific literature. He was simply "Ern."

The second half of this book can deal only briefly with the highlights of a career covering more than 40 years. Campbell tries to keep Ern, the person, closely in view at all times. Indeed, he reminds us that, despite the great shifts of locale and personal and professional growth, Rutherford's vigorous personality is recognizable and unchanged always.

Rutherford was not a particularly modest person. ("He had so little to be modest about!") He did recognize his debt to his forebears and to opportunity; at a youthful age, he had composed an essay on the topic of the relative importance of inheritance, education, and experience. But later, at the height of his career, when a colleague commented that he was fortunate "to have ridden such a powerful wave" of science, Rutherford retorted, "Well, I made the wave myself, didn't I?"

Campbell addresses his writing to the youth of New Zealand, but there is much here to interest and intrigue those of other generations and from other parts of the world. It is enlightening to observe that, in such a different social milieu and more than a century ago, there were serious concerns about how science might be taught and debates about its social role. And it is illuminating and challenging in this age of "multiple choice" to read the examination questions set at Canterbury College.

This book contains intriguing details. Where else could one learn that Rutherford (Ern) was not aware of his correct name (Ernest) until age 24 when, on his departure from New Zealand, he had to produce his birth certificate? Or that the news that he had received the Nobel Prize in Chemistry in November 1908 had to compete (unfavorably) in the *Nelson Evening Mail* with the more eagerly awaited news about the result of the 34th week of the Nelson Poultry Association's egg-laying competition?

John Campbell's task—to complete and correct the image of Rutherford in the eyes of his compatriots—was no mean one. And if, in these labors, he has produced something that will add new lore and piquancy to the image that we all have of one of the great creators of modern physics (and chemistry), then we can all be grateful that he has labored so long and so faithfully and produced this biography *sui generis*.

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Henry Norris Russell: Dean of American Astronomers

▶ David H. DeVorkin
Princeton U. Press, Princeton,
N.J., 2000. \$49.50 (499 pp.).
ISBN 0-691-04918-1

David H. DeVorkin, curator of the Smithsonian Institution's National Air and Space Museum and author of various works on space science, has turned his scholarly attention to Henry Norris Russell, a gradually fading yet seminal figure in early 20th-century astronomy. DeVorkin's *Henry Norris Russell: Dean of American Astronomers* is a solid, assiduously researched, and thoroughly documented work. For its rather stolid style, however, it will, unfortunately, probably not be read as widely as it ought.

Russell was born in 1877 in the cloistered Long Island, New York, village of Oyster Bay, where his father, Alexander Gatherer Russell, a Presbyterian minister, attracted to his congregation such luminaries as Theodore Roosevelt Sr. It was from his mother, Eliza Hoxie Norris Russell, and his maternal grandmother, Maria Schaeffer Hoxie, that young Henry inherited his gift for mathematics. (Maria distinguished herself as the first recipient of a mathematics medal from the Rutgers Female Institute.) Henry Russell attended private school in Princeton, New Jersey, then enrolled in the "local" university there.

Russell graduated from Princeton University with honors in 1897 and remained on campus to take his doctorate three years later. Although well respected for his erudition, the youth was little envied by his classmates, coming across to them as a largely one-dimensional figure who was subjected to good-natured teasing as he scurried, preoccupied, from classroom to classroom. Later, during a stint at the University of Cambridge, George Darwin, the Plumian Professor of

Astronomy and fifth child of the great evolutionist, classified Russell's as "a grinding mind." Occasionally, when the press of studies and research became too great, Russell suffered mental breakdowns, the first of which occurred following the completion of his doctoral dissertation: "The General Perturbations of the Major Axis of Eros by Action of Mars." After he made the acquaintance of the similarly afflicted George Ellery Hale, founder of the Yerkes, Mount Wilson, and Mount Palomar Observatories, the two astronomers entered into long conversations about the origins and pathology of their debilitating illnesses.

DeVorkin takes great pains to establish his subject as a pioneer in the fledgling field of astrophysics. He covers in detail the period following Russell's acceptance in 1905 of a post as instructor and, in 1912, the directorship of the observatory at Princeton. From then on, Russell passed the better part of 60 years researching most of the major problems associated with the new science, garnering every major honor and accolade along the way. Among his many contributions was the development of a theory of stellar evolution that fit the known data like a glove. This research acted as a stimulus to other astrophysicists, including Arthur Eddington, and it was in the context of this work that Russell, together with Ejnar Hertzsprung, created the Hertzsprung–Russell diagram, which charted the luminosity of stars as a function of their surface temperatures. Russell's early work on binary stars, much of it conducted with the assistance of his gifted protégé Harlow Shapley, led to the first systematic analysis of the variation of light received from these eclipsing bodies. In the 1920s, when he was at the height of his powers, Russell initiated a series of quantitative investigations on the absorption-line spectrum of the Sun that enabled scientists to determine the abundance of various chemicals in the solar atmosphere. Intrigued by the microcosm as much as by the macrocosm, he teamed with fellow spectroscopist Frederick A. Saunders of Harvard University to devise the theory of L–S coupling to explain spectra produced by atoms having more than one valence electron.

Much of this and more was well beyond the ken of amateur astronomers, to say nothing of people who harbored only a casual interest in the stars. Consequently, in the spring of 1900, Russell began writing a column on astronomy for *Scientific American*,

a labor of love that would span more than four decades and one that, besides reaching a larger, more general audience, had the benefit of serving as a therapeutic outlet for its frequently agitated author.

DeVorkin's biography is easily the most authoritative work on Russell's science—a full quarter of the book is devoted to bibliography, endnotes, and related materials. It will be welcomed by scholars with an interest in the major astronomical problems of the 20th century, most particularly those associated with astrophysics. However, as the story of a great scientist, it is painfully slow going and fails to command reader interest by an artful integration of Russell's life and times, or to provide a sense of the thrill of discovery in the most exciting century of astronomy yet. This, coupled with prose too technical for an all-too-brief glossary to overcome, means that *Henry Norris Russell* will find few readers among the very kind of lay audience to which its subject reached out over the course of 40-odd years.

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