Symmetry, Spectroscopy, and Crystallography

The impact of stereochemistry can hardly be over-emphasized: the mechanisms of enzymatic reactions and other important biochemical processes, the biological activity of drugs, modern organic synthesis and drug design, cannot be understood without some knowledge of stereochemistry. Indeed, it occupies a special place between chemistry, life sciences, pharmacology, and technology. However, its most basic concepts remain somewhat vague, even for a majority of chemists.

One of the causes of the frequent misunderstandings between chemists from different fields is the compartmentalization of knowledge into different disciplines. Although interdisciplinarity is the order of the day, in reality scientists specialized in different techniques are having increasing trouble in communicating with each other. Synthetic organic chemists tend to think in two dimensions, rarely looking beyond tetrahedral carbon atoms, crystallographers often view molecules as static objects and ignore dynamics, while spectroscopists and theoreticians often concentrate on the molecule and disregard its environment. However, structural chemistry is a truly interdisciplinary science, which requires combined use of all the four approaches mentioned above.

The main strength of Robert Glaser's *Structural Nexus* lies in its interdisciplinary approach. It is a synthesis of the author's half-century of experience in structural chemistry, and combines different views and different methods used for the elucidation of three-dimensional molecular structures: strategies and routes for synthesis, basic characterization, crystallography, electron microscopy, and a plethora of spectroscopic techniques.

The book is not organized according to different methods; instead the chapters are divided according to particular stereochemical phenomena and problems that a structural chemist might encounter. It starts with the basic concepts of symmetry and chirality, including microscopic and macroscopic natural objects (Chapters 1 and 2), molecular conformation, which can often be flexible (Chapter 3), and a brief historical development of basic concepts in structural chemistry (Chapter 4). Optical properties of matter related to chirality (birefringence, optical rotation, circular dichroism, etc.) are discussed in Chapter 5, while the symmetry aspects of the molecules that can be deduced from NMR spectroscopy (including dynamic phenomena) are the topic of Chapter 6. Dynamic aspects of chirality, and the generation of chirality in synthesis, are described in Chapters 7 and 8. Symmetry properties of extended periodic and quasiperiodic arrays, as well as some basics of X-ray diffraction, are described in Chapter 9. Chapter 10 is devoted to pseudosymmetry (i.e., an approximate, but not exact, symmetry), and Chapter 11 deals with high-symmetry molecules, both achiral and chiral. A large portion of the book is devoted to conformations of flexible molecules and their relevance to drug design (Chapters 12–16). The last chapter is about helical symmetry and asymmetry, which is present not only in the well-known example of double-helix DNA, but also in a variety of polymeric and cyclical molecules.

The book describes specific chemical problems whose solution requires a particular method (or a combination of methods), and thus the main principles of structural chemistry are reached by induction, rather than by purely theoretical deduction (as is common in textbooks). It is particularly noteworthy that the author does not dwell on the ubiquitous asymmetrically substituted tetrahedral carbon atom, but presents chirality in a much more comprehensive way, introducing C_2-symmetric chiral molecules and moieties that induce C_2-symmetric chirality, chiral tetrahedral and octahedral clusters, etc. It is my opinion that the chiral tetrahedral carbon atom should be regarded as only a special case of molecular chirality, not as a prototype of a chiral molecule, and is therefore poorly suited as an introduction to the wide subject of stereochemistry. The *Structural Nexus* offers a refreshing novel view of the old topic.

The book is mostly concerned with structural organic chemistry, although some smaller parts are devoted to coordination compounds. It was a pity not to include the stereochemistry of metal atoms with coordination numbers greater than four (for example, tetragonal pyramids, octahedra, Archimedes' antiprisms, etc.), since it is both more diverse and more interesting than that of the ubiquitous tetrahedral carbon atom.

The book is well-written and easy to read, indeed it makes enjoyable reading. It should be of interest to everyone connected with structural chemistry—synthetic organic chemists, crystallographers, spectroscopists, theoretical chemists, materials scientists, and drug-designing pharmacologists—ranging from PhD students to experienced researchers.

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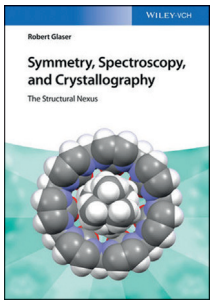
International Edition: DOI: 10.1002/anie.201602425
German Edition: DOI: 10.1002/ange.201602425



Symmetry, Spectroscopy, and Crystallography
The Structural Nexus
By Robert Glaser. Wiley-VCH, Weinheim 2015. 312 pp., hardcover, € 99.00.—ISBN 978-3527337491