JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Book Review

Long-Range Charge Transfer in DNA I and Long-Range Charge Transfer in DNA II. Topics in Current Chemistry, 236 and 237, respectively Edited by Gary B. Schuster (Georgia Institute of Technology). Springer-Verlag: Berlin, Heidelberg, New York. x + 200 pp. $189.00. ISBN 3-540-20127-0 (for DNA I) and x + 244 pp. $199.00. ISBN 3-540-20131-9 (for DNA II).

Bruce E. Eaton, and Jonathan Vaught

J. Am. Chem. Soc., **2005**, 127 (18), 6911-6912• DOI: 10.1021/ja040960b • Publication Date (Web): 16 April 2005

J|A|C|S
BOOK REVIEWS

Long-Range Charge Transfer in DNA I and Long-Range Charge Transfer in DNA II. Topics in Current Chemistry, 236 and 237, respectively. Edited by Gary B. Schuster (Georgia Institute of Technology). Springer-Verlag: Berlin, Heidelberg, New York. x + 200 pp. $189.00. ISBN 3-540-20127-0 (for DNA I) and x + 244 pp. $199.00. ISBN 3-540-20131-9 (for DNA II).

Long-Range Charge Transfer in DNA I is an excellent contribution to the *Topics in Current Chemistry* series and contains eight reviews that cover many of the experimental approaches to studying charge transfer in DNA. All of these reviews are written by well-known authors who have made significant contributions to the field. As is typical for this type of review, the references cited in each chapter are primarily from the authors' own work. Overall, the chapters are well-written, and the figures and schemes are of sufficient quality and clarity to reinforce the points being made in the text. One drawback of this book is the lack of color figures, which this reviewer finds helpful when trying to visualize complex structures, such as DNA.

This volume covers mostly hole migration as an electron-transfer process in DNA and is up-to-date with the current understanding in the field. The first review by Cadet et al. covers one-electron oxidation of pyrimidine and purine DNA bases, including high-intensity UV photochemistry of isolated DNA lesions. The next review by Giese covers hole transfer through DNA by G- and A-hopping mechanisms and how mismatches and proton transfer affect hole migration in DNA. Lewis et al. provide an excellent review covering hole injection and the effects of cross-linked DNA hairpins. Consideration is given to the dynamics of DNA in the models employed, and the review is concluded by a comparison of other experiments in hole transport to theory. The next review by Barton et al. is a lucid, *tour de force* description of experimentation on charge transport in DNA. A wide variety of physical and biological topics are covered, including metallointercalators, organic intercalators, and modified bases as probes for electron transfer. Significant discussion of perturbations to π-stacking and the effects on charge transfer is provided, and there is even a small section on in vivo DNA charge transfer. Majima et al. follow with a short review that covers the kinetics of hole migration by pulse radiolysis and includes some discussion of pyrene- and phenothiazine-conjugated DNA in electron transfer. Next, Nakatani et al. provide an interesting and insightful review on site-selective hole injection into DNA by substituting thymidine with cyanobenzophenone-deoxyuridine and hole trapping with cyclopropyldeoxyguanosine. In the final chapter, Carell et al. focus not on hole migration, in contrast to the other reviews in this volume, but rather on excess electron transfer in synthetic chemically modified DNA systems and cover single-electron reduction of nucleobases in biology and model systems. This discussion extends beyond DNA to include DNA:PNA hybrids. Overall, these authors give an excellent account of the diverse and sometimes conflicting field of charge transfer in DNA.

Long-Range Charge Transfer in DNA II is wonderfully complementary to Volume I. It contains seven reviews that are more heavily weighted toward theoretical research than the previous volume. As with its predecessor, all of the chapters in this book are written by well-known, leading researchers in the field and include a number of references to the authors' own work. The chapters are well-written and well-illustrated.

This volume covers the large and at times conflicting evidence of charge transfer in DNA more or less completely. The underlying theme of the book appears to be that DNA systems are vastly complex, making the understanding of charge transfer in them difficult; however, because of the availability of more data, some progress has been made in our understanding of this topic, although much remains to be done to control and utilize charge transfer in DNA. The first three reviews cover theory and provide a mathematical rationale for the physical processes that govern charge transfer in DNA, whereas the next three provide experimental evidence for some aspects of this phenomenon. The last review provides a concise summary of the volume by tying theory to experimental evidence as it applies to the use of charge transfer in DNA-based devices.

In the first review, Berlin et al. provide an excellent introduction to the theory and mathematical treatment of charge transfer in DNA. Several types of models are discussed as are as the limitations and usefulness of these models. Following this introduction is a more in-depth look at the quantum chemical treatment of charge transfer in DNA by Rösch et al. Expanding on this topic is the next review by Conwell, which lays out the theoretical evidence for polarons and their role in charge transport in DNA. A chapter by Cai et al. follows, providing experimental evidence of charge transport in DNA at low temperatures. This review provides a good starting point for considering the experimental evidence surrounding charge transfer in DNA as its topic is the low temperature regime where DNA is rigid and some of the complexities of DNA systems are minimized. Shafirovich et al. discuss the use of 2-aminopurines at specific sites in DNA to probe the mechanisms of oxidative damage to DNA and to provide evidence for the participation of solvent protons in the reaction. In the next review, Thorp rounds out the experimental section in the volume beautifully by discussing the use of electrochemistry to study charge transfer in DNA, an approach different from that taken by some of the previous researchers. The last review, by Porath et al., summarizes the theoretical and experimental evidence for charge transport in DNA and how this information is being used to enhance understanding of the topic and, more importantly, to develop the technology for harnessing the ability of DNA to transfer charge in nanoscale devices.

The volume clearly summarizes much of the theoretical and experimental evidence surrounding charge transport in DNA.

The mathematical and quantum treatment of the physical processes involved provides the basis for understanding this complex topic, and the experimental evidence correlates well with the theory behind it, providing an informed global view of the topic. This text is highly recommended for anyone doing research in the field of charge transport in DNA. It is a valuable reference that might also be of use in teaching a graduate level course on this challenging subject.

Bruce E. Eaton and Jonathan Vaught, *North Carolina State University*

JA040960B

10.1021/ja040960b