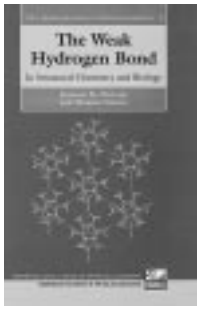
Not the Weakest Link

The Weak Hydrogen Bond. By *Gautam R. Desiraju* and *Thomas Steiner.* Oxford University Press, Oxford 1999. xx+507 pp., hardcover $ 150.00.—ISBN 0-19-850252-4

I have in my shelves three kinds of books. There are some that I discovered, when I got them, were useless, and now they are a little dusty and forgotten. There are others that you have to read quickly because they will soon be obsolete, like some Annual Reports. Finally, there are those books that become well worn out and that your colleagues often try to borrow from you. *The Weak Hydrogen Bond* clearly belongs to this third group.



The first reason is that the authors are both very well known in the field of weak interactions and, although both are crystallographers, their domains of expertise differ considerably. Professor Gautam R. Desiraju is the author of some classic books such as *Organic Solid State Chemistry* and *Crystal Engineering*, titles which somewhat define his speciality. Dr. Thomas Steiner acquired fame worldwide for his statistical studies of hydrogen bonds (HBs) and for some diagrams that are known as Steiner plots.

The second reason is that *The Weak Hydrogen Bond* (WHB; other authors have called it the "non-conventional hydrogen bond", although the two names are not exactly equivalent) contains much useful information, well-ordered and easy to find with many drawings, graphs, and tables. This allows the authors to summarize the wealth harvested in 880 references into only 507 pages (there is an illustrative discussion of the origin of the references on page 446).

The book is divided into five main chapters. The first one introduces the WHB in relation to HBs in general; this is necessary because its boundaries are not clear. Chapters 2 and 3 correspond to the development of the concept of WHB, while the last two chapters are devoted to WHBs in supramolecular chemistry and crystal engineering (Chapter 4) and in biological structures (Chapter 5). Even the last chapter ("Conclusions") contains a lot of useful information, as well as new insights about the future of this topic. There are some exceptionally good sections, like that dealing with π acceptors in Chapter 3. The chapter dealing with crystal engineering is, as expected, very good, but it was really a pleasant surprise that the biological chapter is also very good (we must remember that Dr. Steiner was a former student of Prof. Saenger).

Some important topics are thoroughly reviewed in Chapter 3, such as agostic interactions (p. 280), dihydrogen bonds (p. 283), transition metal hydrides (p. 287), and inverse hydrogen bonds (p. 291). These are welcome, since there is a need for clear definitions to avoid further confusion.

As I have said, the chapter on crystal engineering is written with authority. I liked particularly the discussion on supramolecular synthons and on supramolecular retrosynthesis: this is certainly the way to progress in this fascinating and promising field.

The importance of the WHB in biological structures is discussed in detail in Chapter 5, which is a good introduction to the subject and its difficulties. Because C–H donors and π acceptors are ubiquitous in biological macromolecules, WHBs have an important role in their structure and recognition properties. The large amount of water, 30–80 %, complicates the structural studies of "living" molecules considerably. The HBA (acceptor) and HBD (donor) properties of water are discussed in a way that will surprise many theoretical chemists. Although there is a detailed discussion of organic fluorine as a weak HBA (Chapter 3), the controversial role of Kool's difluorotoluene, as a nonpolar isostere for thymine, is not examined in Chapter 4.

If there is a small criticism that I would make about this book, it is that NMR spectroscopy is almost absent, not only for solutions but for the solid state as well. The book was edited by the International Union of Crystallography. Therefore the stress is put on diffraction methods; nevertheless, vibrational and gas-phase rotational spectroscopies are discussed in Chapter 1.

The system of including the titles of references, typical in crystallography, is greatly appreciated because on finding the title you get complementary information to decide if the original paper is worth reading. On the other hand, the index is quite poor: neither "NMR" nor "nuclear magnetic resonance" is listed, despite the fact that there are some pages dealing with this topic, including ^{17}O and ^{31}P measurements.

The main problem with a book dealing with a subject of "intense and rapidly growing interest", as the authors recognize in their preface, is that the number of relevant papers is constantly growing, so that there are many that one would have liked to see cited in the book. But I think this is unavoidable for any book on a living topic. Paradoxically, the book will have a great effect on WHB studies, which in turn will make a second edition

necessary in, I venture to say, ten years from now.

Clearly structural chemists and crystallographers are the natural readers of this book, but it is equally relevant for computational, material sciences, and medicinal chemists, who will all learn a lot from the enjoyable experience of reading it.

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Molecular and Supramolecular Chemistry of Natural Products and Their Model Compounds. By *Jürgen-Hinrich Fuhrhop* and *Claus Endisch.* Marcel Dekker, New York 2000. ix+602 pp., hardcover $ 195.00.—ISBN 0-8247-8201-1

Although two authors were involved in the preparation of this book, they undertook quite different tasks. While Dr. C. Endisch produced the illustrations, the text is the work of Professor J.-H. Fuhrhop. This is pertinent because the book presents a distinctive and personal account of its topic, in keeping with the highly original research contributions Professor Fuhrhop has made over the past three decades. Viewing the contents list and introduction, the special perspective is quickly apparent. It is clearly felt, with some justification, that the proteins, carbohydrates and lipids which make up the bulk of the world's biomass are more significant "natural products" than the secondary metabolites which dominate most other accounts. Also, the author is more interested in the complex aggregates formed by amphiphilic molecules in water than the 1:1 "substrate–receptor" complexes which feature prominently in mainstream supramolecular chemistry.

As a result, certain aspects of the coverage may surprise some readers. For example, a book with this title might be expected to contain substantial sections on cyclodextrins, the vancomycin group of antibiotics and the ionophore antibiotics. In fact, the cyclodextrins are allocated just three pages, the ionophores receive occasional, selective mention (totaling, perhaps, two pages), and the vancomycin group do not seem to feature at all.

Instead, we receive a tour through the major classes of biomolecules, typically considering a) occurrence and structure, b) synthesis, c) reactivity, and d) aspects of their supramolecular chemistry (or, as the author prefers, their *synkinesis*). The first, introductory chapter gives an overview of "Structure and Reactivity Patterns in Natural Compounds", with sections on structure and conformation, spectroscopy, synthesis, reactivity, and synkinesis. Although there is much useful and interesting material here, the coverage is necessarily selective. There follow chapters on lipids and membranes, steroids, carbohydrates ("Orgies in Biomass and Stereochemistry"), carotenes, vitamins, DNA ("A Polar, Flexible and Fragile Matrix"), and proteins.

As illustrated by the chapter headings, the style is individual, often entertaining, and sometimes provocative; not everyone will agree that "there are more open questions in carotene chemistry than anywhere else in bioorganic chemistry". The sections on structure, synthesis, and reactivity of the various classes of natural compounds provide valuable background and reference data. The supramolecular/synkinetic sections concentrate on self-assembly phenomena, almost exclusively in aqueous solution, and on the development of functional, mainly biomimetic supramolecular systems (also operating in water).

Unfortunately, as so often seems to be the case, the authors have not been served well by their editors. The book contains a rather large number of minor errors which could have been removed by adequate proofreading. In one case, it seems that two schemes from different chapters have been interchanged by mistake.

Overall, this is an interesting and stimulating book, which can be warmly recommended to workers in supramolecular and biomimetic chemistry. As a textbook it is perhaps too personal to serve as the sole reference for a course. However, it will certainly be a valuable resource for students at advanced undergraduate and postgraduate levels.

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