in the introduction that nowhere in this book must the reader accept arbitrary assumptions or the author's personal view; nevertheless, this book is very personal. But it does present a both valid and unconventional introduction to theoretical chemistry, based on the Bader analysis of electron density.

One may argue that it is unsatisfactory to insist on analyzing the electron density without first worrying about its physical origin, in other words, without first considering the solution of the Schrödinger equation. In fact, the presentation given here is essentially based on a classical picture (the electron density as a classical variable). The Schrödinger equation is mentioned for the first time on page 130. The subtitle "A Quantum Theory" is nevertheless not unjustified, if one considers some of the discussions in Chapters 5, 6, and 8.

For someone working in the field of theoretical chemistry, Bader's book is stimulating, though sometimes hard to read. It is, again paradoxically, the claim that it should be understandable even for the uninitiated reader which makes the access to this book difficult. In fact in addition to a presentation of the author's own work, one finds a great deal of well-known material, which is often so disguised that one does not recognize it immediately. Perhaps a naive reader who reads this book as it is intended--as an introduction to theoretical chemistry--will not mind this.

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Manganese Redox Enzymes. Edited by *V. L. Pecoraro*. VCH Publishers, New York/VCH Verlagsgesellschaft, Weinheim, 1992. X, 290 pp., hardcover $ 110.00/DM 186.00--ISBN 0-89573-729-9/3-527-27934-2

This volume presents a detailed overview of the current state of knowledge of manganese containing metalloenzymes that participate in oxidation/reduction processes, most of which evolve dioxygen in their reactions. Heavy emphasis is given to the oxygen evolving complex (OEC) from photosystem II which performs the light driven four-electron oxidation of water to dioxygen, the reverse of the more commonly studied reaction of dioxygen reduction. The problem is presented primarily from a bioinorganic perspective, with emphasis on biophysical measurements which depend on metal centered physical properties and on manganese coordination chemistry.

Based on the contents of this book, the field of manganese redox biochemistry has made significant progress and is poised to make solid advances in understanding this central and highly complex chemistry. The current level of understanding is significantly behind that of iron sulfur, iron porphyrin, copper metalloprotein, and photosynthetic reaction center chemistry in that there is relatively little structural information on the proteins and there are no clearly correct low molecular weight model compounds. However, the amount of physical information on the proteins and low molecular weight compounds and the general knowledge of the coordination chemistry of polynuclear Mn compounds with oxidation states above II is increasing rapidly. The readers of this book will get a good feeling for the level of knowledge and the excitement of the field, as well as the controversies and uncertainties.

Technically, the book is well produced in a consistent typeface. There are few typographical errors, and figures are generally clear except for several of the crystal structure (ORTEP) representations which are poorly labeled and reproduced.

There are 12 chapters in the book. The first is a general review (E. L. Larson and V. L. Pecoraro) of Mn coordination chemistry and magnetic properties of Mn-containing molecules, as well as a summary of the properties of Mn-containing biomolecules and the current candidates for low molecular weight model systems. Chapter 2 (J. E. Penner-Hahn) concerns Mn catalases and presents kinetic as well as structural and magnetic data. Chapter 3 (W. D. Frasch) presents kinetic data on OEC reactions with alternate substrates and inhibitors (H_2O_2, alcohols, NH_2OH, CN^-, Ca^{2+}) and is concerned with photosystem 2 preparations which contain more components than those discussed by other authors. Chapter 4 (C. F. Yocum) discusses the requirement for Ca^{2+} and Cl^- by the OEC. Chapter 5 (J. P. Dekker) concerns interpretation of an optical signal in the 250–350 nm range which varies with oxidation state change in the OEC. Chapter 6 (T. Vänngård, Ö. Hansson, and A. Håddy) is particularly focussed on the complex problem of the EPR signals generated by OEC preparations. Chapter 7 (G. W. Brudvig and W. F. Beck) reviews, particularly up to late 1989, the available information on the interactions of "ligands" (Cl^-, amines, ammonia, NH_2OH, hydrazine, H_2O_2) with the OEC. Chapter 8 (K. Sauer, V. K. Yachandra, R. D. Britt, and M. P. Klein) provides a discussion of the particularly important EXAFS results that many of the other authors quote in order to focus the speculation regarding the structure of the Mn center(s). Further EPR results are also extensively discussed. The use of solvent NMR relaxation as a probe is presented in Chapter 9 (R. R. Sharp). Chapter 10 (V. L. Pecoraro) presents a detailed overview of known low molecular weight Mn complexes and discusses the limitations on Mn–Mn distances provided by various bridging atom arrangements. Chapter 11 (M. K. Stern and J. T. Groves) discusses a separate issue in small molecule Mn chemistry, oxygen transfer by oxo-Mn porphyrins. The last chapter (W. H. Armstrong) presents more results and the motivation behind the construction of some polynuclear model compounds.

