Book Review

Robert Burns Woodward: Architect and Artist in the World of Molecules

by Otto Theodor Benfey and Peter J. T. Morris, Eds. (Chemical Heritage Foundation, 2001) 470 pp., ISBN: 0941901254; $45.00 (hard cover)

Reviewed by Bernard Miller, Department of Chemistry,
University of Massachusetts, Amherst

The structure known, but not yet accessible by synthesis, is to the chemist what the unclimbed mountain, the uncharted sea, the untilled field, the unreached planet, are to other men ... The unique challenge which chemical synthesis provides for the creative imagination and the skilled hand ensures that it will endure as long as men write books, paint pictures, and fashion things which are beautiful, or practical, or both.

Robert Burns Woodward*

It is fitting that this stirring description of the beauty of organic synthesis should come from the pen of the greatest practitioner of the art in our time - perhaps the greatest (in competition with Emil Fischer and Sir Robert Robinson) of all time.

Certainly, Robert Burns Woodward was known not only for the remarkable work carried out in his laboratory, but for the clarity, precision, and elegance of his reports of that work. His lectures, frequently featuring complex structures drawn by hand in chalk of many colors, put the usual lecturer's parade of slides to shame. (Indeed, Woodward seemed to resist the use of mechanical presentation aids as long as possible. As the last of the chalk-talkers, I rely on his example to support my own contention that the human mind works at the same rate as a piece of chalk on a blackboard.) Several of Woodward's lectures are included in this Festschrift, including his lectures accepting the Nobel prize and the Cope medal, as well as a transcript of his lecture, presented in Sheffield, England, on the Woodward-Hoffmann rules.

———————-

*From "Art and Science in the Synthesis of Organic Compounds: Retrospect and Prospect" in *Pointers and Pathways in Research*, M. O'Connor, ed., CIBA of India, Bombay, 1963, quoted in the book here reviewed

Most reader's will probably smile knowingly on reading Woodward's comments about publishing a literal transcript of the Sheffield lecture:

> "Those who have had the devastating experience of seeing what they may well have imagined to be their lucid, well phrased, and even eloquent expositions will appreciate my reluctance to have this laid bare here. Only the most powerful advocacy ... of the view that a mean fraction of a loaf is better than none has brought me to perpetrate this literary offense."

Woodward was certainly aware that this lecture, like all his lectures, beautifully demonstrates "lucidity, good phrasing, and even eloquence." [Notice the phrasing of his modest demurrer, by the way: not "a half a loaf", but "a mean fraction of a loaf."] The care with which Woodward approached his lectures is illustrated in this book by the reproduction of part of the handwritten manuscript for his Cope lecture. The paper almost appears to resemble an actor's script, with words that he wished stressed written in capitals or underlined. Since Woodward would hardly have recopied a 43-page manuscript by hand, it must be concluded that this was the first draft. It is therefore astonishing that, in the pages reproduced, there are only a few additional phrases inserted in the margins, with very little crossing out and rewriting. One has to conclude that these remarkably polished, felicitous lectures proceed almost from the author's mind to the paper, and then to the lectern.

While Woodward's lectures are fascinating, this volume quite properly consists in large part of reprints of selected papers from his work. These papers include examples of his contributions to physical organic chemistry, such as the "Woodward Rules" relating the frequency of UV absorptions to chemical structures, the "octant rule" relating optical rotary dispersion spectra to chemical structures, and, of course, the "Woodward-Hoffmann Rules" for predicting, and explaining, the course of pericyclic reactions. In addition, this book includes the brief communications that include the first published proposals that ferrocene and its derivatives have "sandwich" structures and aromatic properties.

The principal emphasis of this book (as was Woodward's emphasis), however, is on synthesis. Thus, papers describing the syntheses of quinine, cholesterol and cortisone, strychnine, reserpine, chlorophyll, and vitamin B12 are republished here - a total of twenty two papers altogether, including his Nobel Prize lecture describing the synthesis of cephalospirin C.

It is a pity that the journals in which Woodward's papers were published did not allow for the same multicolored presentations as his lectures. Still, even in plain black and white,

his papers are a pleasure to read - and reread. Chemists of a certain age will already have read most of these papers as they appeared - in the *JACS* and other journals. They should still find great pleasure in re-reading them, and are likely to find new favorites. Despite all the lectures I have given introducing students to the UV spectra of conjugated ketones, for instance, I read Woodward's original paper on the subject (one of his earliest independent publications) for the first time in this book. Not only was the presentation as elegant as would be expected of Woodward, but it was fascinating to see his immediate application of the "Woodward Rules" to reassigning structures to several compounds improperly identified in the literature. (Woodward's amazing familiarity with the literature was evident there.)

All the reprints (grouped together by subjects) are preceded by essays by Peter Morris. His introductions, which discuss the historical backgrounds leading to Woodward's work and offer comments on particularly critical aspects of the Woodward papers, can stand by themselves in providing a fascinating history of a large segment of organic chemistry.

In addition to Woodward's own words, this large, well-produced volume includes many discussions of Woodward's work and personality by other writers. These contributors include, for instance, Woodward's daughter Crystal.

I cannot resist an anecdote here. A half-century ago, a fellow graduate student at Columbia came into my lab- oratory, wide eyed, to proclaim that Crystal Woodward was bound to follow her father as a Nobel Prize winner in Organic Chemistry. Crystal, then barely out of junior high, had taken advantage of a stay in New York to visit Gilbert Stork, an old family friend. While Stork had to attend to business, Crystal had wandered across the hall to my friend's laboratory, and while casually rummaging through a copy of the JACS, had wondered. "Can this be right? This paper doesn't seem reasonable to me." After my classmate and several other talented graduate students had considered the matter at length, they concluded that the paper in question, by a distinguished organic chemist, did indeed contain a subtle error in reasoning. It was no surprise that my friend was awestruck by the young girl's knowledge and talent. However, the whole thing was a setup: Stork had primed Crystal with the script, and sent her off to hoodwink his more gullible graduate students.‡

So Crystal Woodward's primary interest is in art, rather than chemistry. However, her attempts in this volume to analyze the aesthetic nature of Woodward's work do not really seem to lead to much enlightenment about the nature of his art. — Of course, the same is true of most such attempts. It is hard to find a unifying principle when art museum exhibits can range from Rembrandt portraits to urinals and piles of used sneakers.

Other contributions provide more interesting discussions about Wood- ward's life and personality. A paper by Woodward's best friend in junior high school, for instance, records the early experiences of the two young boys in repeating classical chemistry experiments, and takes us back to the days when teenagers were casually synthesizing hydrogen cyanide and chlorine gas in their home laboratories, and preparing, and exploding, hydrogen gas and nitrogen triiodide. It is a far cry from the present, when even college upperclassmen and women are forbidden to run experiments using any solvents other than water.

Other notable contributions include a delightful set of reminiscences by Frank Westheimer, and comments by Albert Eschenmoser on Woodward as a collaborator.

———————-

‡ The graduate student anticipated Woodward's Nobel Prize by about thirteen years. [ed.]