



Rudolf Janoschek (Ed.)

Chirality

From Weak Bosons to the α -Helix

With 80 Figures, 18 Tables
and 95 Schemes

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Preface

*Les hypothèses, n'en déplaise à mon contradicteur,
sont l'âme des progrès de la science.*

Louis Pasteur

The concept of chirality, established 100 years ago, plays an important role in almost all domains and dimensions of our recent scientific view of life. Chiral properties can be found in fundamental nuclear particles, in molecules, and in the macroscopic world of living nature (plants and animals) and inanimate nature (crystals). In particular, chirality, or more precisely chiral excess, is evident in human beings. For example, the expected symmetry of the hands turns out to be functionally non-existent. Consequently chirality occurs in the technical sphere, where screws are the best-known examples, since most of them are made for right-handed people. Chirality is not confined to static objects but influences processes such as chemical reactions.

The occurrence of chiral objects on different dimensional scales has been treated in the past in mutually independent frameworks. There were, however, two remarkable events from which the conclusion can be drawn that the appearance of chirality in various fields has a common cause. On the one hand, physicists found evidence that the well-known biomolecular homochirality can be traced back to the chirality of weak bosons. At the same time, on the other hand, the so-called thalidomide tragedy occurred when thalidomide molecules of a certain chirality, taken by pregnant women, caused deformed children.

Spectacular events like these are reason enough for a group of authors to compile a survey on important aspects of chirality in a book which comprises topics from nuclear particle physics and various fields of chemistry to pharmacy. The authors agreed that they would not write for specialists in their respective fields of research but for anybody with a sound scientific education.

Although it is chemistry which dominates in this book, chirality is introduced in the chapter of fundamental-particle physics. There are two reasons for this. On the one hand, physicists carefully define the notions that will be applied later. On the other, the chirality of certain fundamental particles seems to be the origin

of biomolecular homochirality as mentioned before. Corresponding theories on the basis of molecular kinetics are introduced in the second chapter. The third chapter deals with the mathematical treatment of molecular chirality. Two crucial experimental methods for the determination of absolute stereochemistry, circular dichroism and anomalous X-ray diffraction, are presented in the fourth and fifth chapters.

The second half of the book is dedicated to the synthesis and separation of enantiomers of chiral chemical compounds. After a general introduction to chiral phenomena in organic chemistry, the main strategies for the production of chiral compounds are reviewed. These are enzymatic catalysis, synthesis using prochiral auxiliary compounds, and catalysis by means of chiral transition-metal complexes. Finally the separation of enantiomers by the technique of liquid chromatography is described. These contributions cover to a large extent the requirements in organic chemistry, biochemistry, and pharmaceutical chemistry. The closing chapter presents a study of biopolymeric structures, in particular the α -helix, which is the final point on our scale of dimensions for chiral objects.

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Rudolf Janoschek

Contents

List of Authors	XI
1 Parity Violation in Atomic Physics	
<i>H. Latal</i>	
1.1 Introduction	1
1.2 Parity	2
1.3 Elementary Particles and Forces	4
1.3.1 Leptons and Quarks	4
1.3.2 Forces and Interactions	5
1.3.3 Spin and Helicity (Chirality)	7
1.3.4 Unified Theory of Weak and Electromagnetic Interactions (“Standard Model”)	10
1.4 Parity-Violating Effects in Atoms	12
1.4.1 Phenomenology	13
1.4.2 Experiments	15
1.5 References	17
2 Theories on the Origin of Biomolecular Homochirality	
<i>R. Janoschek</i>	
2.1 Introduction	18
2.2 Observability of Chiral Molecular Structures	19
2.3 Kinetic Models for Unstable Equilibrium	21
2.4 Kinetic Models with Intrinsic Asymmetry	24
2.5 Parity-Violating Energy Differences Between Enantiomers ..	26
2.6 Homochirality from Stochastic Equations	30
2.7 References	32
3 Chirality and Group Theory	
<i>G. Derflinger</i>	
3.1 Introduction	34
3.2 The Principle of Pairwise Interactions	35
3.3 The Theory of Chirality Functions	38
3.4 The Approximation Methods	42
3.5 Determining the Lowest-Degree Chirality Polynomials	46
3.6 Qualitative Completeness and Supercompleteness	48
3.7 Counting Enantiomeric Pairs	52
3.8 References	57

4 Helicity of Molecules – Different Definitions and Application to Circular Dichroism*G. Snatzke*

4.1	Introduction	59
4.2	The Ideal Finite Helix	60
4.3	Real Molecules or Parts of Them, Fractions of a Helix	63
4.4	Rules	66
4.4.1	The Torsional-Angle-Rule (CIP)	66
4.4.2	The IUPAC-Axis-Tangent-Rule	67
4.4.3	The Two-Tangent Rule	68
4.4.4	The Spade-Product Rule	70
4.4.5	The Spiral-Staircase-Rule	71
4.5	Some Applications	72
4.6	Summary	84
4.7	References	85

