

CONTENTS

1. Zirconium and Hafnium	3
1.1 The Metals and their Aqueous Chemistry	3
1.2 Oxides	5
1.3 Halides	6
1.4 Other Binary Compounds	7
1.5 Complexes of Zirconium and Hafnium	7
1.6 Alkoxides and Dialkylamides	10
1.7 The Borohydrides	11
1.8 Compounds Involving Metal-Carbon Bonds	11
2. Niobium and Tantalum	15
2.1 The Metals, their Occurrence and Extraction	15
2.2 Oxides	16
2.3 Halides	17
2.4 Other Simple Binary Compounds	22
2.5 Alkoxides and Dialkylamides	23
2.6 Complexes of Niobium and Tantalum	23
2.7 Organometallics	24
3. Molybdenum and Tungsten	27
3.1 Oxides	27
3.2 Oxy-anions	28
3.3 Halides	30
3.4 Oxohalides and Complex Oxohalides	33
3.5 Complexes of Molybdenum	34
3.6 Organo-compounds	41
4. Technetium and Rhenium	43
4.1 The Metals and their Aqueous Chemistry	43
4.2 Halides	44
4.3 Oxides	45
4.4 Oxohalides	46
4.5 Perrhenates and Pertechnetates	47
4.6 Complexes of Technetium	47
4.7 Complexes of Rhenium	48

5. Ruthenium and Osmium	59
5.1 Aqueous Cationic Chemistry	60
5.2 Halides	60
5.3 Oxides and Oxo-anions	64
5.4 Nitrido Complexes of Osmium	65
5.5 Complexes of Ruthenium	66
5.6 Complexes of Osmium	76
6. Rhodium and Iridium	81
6.1 The Metals and their Aqueous Chemistry	81
6.2 Halides	82
6.3 Oxides	83
6.4 Some Other Binary Compounds	83
6.5 Complexes of Rhodium	83
6.6 Complexes of Iridium	94
7. Palladium and Platinum	107
7.1 The Metals and their Aqueous Chemistry	107
7.2 Halides	108
7.3 Oxides	110
7.4 Some Other Binary Compounds	111
7.5 Complexes of Palladium and Platinum	111
7.6 Organo-compounds of Pt(II) and Pt(IV)	132
7.7 Recent Applications	134
8. Silver and Gold	137
8.1 The Metals , their Occurrence and Extraction	138
8.2 Hydrated Ions	138
8.3 Oxides	138
8.4 Halides	139
8.5 Other Compounds of Ag(I)and Au(I)and their Complexes	140
8.6 Complexes of Silver (II)	145
8.7 Complexes of Gold (II)	147
8.8 Complexes of Silver (III)	147
8.9 Complexes of Gold (III)	148
8.10 Gold (III) Organo-compounds	149
8.11 Gold (V)	153

9. Metal Complexes Containing π-Bonding Ligands	154
9.1 Bonding in an Octahedral Metal Carbonyl	154
9.2 Discussion of the Molecular-orbital Diagram	160
9.3 The Bonding in an Octahedral Complex (Using Group Theory)	161
9.4 General Consideration	162
9.5 The Binary Carbonyls and their Derivatives	163
9.6 Metal Cyclopentadienyl and Arene Systems	172
9.7 Other Transition-metal π Complexes	177
9.8 Transition-metal Alkyls and Aryls	183
9.9 The Binary Carbonyls. Synthesis and Structure	184
10. The Lanthanides	188
10.1 Introduction	188
10.2 The Metals	191
10.3 Simple Compounds of Rare-earth Metals	192
10.4 Electronic Spectra and Magnetic Properties of the Lanthanides	199
10.5 Co-ordination Compounds of the Lanthanides	205
10.6 Stability Constants of Lanthanide Ions in Water Solution	215
10.7 Lanthanide Complexes as N.M.R. Shift Reagents	217
11. The Actinides	220
11.1 Electronic Structures and Oxidation States	220
11.2 Availability of the Actinides	222
11.3 Chemical and Structural Properties of the Actinide Series	226
11.4 Electronic Spectra of the Actinides	232
11.5 Actinium	235
11.6 Thorium	235
11.7 Protactinium	238
11.8 Uranium	241
11.9 Neptunium, Plutonium and Americium	250
11.10 Curium and the Succeeding Actinides	255
11.11 Organo-compounds of the Actinides	258
11.12 The Post-actinide Elements	260
Bibliography	262
Index	267