

# *Inorganic Rings and Cages*

---

D. A. Armitage  
*Lecturer in Inorganic Chemistry,  
Queen Elizabeth College, London*



H 106



Edward Arnold

Inv.-Nr. 4114

A0 I

---

# *Contents*

## Preface

## INTRODUCTION

<b>1    <i>The Alkali Metals</i></b>	<b>1</b>
Alkoxides	1
Amides	4
Hydrogen derivatives	6
Appendix	6
<b>2    <i>Beryllium and Magnesium</i></b>	<b>8</b>
Inorganic salts	8
Hydrides	10
Amides of Beryllium and Magnesium	16
Alkoxides	20
Beryllium 20; Magnesium 24	
Thio derivatives of Beryllium and Magnesium	26
Organoberyllium and organomagnesium halides	30
Organomagnesium halides 30; Organoberyllium halides 35	
Appendix	39
<b>3    <i>The Group III Elements</i></b>	<b>41</b>
Elemental Boron and its derivatives	41
Diborane(6)	44
Polyboron hydrides	47
The anionic boron hydrides $B_nH_n^{2-}$	60
$B_{10}H_{10}^{2-}$ , 60; $B_{12}H_{12}^{2-}$ , 62; $B_nH_n^{2-}$ ( $n = 6-9, 11$ ) 63	
Borohydrides	64
The octahydrotriborate anion $B_3H_8^-$	66
The carboranes	67
Open-cage- or <i>nido</i> -carboranes 68; Closed-cage- or <i>closo</i> -carboranes 72; Large carboranes containing a single carbon	

atom 79; Carboranes containing a heteroatom 81; Boron hydride cages incorporating a heteroatom 82	
Transition metal complexes of boron cages	83
Halogenated boron cage compounds	88
Cyclic nitrogen derivatives of the Group III elements	89
1,3,2,4-Diazadiboretidines $[RBNR']_2$ 90; Borazines $[RBNR']_3$ 91; Fused and polycyclic borazines 94; Tetrameric borazynes $[XBNR]_4$ 96; Oligomers of $R_2BNR'_2$ 97; Oligomers of $R_2MNR'_2$ ( $M = Al, Ga, In, Tl$ ) 100; Nitrides 102; Hydrazine derivatives 103; Miscellaneous cyclic compounds 105; Unsymmetrical 4-membered rings 106	
Cyclic phosphorus and arsenic derivatives of the Group III elements	109
Cyclic Group III oxygen compounds	113
Borates 113; Boroxine and its derivatives 114; Halogenoboroxines and alkoxyboron halides 116; Oxygen derivatives of the post-boron elements 118; Miscellaneous oxyanion complexes 123	
Sulphur and selenium derivatives of Group III	124
Cyclic Group III halogen compounds	129
B-Halogenated borolanes and boraindanes 130	
Appendix	144
 4 Silicon, Germanium, Tin and Lead	152
The structures of the elements	152
Anionic derivatives of the elements	153
Cyclopoly-silanes, -germanes and -stannanes	156
Phenylcyclopolsilanes 157; Methylcyclopolsilanes 159; Cyclo-polygermanes 160; Cyclopolytannanes 162	
Cyclic nitrogen derivatives of silicon, germanium and tin	165
Perchlorocyclosilazanes 166; Organo-substituted cyclodisilazanes 167; Cyclotri- and -tetrasilazanes 173; Cyclic germanium-nitrogen and tin-nitrogen compounds 185; Miscellaneous silicon-nitrogen rings 187; Cyclosiloxazanes 189; Co-ordination compounds 193	
Phosphorus derivatives of silicon, germanium and tin	195
Synthesis 195; Properties 197	
Cyclic oxygen derivatives of silicon, germanium and tin	198
Introduction 198; The silicates 199; Silica 209; Oxides of germanium, tin and lead 212; Cyclosiloxanes 212; Cyclic germanium-oxygen compounds 225; Cyclic tin-oxygen compounds 226; Organo-tin and -lead salts in solution 238	
Complexes of the Group IV elements	239
Sulphur derivatives of the Group IV elements	240

## *Contents*

MX <sub>2</sub> compounds (M = Group IV element, X = Group VI element) 241; Halogenocyclodisilthianes 242; Organo-Group IV sulphides 243	
Exchange reactions	250
Halides of the Group IV elements	252
Appendix	261
<b>5 The Group V Elements</b>	<b>266</b>
The structure of the elements	266
Cyclopentazoles	269
Cyclopoly-phosphines and -arsines	270
Synthesis 270; Reactions 272; Structural determinations 279; Phosphorus cage compounds 282	
Nitrogen compounds	283
The cyclopolyphospho-III-azanes and their arsenic analogues 283; The phospho-V-azanes 285; Azides 291; Cage compounds 291; The phospho-V-azenes 296	
Oxygen derivatives	314
Anionic compounds 314; Oxides of Group V 317	
The binary phosphorus sulphides	320
Organo-substituted cyclic phosphorus-sulphur compounds	325
Appendix	332
<b>6 Sulphur, Selenium and Tellurium</b>	<b>338</b>
The elements	338
Cationic derivatives of sulphur, selenium and tellurium	342
Sulphur-nitrogen compounds	343
Halogen-substituted sulphur-nitrogen rings	348
Oxygen derivatives of sulphur and selenium	353
The Group VI tetrahalides	354
Appendix	358
<b>7 The Halogens</b>	
Formulae Index	365
Specific Index of Compounds	376
General Index	384