BOOKS

A Life That Bridged the Old and the New In Physics, Chemistry, and Technology

Walther Nernst and the Transition to Modern Physical Science

Diana Kormos Barkan
Cambridge U. P., New York, 1999.
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Reviewed by Helge Kragh

Walther Nernst (1864–1941) was a pioneer of physical chemistry who did important work in electrochemistry, thermodynamics, and low-temperature physics. Less successfully, in the 1920s, he entered astrophysics and suggested a steady state model of the universe. Although his earliest work was in the new physical chemistry, and he became a Nobel laureate in chemistry in 1920, Nernst was a physicist by training and mentality. His career is thus well suited to illustrate the relationship between physics and chemistry in the transition to modern physical science that occurred during the period from 1890 to 1920.

Diana Barkan, a historian of science with a background in chemistry, analyzes the relationship in considerable detail in her scholarly biographical study, *Walther Nernst and the Transition to Modern Physical Science*. Her biography of Nernst is a much needed improvement over such earlier studies as Kurt Mendelssohn's *The World of Walther Nernst* (Macmillan, 1973).

Barkan's picture of Nernst and his science includes many new and interesting interpretations, solidly documented and based on meticulous archival studies. For example, she shows that Nernst's route to his famous heat theorem (or the third law of thermodynamics) was not linked to the older tradition of thermochemistry but rather to problems of theoretical physics. Moreover, she argues that Nernst's work on low temperatures and specific heats grew out of a practically oriented, technological research program that started many years before Albert Einstein's 1907 quantum theory of specific heats.

The technological context plays an important role in Barkan's book, as in her excellent chapter on Nernst's invention of the electrolytic glow lamp. For this reason, the book is not only a significant contribution to the history of physics and chemistry, but also to the history of technology.

Barkan also focuses on Nernst's interactions with such important physicists as Max Planck and Einstein. Her account of Nernst's role in the first phase of quantum theory, up to the 1911 physics Solvay congress, is a fine and innovative contribution to the history of quantum physics, and her chapter on the long drama that resulted in Nernst's Nobel Prize is a masterpiece. The book is primarily addressed to historians of science and technology, but it will also be of interest to many physicists and chemists.

I found it somewhat unsatisfactory that Barkan chose to end her book at about 1920, when, she claims, "Nernst's own scientific research virtually stopped." Yet, between 1921 and 1938, Nernst did much research in astrophysics and cosmology, a fact that Barkan notes but otherwise ignores. The book would have been even more valuable if it had included all of Nernst's major research areas and not just those that made an impact on mainstream science. It should also be noted that the book contains several unaccountable errors. For example, "the mathematician Ciamician" should probably be the Italian chemist Giacomo Ciamician; Barkan misdates the first chemistry Solvay congress to 1921 (it should be 1922); and she writes that the mother of the Danish chemist Niels Bjerrum was a professor at the University of Copenhagen, which she was not.

More seriously, at least to historians, the reference system is a mess. The bibliography refers to only some of the cited works, apparently arbitrarily, and many of the works referred to in the notes are impossible to locate in the book. For example, on page 208 there are references to "Shapin, 1994" and "Friedman (1981)," but neither of these—and there are many other examples—is listed in the bibliography or elsewhere in the book. On page 155 there is a reference to "Mendelssohn, *Cryogenics*," whereas the bibliography lists Mendelssohn's book *Cryophysics* (New York, 1960); in a note the reader is referred to "the account of K. Mendelssohn," but the bibliography lists three works of Mendelssohn; and so on. It is a shame that this fine piece of scholarship is tainted by such elementary flaws.

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Greenhouse: The 200-Year Story of Global Warming

Gale E. Christianson
Walker and Co., New York, 1999.
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Greenhouse: The 200-Year Story of Global Warming is the biography of an idea. At least that's what Gale Christianson tells us in the preface to his new book. Christianson is a historian of science at Indiana State University. When he adheres to his stated mission, he writes energetic, informative, and engaging prose. But when Christianson begins to examine the scientific underpinnings of assessments of global warming, the book loses its focus—along with much of its appeal.

To be sure, Christianson sets himself on a hard path. Unlike a person, the normal subject of a biography, a scientific construct exists in many places and contexts simultaneously. It can last generations and can evolve into a theory (or several theories) very different from the form in which it first appeared. Even in a mature field like physics, portraying the growth of an idea is challenging. Imagine, for example, a biography of "the quantum." In the geosciences, where the understanding of global systems is in its infancy, the task is herculean.

Appropriately enough, the book begins with brief biographical sketches of Jean-Baptiste-Joseph Fourier, James Hutton, Charles Lyell, and many of the others who laid the groundwork for modern Earth-system science. The next section is essentially a history of the industrial revolu-

tion, beginning with the coal mines, steam engines, and automated looms of Great Britain, and continuing in the US with Andrew Carnegie, John D. Rockefeller, and their empires. We are given a portrait of Svante Arrhenius, probably the first person to investigate quantitatively the link between atmospheric composition and climate. Christianson then touches on paleoclimatology, with descriptions of Anasazi and Viking settlements and their climate-driven ends. We also meet Charles Keeling (who has monitored the rise in atmospheric CO_2 continuously since 1958) and Thomas Midgely (the inventor of chlorofluorocarbons). For the nonhistorian, there are some gems here.

