Preface

‘The number of large dimensions to space is something that plays a key role in what can occur in the universe. Remarkably, universes with three large dimensions of space are very special. If there are more than three large dimensions, no stable atom can exist [. . .]. [And] only in three dimensions do waves propagate in a sharp, undistorted fashion.’

John D. Barrow [1]

On that account, we exist in a Universe of three spatial dimensions, seemingly the only dimensionality compatible with the emergence of observers. This, of course, implies that chemists, biophysicists, biochemists, and pharmacologists, our intended audience, need to give explicit consideration to the three dimensions of space which form the stage of their observations and rationalizations, and the scaffold of their models.

Our objective as editors (and authors) is to present the molecular scale of matter in the broad diversity and richness of its three dimensions, giving due attention when relevant to the temporal dimension in which molecules exist, act, and react. The field is huge and has been expanding continuously ‘up’ and ‘down’ the scale of complexity: ‘down’ into the atomic and quantum ranges, and ‘up’ into the biochemical, macromolecular, and supramolecular ranges.

Rather than a doomed attempt at covering this immense range, we focus herein on two significant fields of three-dimensional chemistry, two research fields that have in recent times welcomed the steady arrival of newcomers eager to make an impact but whose mastery of conventions, concepts, and context needs cultivating. Also part of our intended audience are more seasoned scientists who wish to raise their eyes to a broader context and seek inspiration in adjacent areas of research. Specifically, the two fields we focus on are a presentation of the guiding principles in organic stereochemistry, followed by a focus on the biochemical and medicinal relevance of this discipline.

Our treatment of Guiding Principles gives priority to didactic clarity and nomenclature issues, as detailed and illustrated in Parts 1 to 4:

- ‘Symmetry Elements and Operations, Classification of Stereoisomers’
- ‘Stereoisomerism Resulting from One or Several Stereogenic Centers’
- ‘Other Stereogenic Elements: Axes of Chirality, Planes of Chirality, Helicity, and (E,Z)-Diastereoisomerism’
• ‘Isomerisms about Single Bonds and in Cyclic Systems’.

This is followed by Parts 5 to 8 which focus on the biomedical relevance of stereochemistry, with special reference to the biochemistry and pharmacology of medicinal compounds. Here, examples and applications will be discussed and illustrated based on their relevance to a given specific stereochemical aspect:

• ‘Chirality in Molecular and Clinical Pharmacology’
• ‘The Conformational Factor in Molecular Pharmacology’
• ‘The Concept of Substrate Stereoselectivity in Biochemistry and Xenobiotic Metabolism’
• ‘Prostereoisomerism and the Concept of Product Stereoselectivity in Xenobiotic Metabolism’.

In accord with our biomedical focus, examples and applications are taken from endogenous and mainly exogenous domains of biochemistry. By endogenous, we mean physiological chemistry, in other words the enzymatic reactions underpinning the normal function of living organisms. But this book will give particular consideration to exogenous domains of biochemistry, namely the molecular interplay between organisms and exogenous compounds. Such compounds (known as ‘xenobiotics’) are defined as the innumerable chemicals (natural and human-made) which are devoid of normal physiological roles, but to which all organisms are exposed. Xenobiotics include drugs, agrochemicals, pollutants, many natural compounds, and the like. The exogenous domains considered will include molecular pharmacology and toxicology, with an emphasis upon the metabolism of drugs and other xenobiotics. Their significance in current research and technology is huge and increasing, a fact this book will acknowledge and hopefully promote further.

Finally, the book contains a gift for broad-minded readers with an interest in the historical roots of stereochemistry:

• Part 9: ‘Molecular Chirality in Chemistry and Biology: Historical Milestones’.

To avoid misunderstandings, we also need to stress what this book is not about, namely the more technical aspects of stereochemistry such as asymmetric synthesis [2], stereoselective analytical and separation methods [3], and issues related to drug development [4] and patentability [5]. The few references given below are just the tip of the iceberg of the many excellent sources available.

The nine Chapters of this book have already been published as reviews in the January to September 2013 issues of the Helvetica Chimica Acta. They are reproduced here with a number of modifications and with important material added, namely an extensive Glossary.
and an Index. The format and layout of the Chapters are essentially identical with those of a previous two-volume book on drug metabolism co-authored by B.T. and Stefanie Krämer [7].

It remains for us to express our gratitude to the colleagues whose contributions did much to improve this book. First and foremost, we are deeply indebted to Prof. Dieter Seebach for his kind Foreword and for reading and correcting Chapters 1 – 8. His encyclopedic knowledge and sharp eye have done marvels to spot errors and typos. And to our gracious readers, we wish the same pleasure and fascination we enjoyed while creating this work.

The Editors

REFERENCES


