Erich Hückel (1896-1980) From Physics to Quantum Chemistry. Andreas Karachalios, translated by Ann M. Hentschel, Boston Studies in the Philosophy of Science, Vol. 283, Springer-Verlag, Dordrecht, Heidelberg, London, New York, 2010, x + 200 pp. ISBN 978-90-481-3559-2; $139.

Erich Hückel and the late American comedian Rodney Dangerfield shared one thing in common. They "got no respect!" Hückel's contributions to molecular orbital theory have been undervalued by the quantum chemistry community for many years. Jerome Berson's 1996 article in the centennial year of Hückel's birth (*Angew. Chem. Int. Ed. Engl.*, **1996**, *35*, 2750-2764) played a big part in calling attention to Hückel's contributions, and now we have this fine biography by Andreas Karachalios of the University of Mainz that will allow English-reading scientists to evaluate Hückel's work in detail. Although Hückel wrote an autobiography shortly before his death in 1980 (*Ein Gelehrtenleben Ernst und Satire*, Verlag Chemie, Weinheim, 1975), the lamentable lack of knowledge of German among present day American chemists (your reviewer among them) means that an English language biography is absolutely necessary for US readers to appreciate Hückel's accomplishments.

Karachalios obviously used Hückel's autobiography a great deal in crafting this work, but he also made use of many supporting documents—letters to, from, and about Hückel, minutes from his oral examinations, evaluations in connection with job searches, reports to the Rockefeller Foundation, etc. The result is a thorough description of Hückel's life coupled with a detailed description of his work in quantum chemistry. Over three-fourths of the book touches on events prior to the outbreak of World War II. Sadly, there was not much of significance to report on after the war was over.

The author points out the significance to quantum chemistry of the year 1896, for Robert Mulliken and Friedrich Hund were born in that year along with Hückel. His father Armand was a doctor and an amateur scientist. He encouraged the scientific interests of his three sons, Walter, Erich, and Rudi. Walter, who went on to become an outstanding organic chemist, undoubtedly helped move Erich's research into areas of significance to organic chemistry. Hückel took a doctorate in physics from Peter Debye, worked for David Hilbert and then Max Born, and then took a second degree (the Habilitation) from Debye. His degree was on the theory of strong electrolytes. This resulted in the famous Debye-Hückel theory of electrolytic solutions, probably the introduction for most of us to the name of Hückel. Receiving an international fellowship, Hückel spent time at the Niels Bohr Institute in Copenhagen in 1929, a stay that probably inspired him to apply quantum mechanics to chemistry.

Hückel's first important excursion into quantum chemistry dealt with the nature of the double bond (*Z. Phys.*, **1930,** *60*, 423-456). Scientific thought at that time was of the view that the two bonds were chemically equivalent. Hückel's result was that there were two bonds, bonds that would correspond to what we now say are a π bond and a σ bond. The next year Hückel published his famous paper on aromaticity, a paper much more referenced than read (*Z, Phys.*, **1931**, *70*, 204-286). Like the paper on double bonding, Karachalios goes over this 82-page paper in detail. Hückel actually treated the benzene problem with two methods—one equivalent to the valence bond method and the other with what we now call the Hückel MO theory. His MO results showed that benzene should have special stability but that cyclobutadiene and cyclooctatetraene would not, *i.e.*, results consistent with what later chemists called the 4n + 2 rule. Karachalios devotes about 64 of his 200 pages to these two important papers.

Unfortunately, Hückel's treatment did not carry the day in the 1930s. Pauling and his coworkers pushed their use of resonance theory. Hückel was a weak communicator, while Pauling was superb in that area. In his autobiography Andrew Streitwieser states that Hückel molecular orbital theory did not come into its own until the 1940s (*A Lifetime of Synergy with Theory and Experiment*, ACS, Washington, DC, 1997, p181), and Streitwieser mentions that Hückel himself (p 182) attributed acceptance of HMO theory to Streitwieser's classic book, *Molecular Orbital Theory for Organic Chemists*. Perhaps Streitwieser summed up the situation best with these sentences I quote from p 181 of his autobiography:

> Erich Hückel was a physicist who worked between two worlds. Because he was a physicist, organic chemists paid no attention to him, and because he worked in chemistry, physicists paid him no heed.