5 Anomalous Dispersion of X-Rays and the Determination of the Handedness of Chiral Molecules*C. Kratky*

5.1	Introduction	86
5.2	“Normal” X-Ray Diffraction	88
5.2.1	Scattering from a Crystal	91
5.2.2	Friedel’s Law and When It Breaks Down	92
5.2.3	Physical Origin of Anomalous Scattering	95
5.3	Past, Presence and Future Use of Anomalous Scattering	98
5.3.1	Outlook	101
5.4	References	102

6 Chirality in Organic Synthesis – The Use of Biocatalysts*K. Faber and H. Griengl*

6.1	Chirality in Organic Chemistry and Biochemistry	103
6.1.1	Explanation of Basic Terms	103
6.1.2	Comparison of Properties: Enantiomers and Diastereomers	104
6.1.3	The Importance of Enantiomeric Purity	105
6.1.4	Methods of Obtaining Enantionerically Pure Chiral Compounds	106
6.2	Biocatalysts in Organic Chemistry – General Remarks	107
6.2.1	Enzymes	107
6.2.2	Whole Cell Systems	108
6.2.3	Types of Selectivities Achieved	108
6.3	Enzymes	110
6.3.1	Classes and Nomenclature	110
6.3.2	Properties and Stabilities	111

6.3.3	Coenzymes	111
6.3.4	Enzyme Mechanisms	113
6.3.5	Active Site and Enzyme Models	113
6.4	Use of Whole Cell Systems	115
6.4.1	Principles	115
6.4.2	Application to Unnatural Substrates	116
6.5	Application of Biocatalytic Hydrolysis	116
6.5.1	General Remarks	116
6.5.2	Resolution of Racemates	116
6.5.3	Asymmetrization of Prochiral and <i>meso</i> -Compounds	118
6.5.4	Selective Protection and Deprotection	118
6.5.5	Mild Conditions	118
6.6	Reduction and Oxidation Using Biocatalysts	118
6.6.1	Introduction	118
6.6.2	Enzymatic Cofactor Recycling	120
6.6.3	Enantioface Differentiation in Reduction of Ketones	121
6.6.4	Oxidation of Ketones	123
6.6.5	Hydroxylation of Nonactivated Carbon Atoms	123
6.6.6	Other Oxidations	124
6.7	Further Applications	125
6.7.1	Use of Organic Solvents, Transesterification	125
6.7.2	Lyase-Catalyzed Additions to Double Bonds	127
6.7.3	C-C Bond Formation and Cleavage	127
6.7.4	Transferases	128
6.8	Special Techniques and Novel Developments	130
6.8.1	Immobilization Techniques	130
6.8.2	Artificial and Modified Enzymes, Enzyme Mimics	131
6.8.3	Catalytic Antibodies	131
6.9	Comparison of Methods and Outlook	132
6.9.1	Advantages and Disadvantages of Biocatalysts	132
6.9.2	Future Developments and Trends	133
6.10	References	133

7 Preparation of Homochiral Organic Compounds

E. Winterfeldt

7.1	Introduction	141
7.2	Separation Techniques	141
7.3	Homochiral Building Blocks from Natural Products	142
7.4	Auxiliary Modified Substrates	147
7.5	Homochiral Reagents	156
7.6	Homochiral Catalysts	161
7.7	References	163

8	Transition Metal Chemistry and Optical Activity – Werner-Type Complexes, Organometallic Compounds, Enantioselective Catalysis	
	<i>H. Brunner</i>	
8.1	Werner-Type Complexes	166
8.2	Organometallic Compounds	170
8.3	Enantioselective Catalysis with Optically Active Transition Compounds	174
8.4	References	178
9	Strategies for Liquid Chromatographic Resolution of Enantiomers	
	<i>W. Lindner</i>	
9.1	Background of Basic Chromatographic Terms	180
9.2	Strategies to Separate Enantiomers by Chromatographic Techniques	181
9.3	Thermodynamic and Kinetic Considerations for Chromatographic Enantioseparation	184
9.4	Enantioselective Liquid Chromatography	187
9.5	Direct Enantioseparation by Liquid Chromatography	187
9.6	Chiral Phases Using Polymers as Chiral Selectors	188
9.7	Chiral Stationary Phases Using Proteins (Polypeptides) as Chiral Selectors	190
9.8	Chiral Stationary Phases Based on Synthetic Chiral Polymers	192
9.9	Chiral Stationary Phases Based on “Brush Type” Immobilization of Small Selector Molecules	193
9.10	Final Remarks on Brush Type and Inclusion Type CSPs ...	201
9.11	Indirect Enantioseparation	202
9.12	Final Remarks	203
9.13	References	203
10	The Nucleoproteic System	
	<i>S. Hoffmann</i>	
10.1	Introduction	205
10.2	The Chiral Message	205
10.3	The Evolution of the Chiral Amphiphilic Patterns	207
	10.3.1 Darwinian Selection for Chiral Information- Processing Patterns	208
	10.3.2 Basal Geometries of Chiral Nucleoproteic Constituents	212
	10.3.3 The DNA-RNA-Protein Triad	218
10.4	Stabilization Within the Dynamics	225
10.5	Outlook	234
10.6	References	234

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