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Reflections on Symmetry in Chemistry ... and Elsewhere. By *E. Heilbronner* and *J. D. Dunitz*. Verlag Helvetica Chimica Acta and VCH, Basel and Weinheim, 1993, 154 pp., hardcover DM 58.00—ISBN 1-56081-254-0

The book seems to have come out at the wrong time, just *after* Christmas! But there are Christmases to come and this marvelous, handsomely produced volume will find a place under many (slightly unsymmetrical) trees, a token of affection from the chemist's significant other (or vice versa). Like other gifts under those trees, it is almost certain to be wrapped in multicolored paper decorated with some repeating pattern. I remember well as a child looking for the repeat in the paper. The revealable mysteries of these patterns are the melody of this book. Each motif in the Christmas wrap is unique (though designers do tend to copy each other), but if it is to be repeated regularly ("translated") throughout the plane, the pattern, in its symmetries, is constrained by the geometry of our space. There is an infinite variety of designs for the basic unit, but only 17 ways to propagate them in the plane.

"Reflections on Symmetry" is the best popular exposition ever written on symmetry and its role in chemistry. What makes it so good? First, the mastery of the authors, two chemists who have thought more deeply about symmetry and structure (geometrical and electronic) than most of us. Their expertise is a gift to us. Then, the authors are both master tellers of stories, chemical raconteurs. They will not pass up a tale of folly, you can be sure. One wonderful and instructive story they relate is of some crystallographers who took too seriously (or were too lazy to build a model) a distorted journal drawing of a cyclohexane ring. Or the incensed reaction of Henry Edward Armstrong to W. L. Bragg's "failure" to find NaCl molecules in the structure of solid salt: "Chemistry is neither chess nor geometry, whatever X-ray physics may be ...". Third, Dunitz and Heilbronner are master teachers. They know how to rivet our attention with a cigar game (most appropriate to one of the authors, who once gave me a twisty Havana I couldn't find in Havana) that teaches us the importance of perceiving inversion symmetry. Or a striking way of solving a chessboard tiling problem as a lead-in to orbital symmetry control, that phenomenon illustrated with patented blue and yellow orbitals. Only rarely, once in a blue moon (or in a yellow, purple and brown tiling of scalene and equilateral triangles), do the authors misjudge the abilities of lesser mortals to juggle shapes.

The story, that of the role of symmetry in chemistry, is told by Dunitz and Heilbronner with immense wit, best characterized as Scottish/Bavarian. The great and utterly untranslatable German humorist, Karl Valentin, would have been proud of his disciples. So the way an enzyme deals differently with two seemingly symmetrical faces of a molecule is made crystal clear by a photo of a tea cup worn asymmetrically after many years of use by one of the authors. And a hand holding a handed molecule in an illustration sports a bloodied bandage, perhaps the result of a right-hander coping with a left-handed scissors.

The authors, in love with structure, following the pictorial nature of chemistry, of course use a multitude of drawings and photographs. Ruth Pfalzberger deserves great credit for these. The drawings are effortlessly integrated into the text. And it is striking the way they too partake of the wit and pedagogic sensitivity of Dunitz and Heilbronner. Thank God, there are not too many Escher reproductions.

What would I fault? Nothing in the book itself, only an attitude, one I can understand, that gives more value to simplicity and symmetry than it deserves. Symmetry is beautiful (in a simple way), symmetry elicits a sense of peace, repose, and stability. But it's really asymmetry that's interesting. In asymmetry is variety and tension. And richness. Especially in chemistry should we value diversity and difference—what's interesting about steroids is not the underlying molecular skeleton, but the variety of function and biological activity that comes from asymmetrical substitution. Perhaps I'm not entirely fair. Asymmetry without an inkling of order is chaos. Whatever beauty is, the tense edge of symmetry and asymmetry contributes to it. Heilbronner and Dunitz sing the praises of symmetry, but in a closing sentence to a chapter they say "... it could appear that the Gods, unlike humans, have a long-term preference for low symmetry".

It is rare that a book that teaches fundamentals of a science carries the clear stylistic mark of its authors. On every page this gem of exposition does: I read it, and I see the white-haired gentleman who asks hard questions about structures while walking up a Swiss mountain trail; I hear the jovial raconteur of orbital follies handing me a cigar and a glass of wine. I see and hear, and you can read, both of them telling, with deep affection, the wonderful story of symmetry in chemistry.

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