Despite Debye's best efforts, he was unable to obtain a permanent position for Hückel. Hückel first wound up at Leipzig with the equivalent of a senior post-doctoral position and then in 1930 went to Stuttgart as a lecturer, where he remained until 1937. All this time he was supported by what we would call in the US "soft money." This probably played a part in his decision in 1934 to join an organization associated with the Nazi party. A position at the University of Marburg became open in 1937. The prime candidates were Hückel, Friedrich

Hund, and Helmut Hönl. The faculty favored Hund, but Hückel's favorable political activity won the day. After the war Hückel suffered various illnesses and fits of depression. He never regained his creativity and drive from the 1920s and 1930s. He retired in 1962 and died on February16, 1980.

I have often wondered why Hückel and for that matter Friedrich Hund never won the Nobel Prize. The optimum year would have been 1966—the year that Robert Mulliken won an unshared Nobel Prize in chemistry for his work on molecular orbital theory. There would have been room for two other people to share this prize. Indeed, in his autobiography (*Robert S. Mulliken: Life of a Scientist*, Bernard J. Ransil, Ed., Springer-Verlag, Berlin, Heidelberg, New York, 1989) Mulliken stated (p 192) that he would have been happy to share the prize with Hund. I imagine in 1966 Hückel would still have been viewed as not at the same level as Mulliken, but surely Hund's stature equaled that of Mulliken. It would be interesting to know whether in the '60s Hund and Hückel had been nominated for the award. Unfortunately, knowledge of Nobel nominations is not available until 50 years have passed after the nomination. So far as name recognition is concerned, present day chemistry students have all heard of Hund (Hund's Rule), those taking organic chemistry know about Hückel molecular orbital (HMO) theory;but very few will ever have heard of Mulliken. Still, I imagine Hückel and Hund would have gladly traded their posthumous fame for a share of the Nobel Prize. One strength of the book is the extensive set of footnotes. Readers should look at them in detail, because often they contain fascinating mini-biographies of significant figures in physics and chemistry. Occasionally the footnotes are used inefficiently. For example, the author uses several footnotes to give biographical details about noted chemists Hermann Mark and Christopher Ingold, when he could simply refer to Mark's autobiography (*From Small Organic Molecules to Large: A Century of Progress*) or to Kenneth Leffek's biography of Ingold (*Sir Christopher Ingold, A Major Prophet of Organic Chemistry*). Also, would it have cost too much to have included just one picture of Hückel? However, these are minor quibbles. This is an important and much needed book. I consider it a must buy for historians of quantum chemistry. Now what we need next is an English translation of Hückel's autobiography. Chemical Heritage Foundation, are you listening? *Dr. E. Thomas Strom, Department of Chemistry and Biochemistry, University of Texas at Arlington, Arlington, TX 76019-0065.*

FUTURE ACS MEETINGS

March 27-31, **2011**—Anaheim, CA

August 28-September 1, **2011**—Denver, CO

March 25-29, **2012**—San Diego, CA

August 19-23, **2012**—Philadelphia, PA

April 7-11, **2013**—New Orleans, LA

September 8-12, **2013**—Indianapolis, IN

March 16-20, **2014**—Dallas, TX

September 7-11, **2014**—San Francisco, CA

March 22-26, **2015**—Denver, CO

August 16-10, **2015**—Boston, MA

March 13-17, **2016**—San Diego, CA

August 21-25, **2016**—Philadelphia, PA

April 2-6, **2017**, San Francisco

September 10-14, **2017**, St. Louis