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Book Review

The Photosynthetic Reaction Center by Johann Deisenhofer and James R. Norris, Editors

Academic Press, San Diego, CA, 1993. Vol. I 432 pages; Vol. II 574 pages. $129.00/£99 per volume.

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The 1984 publication of an x-ray structure for the reaction center from the purple photosynthetic bacterium *Rhodopseudomonas viridis* was a watershed event in the area of photosynthesis. This seminal work, for which J. Deisenhofer, R. Huber, and H. Michel shared a Nobel Prize, stimulated an avalanche of renewed investigations into reaction center structure-function relationships. During the intervening decade, the area has matured into an multidisciplinary science that draws on state of the art theoretical, spectroscopic, structural, and biochemical techniques. This field is surveyed in thirty chapters contributed by some fifty authors, including many who have been instrumental in shaping our current understanding of natural and artificial reaction centers.

Volume I is devoted to the chemical and biochemical aspects of photosynthesis. Three chapters deal with the structure of light-harvesting and antenna pigment-protein complexes in bacterial systems and in higher green plants. These are followed by chapters on reaction center manipulation (genetic analysis, digital imaging spectroscopy, and the production of bacterial reaction centers with modified tetrapyrrole chromophores). The coupling of the bacterial reaction center's electron transfer processes to proton uptake and release is detailed, along with electron transfers between bacterial reaction centers and mobile c-type cytochromes. Higher green plants are the subject of the last four chapters, which focus on the isolation and structure of photosystem II reaction center complexes, the bicarbonate effect in photosystem II, and the structure and function of reaction center cofactors in photosystems I and II.

Volume II, which is concerned with physical aspects of photosynthesis, encompasses a daunting range of theoretical and experimental studies of reaction center structure and dynamics. The engineering of free energy, distance, and Franck-Condon factors for optimal electron transfer rates is considered, and semiclassical trajectory simulations of electron transfer in bacterial reaction centers are described. Several chapters are concerned with the ultrafast (picosecond and femtosecond) laser spectroscopy of primary electron transfer events in wild-type and mutant bacterial reaction centers. Other spectroscopic approaches to characterizing reaction centers include spectral hole-burning, the Stark effect and electric field modulation of electron transfer rates, infrared vibrational difference spectroscopy, and magnetic resonance (EPR, ENDOR, NMR, and electron spin polarization). The structure and spectroscopy of carotenoids are reviewed, as are molecular structures for chlorin and bacteriochlorin models of photosynthetic pigments. Two chapters describe creative approaches to simulating light-harvesting and electron transfer functions in artificial supramolecular assemblies. The very first and last chapters in this series contain descriptions of reaction center structures for the purple bacteria *Rhodobacter sphaeroides* (M. Schiffer and J. R. Norris) and *Rps. viridis* (J. Deisenhofer and H. Michel).

The biochemical scope of these volumes is strongly focused on purple bacteria and photosystem II, because high resolution x-ray structures have only been reported for reaction centers from *R. viridis* and *R. sphaeroides.* There is relatively little material on photosystem I reaction centers, aside from the electron spin polarization work by S. W. Snyder and M. C. Thurnauer, W. Müntele's infrared spectroscopy chapter, and M. C. W. Evans and J. H. A. Nugent's overview of the photosystem I electron transfer components. Because of publication lag (there are few references from 1993 or later), there is no mention of the 6-Å resolution x-ray structure of the photosystem I core antenna-reaction center complex from the cyanobacterium *Synechococcus sp.* (N. Krauss et al., *Nature* (1993) 361: 326–330). When further refined, this structure appears destined to play a key role in future photosystem I work. There is similarly no reference to reaction centers in green bacteria or heliobacteria, which are currently subjects of intense study, although their structures are still unknown. Because reaction centers are the main subject of interest, discussions of antenna structure are limited to three chapters near the beginning of Volume I. However, H. Zuber's chapter on light-harvesting systems lists some 350 antenna literature references, including several extensive reviews.

The quality of science and exposition is uniformly high. Most of the chapters in these two volumes appear to be intended as cumulative reviews of work that has appeared during the last few years. Some are are terse reports of recent research, whose significance will be appreciated primarily by specialists. Although few of the chapters can be immediately digested by readers who are uninitiated to photosynthesis, these exceptions are highly readable (e.g., R. J. Cogdell and A. M. Hawthornthwaite's chapter on the preparation and crystallization of purple bacteria antenna complexes, and the artificial photosynthesis chapters by D. Gust, T. A. Moore, and M. R. Wasielewski). These volumes will be an invaluable resource for new workers in photosynthesis, because they contain a huge number of literature references for building a personal photosynthesis library. More importantly, the authors have succeeded admirably in conveying much of their vibrant field's depth and diversity.