

Contents

| | | |
|------------------|---|-----------|
| Chapter 1 | Phosphines and Phosponium Salts | 1 |
| | <i>By D. W. Allen</i> | |
| 1 | Phosphines | 1 |
| 1.1 | Preparation | |
| 1.2 | Reactions of Phosphines | 20 |
| 2 | Phosphine Oxides and Related Chalcogenides | 26 |
| 2.1 | Preparation | 26 |
| 2.2 | Reactions | 29 |
| 2.3 | Structural and Physical Aspects | 32 |
| 2.4 | Phosphine Chalcogenides as Ligands | 32 |
| 3 | Phosponium Salts | 33 |
| 3.1 | Preparation | 33 |
| 3.2 | Reactions | 35 |
| 4 | $p\pi$ -Bonded Phosphorus Compounds | 38 |
| 5 | Phosphirenes, Phospholes and Phosphinines | 43 |
| | References | 47 |
| Chapter 2 | Pentacoordinated and Hexacoordinated Compounds | 68 |
| | <i>By C. D. Hall</i> | |
| | Summary | 68 |
| 1 | Introduction | 68 |
| 2 | Monocyclic Phosphoranes | 68 |
| 3 | Bicyclic, Tricyclic and Tetracyclic Phosphoranes | 70 |

| | |
|--|------------|
| References | 82 |
| Chapter 3 Tervalent Phosphorus Acid Derivatives | 84 |
| <i>By D. W. Allen</i> | |
| 1 Introduction | 84 |
| 2 Halogenophosphines | 84 |
| 3 Tervalent Phosphorus Esters | 86 |
| 3.1 Phosphinites | 86 |
| 3.2 Phosponites | 87 |
| 3.3 Phosphites | 88 |
| 4 Tervalent Phosphorus Amides | 93 |
| 4.1 Aminophosphines | 93 |
| 4.2 Phosphoramidites and Related Compounds | 96 |
| References | 98 |
| Chapter 4 Quinquevalent Phosphorus Acids | 103 |
| <i>By B. J. Walker</i> | |
| 1 Introduction | 103 |
| 2 Phosphoric Acids and Their Derivatives | 104 |
| 2.1 Synthesis of Phosphoric Acids and Their Derivatives | 104 |
| 2.2 Reactions of Phosphoric Acids and Their Derivatives | 113 |
| 2.3 Selected Biological Aspects | 120 |
| 3 Phosphonic and Phosphinic Acids | 122 |
| 3.1 Synthesis of Phosphonic and Phosphinic Acids and Their Derivatives | 123 |
| 3.2 Reactions of Phosphonic and Phosphinic Acids and Their Derivatives | 144 |
| 3.3 Selected Biological Aspects | 150 |
| 4 Structure | 151 |
| References | 153 |
| Chapter 5 Nucleic Acids and Nucleotides; Mononucleotides | 161 |
| <i>By M. Migaud</i> | |
| 1 Introduction | 161 |

| | | |
|------------------|--|------------|
| <i>Contents</i> | | xi |
| 2 | Mononucleotides | 161 |
| 2.1 | Nucleoside Acyclic Phosphates | 161 |
| 2.2 | Nucleoside Cyclic Phosphates | 190 |
| 2.3 | Nucleoside Pyrophosphates | 191 |
| 3 | Nucleoside Polyphosphates | 196 |
| 3.1 | Nucleoside Pyrophosphates | 196 |
| 3.2 | Nucleoside Polyphosphates | 198 |
| | References | 200 |
| Chapter 6 | Nucleotides and Nucleic Acids; Oligo- and Polynucleotides | 204 |
| | <i>By D. Loakes</i> | |
| 1 | Introduction | 204 |
| 1.1 | Oligonucleotide Synthesis | 204 |
| 1.2 | RNA Synthesis | 209 |
| 1.3 | The Synthesis of Modified Oligodeoxyribonucleotides and Modified Oligoribonucleotides | 210 |
| 2 | Aptamers | 249 |
| 3 | Oligonucleotide Conjugates | 253 |
| 4 | Nucleic Acid Structures | 260 |
| | References | 269 |
| Chapter 7 | Ylides and Related Species | 289 |
| | <i>By N. Bricklebank</i> | |
| 1 | Introduction | 289 |
| 2 | Phosponium Ylides | 289 |
| 2.1 | Mechanistic and Theoretical Studies of Phosponium Ylides and the Wittig Reaction | 289 |
| 2.2 | Synthesis and Characterisation of Phosponium Ylides | 291 |
| 2.3 | Reactions of Phosponium Ylides | 297 |
| 2.4 | Synthesis and Reactions of Aza-Wittig Reagents | 306 |
| 2.5 | Ylides Coordinated to Metals | 307 |
| 3 | Wittig–Horner Reactions of Metallated Phosphine Oxide Anions | 315 |

| | | |
|------------------|--|------------|
| 4 | Horner–Wadsworth–Emmons Reaction of Phosphonate Anions | 316 |
| | References | 318 |
| Chapter 8 | Phosphazenes | 321 |
| | <i>By J. C. van de Grampel</i> | |
| 1 | Introduction | 321 |
| 2 | Linear Phosphazenes | 321 |
| 3 | Cyclophosphazenes | 336 |
| 4 | Polyphosphazenes | 347 |
| 5 | Crystal Structures of Phosphazenes and Related Compounds | 354 |
| | References | 361 |