Christianson covers a lot of history in his first 150 pages. While the treatments are necessarily brief, they succeed in giving life to the personalities and events he chronicles. Unfortunately, the remainder of the book does not match this promising beginning. Christianson subtly shifts his focus and begins to present the science of detecting the existence and consequences of anthropogenic climate change. This 90-page summary is simply too ambitious, losing clarity and rigor as a result. Although the scientific presentations are conceptually sound, there are numerous minor inaccuracies (CO_2 is confused with carbonic acid and described on one occasion as a particulate; Fahrenheit and Celsius scales are muddled; pH is said to rise as lakes become more acidic; the water of the Colorado River is said to be "fully allocated," when in fact it is already over-allocated; and so on).

The author then ventures into very young science, and he fails to take the care needed to distinguish between the well established (the origin of the ozone hole), the less certain (the human signature in recent warming trends), and the speculative (CH_4-hydrate bursts as drivers of rapid climate change). Furthermore, through no fault of the author's, some of the science is already out of date. For example, Christianson's grim projection of atmospheric methane growth is at odds with the current understanding of that species's budget (see E. J. Dlugokencky, K. A. Masarie, P. M. Lang, P. P. Tans, Nature **393** 447 (1998)).

More troubling is his treatment of phenomena tangentially related to global warming: smog, the Antarctic ozone hole, and the El Niño/La Niña cycle. Christianson introduces the first two as cautionary tales and the latter as a preview of possible future climates. His intentions are reasonable enough, but his exposition is far from optimal. London's killer fogs and global warming are related only because both demonstrate human capacity to affect the environment; yet the limits of this relationship are nowhere explicitly stated by Christianson. The presentation of the connection between El Niño and global warming is even murkier, and many readers may come away with the idea that El Niño did not exist before the industrial revolution.

Christianson's presentation also suffers from a lack of evenhandedness. He devotes an entire chapter to climate scenarios based on a report of the Intergovernmental Panel on Climate Change. While he does acknowledge that some of the pictures he paints are at the catastrophist extreme of the predicted envelope, the naïve reader would not know that an equally likely case could involve little if any appreciable climate change.

Any lack of balance, however slight, is a particularly important failing, since the book is aimed at a nonscientific audience. In the course of writing this book, Christianson assembled evidence and drew conclusions. These conclusions are never stated, but are not hard to divine. To his credit, he acknowledges that both sides in the global warming debate "are filtering their arguments through their own ideologies, even as they claim science as their ally." Yet even with, or perhaps because of, this disclaimer we have higher expectations of the author guiding us on this tour.

More important than the conclusions themselves, the act of staking out a position is ill-advised. In Christianson's own words, "[n]o matter which way the dice fall, it is . . . not personal conviction that will have the last word." Yet finding the "truth" is not simply a matter of compiling all the relevant data and choosing a suitably objective sage to adjudicate. Scientific understanding is remarkably fluid, to a degree that few nonscientists appreciate. As much as policy makers may demand a judgment, at this time in our history we are not in a position to make unequivocal statements about future climate.

This is not to say the scientific community (and those who write about science) should remain mute. On the contrary, there is an obligation and moral responsibility to disseminate the fruits of research in their most useful and relevant form. In so doing, scientists need not come to conclusions with false certainty. Instead, they must make the public aware of the great experiment we are conducting with our planet. Our leaders and citizenry must be alerted to the consequences of human activity, both likely and possible. Then it falls to them to decide on a course of action. For scientists to decide on their behalf is presumptuous.

Christianson has made good on part of his obligation: He has written an accessible and generally engaging book for the general public that gives the background, and much of the science, behind global warming. The presentation could be clearer, and the science more precise, but the general framework is sound. Unfortunately, Christianson felt compelled to draw conclusions for us. Far better to let the evidence speak for itself.

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The American Astronomical Society's First Century

Edited by David H. DeVorkin
American Astronomical Society, Washington, D.C., 1999. 350 pp. $45.95 hc ISBN 1-56396-683-2

The tone of this set of essays commemorating the 100th anniversary of the American Astronomical Society (AAS) is set by the frontispiece: a wonderful photograph taken in 1910 of Andrew Carnegie, the industrialist and philanthropist, and George Ellery Hale, the director of the Mount Wilson Observatory and one of the founders of the society. They are shown strolling, arms locked together, heads bowed in conversation. There is no record of what they said, but by browsing through *First Century*, we might eavesdrop a bit to get the flavor of the formative days following the society's founding and of the century's history of astronomy in America. This volume, edited by David H. DeVorkin, curator of the history of astronomy and the space sciences at the Smithsonian Institution's National Air and Space Museum, brings together the many aspects of the founding and growth of AAS. Many of the accounts are written by the players themselves, at least in the second half of this *First Century*.

We learn in the first essay, by Donald Osterbrock, that even the choice of a name for the new organization was no simple matter. The "American Astronomical Society" was favored by traditional astronomers, those working in astrometry and celestial mechanics for