Hydrogen Bonding in Biological Structures by G. A. Jeffrey and W. Saenger. Springer-Verlag, New York, 1991, 569 pages, $79.00

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Hydrogen bonds are seen in so many contexts important to structural biology that they are often taken for granted. The complementarity of bases in DNA is a consequence of the arrangement of the heteroatoms so that they donate and accept hydrogen bonds. The secondary structure of proteins is defined by the conformation of the polypeptide and the hydrogen bonding between the carbonyl oxygen atoms and amide atoms in the peptide bonds. Hydrogen bonds hold macromolecular complexes together. Water molecules bind to macromolecules via hydrogen bonds. But are the features of all these hydrogen bonds the same? Do they have geometries that are as predictable as the length of a single carbon-carbon bond? Comparison of the hydrogen bonds in, for example, beta pleated sheets and DNA base pairs shows immediately how hydrogen bonds can differ from one another. The authors of this monograph, both of whom have devoted much of their careers to understanding this all important "weak" force, present a comprehensive analysis of hydrogen bonding.

Jeffrey and Saenger state at the outset that they will use the results of three dimensional structure analysis and describe this approach as epidemiological: "the prediction of the most probable behavior by means of surveys of the behavior of similar species". They recognize the strengths and weaknesses of this approach and address them at the beginning and throughout the treatise.

The book starts with a discussion of the history and basic concepts involved in hydrogen bonding. In the next section, the many types of hydrogen bonds observed in crystals including two center, three center and CH — O bonds are described. Having given these examples, the authors then discuss the hydrogen bonding observed in small biological molecules such as carbohydrates, amino acids and nucleotides. In these cases the various points are illustrated by tables with specific examples as well as numerous figures. The sections on proteins and nucleic acids contain similar tables as well as some statistical analyses. The book ends with a discussion of hydration starting with the simple ice structures and progressing to the features observed in macromolecules.

The presentation is scholarly and complete. Little is omitted and yet it is not at all heavy going. The text is peppered with phrases such as "the hydrophobic effect arises from the age-old adage that oil and water do not mix". From there you can relax and see what they have to say about the links between thermodynamics and structure. Or in the section about clathrate hydrates there is a quotation: "It is a pleasing thought for a crystallographer that when it snows on some distant planet, it might snow clathrate hydrates". The figures are a mix of accurate representations of molecular structures and schematic diagrams of hydrogen bonding patterns. The section on weak forces is effectively illustrated with "Gulliver, a giant, constrained by a multitude of weak bonds."

"Hydrogen Bonding in Biological Structures" can be used in many ways. For specialists such as molecular biophysicists, this monograph is a valuable reference with a wealth of information that is presented in very accessible ways. The references are complete and the authors do not forget to cite the original crystal structure analyses from which summaries are derived. The material is effectively presented so that it can be read by newcomers to the field. The authors use the device of including "boxes" that give summaries of topics such as cyclodextrins, DNA polymorphism, definitions of torsion angles, and even one giving a comparison of x-ray and neutron diffraction. Enough is contained in these boxes to give you the definitions you need to understand the content of the subject under discussion. Thus, this book could also be used on its own as a graduate text.

It is rare to find a book that is versatile in that it can be used effectively for both teaching and research. This monograph is one such example. It is a real treasure!

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