Biomolecular NMR Spectroscopy by J. N. S. Evans

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Reviewed by Kevin H. Mayo, Department of Biochemistry and The Biomedical Engineering Center, University of Minnesota Health Sciences Center

With the advent of Fourier transform NMR and superconducting magnets in the 1970s, and higher field superconducting magnets, advancing computer and radio frequency electronic technologies in the 1980s and continuing into the present with gradients, NMR spectroscopy has expanded tremendously in each of its main subfields: solution, solid state, in vivo cell metabolism, and imaging. Given the exponential growth in NMR applications as evidenced by the literature during the past two decades, it is astounding that relatively few NMR texts have been written in recent years. *Biomolecular NMR Spectroscopy*, the latest NMR text to hit the shelves, is a welcome sight.

The most expansive subfield in NMR to date is biomolecular solution (high field) NMR spectroscopy, which is the primary subject covered in this text. Evans, however, does deviate somewhat into the field of biomolecular solid-state NMR—one of the author's areas of expertise. The overall aim of this book is to provide a basic introduction to NMR spectroscopy and to exemplify applications in biomolecular NMR with proteins, nucleic acids, carbohydrates, and membranes. The text, therefore, is logically divided into five parts: 1) theory; 2) proteins; 3) enzymes; 4) nucleic acids and carbohydrates; and 5) membranes. Parts 1, 2, and 4 resonate familiar features from two other well-known texts on the subject: Wüthrich's *NMR of Proteins and Nucleic Acids* (Wiley, 1986) and Clore and Gronenborn's *NMR of Proteins* (CRC Press, 1993). The Evans' text, however, enhances, expands, and updates these treatises.

The section on theory (part 1), for example, very effectively integrates the product operator formalism and the more traditional vector model approach (when applicable) in explaining many commonly used two-dimensional and multidimensional, multinuclear NMR pulse sequences, which are discussed systematically, providing a very good reference compendium. This is one of the most useful aspects of Evans' text. Two-thirds of the theory section deals with methods for NMR spectral assignments and structure derivation. The well-written section on "Obtaining NMR Structures" even includes a discussion of which software to use for structure generation and the quality (precision versus accuracy) of the structures generated.

In each of the subsequent four biomolecular subject sections (parts 2 through 5), many good examples from the literature are described. Even a section on protein folding and H/D exchange/trapping has been added to exemplify a more novel use of NMR. Part 2, "Proteins," regurgitates parts of the Wüthrich text, even using some of the same figures (with permission, of course). The general sequence-specific resonance assignment and structure determination approaches, however, are significantly updated from the 1986 Wüthrich "bible," including discourses on more recent non-NOE based sequential assignment and isotopic labeling approaches using multidimensional, multinuclear NMR methodologies. Part 3, "Enzymes," has the flavor of an updated Jardetzky and Roberts *NMR in Molecular Biology* (Academic Press, 1981). The abbreviated section on "The transferred NOE" presented in part 3 could have been expanded given its increased use in the literature, particularly in ligand-receptor (enzyme) conformational studies.

In some ways, *Biomolecular NMR Spectroscopy* attempts to bite off more than it can chew by covering, or by trying to cover, too much material. In this text, Evans clearly emphasizes proteins. This is not out of line, as statistically, proteins are most represented in the literature. The last two parts (4 and 5), however, move very quickly through nucleic acids, carbohydrates, and membranes (17% of the text) and give only a taste of these subfields in biomolecular NMR. Other topics that could have been expanded include, for example, basic relaxation theory, protein/peptide motional dynamics, and, as mentioned above, transferred-NOE. Furthermore, given the currently hot topic of gradients in NMR spectroscopy, it was somewhat disappointing not to see this covered. In part, these subject abbreviations and omissions may be explained by necessary page limitations placed on any single volume text and the personal desires and critiques of a particular reader, e.g., this reviewer. These shortcomings in *Biomolecular NMR Spectroscopy* are parenthetically acknowledged by the author who, to his credit, cites numerous references for supplemental reading. Moreover, several appendices are given to cover examples of product operator calculations, NMR data on amino acids and oligonucleotides, and NMR data on common solvents. The well-referenced Wüthrich random coil chemical shift table is even reprinted in the Appendix, along with ^{13}C chemical shifts of amino acids in neutral D_2O and amino acid spin system patterns presented from actual DQF-COSY and TOCSY spectra.

Biomolecular NMR Spectroscopy is targeted for a graduate or a postgraduate audience, requiring a background in physical chemistry, biochemistry, and mathematics appropriate for the beginning graduate student in biophysics or biophysical chemistry. In this respect, this book could be used either as a lecture text for the beginning graduate student or as a reference text for the accomplished NMR spectroscopist. Overall, *Biomolecular NMR Spectroscopy* is a very useful book. This past semester I used the Evans text in my biophysics/NMR spectroscopy course at the University of Minnesota. In general, students received the text very well and were favorably impressed with the coverage. Therefore, I plan on using this book in my course for the foreseeable future and I highly recommend *Biomolecular NMR Spectroscopy* to you.