

Table of Contents

	Page
Coordination Compounds of Manganese	1
Introduction	1
 33 Complexes with Nitriles or Related Compounds	 3
33.1 General	3
33.2 With Hydrocyanic Acid	3
33.3 With Cyanogen Halides	4
33.4 With Acetonitrile	4
Complexes in Solution	4
Isolated Compounds	6
33.5 With Benzeneacetonitrile	11
33.6 With Propiononitrile or Acrylonitrile	12
33.7 With Benzonitrile	13
33.8 With Substituted Benzonitriles	13
33.9 With Di- and Polycyano Compounds	14
 34 Complexes with Nitro Hydrocarbons	 20
34.1 With Nitroalkanes or Nitrocycloalkanes	20
34.2 With Nitrobenzene or 1-Nitronaphthalene	22
 35 Complexes with Ligands Containing Sulfur	 23
35.1 Complexes with Thiols or Thiones	23
General References	23
General	23
35.1.1 With Alkane- or Benzenethiols	24
35.1.2 With Aminoalkane- or Aminobenzenethiols	28
35.1.3 With Mercaptoalkanols, -phenols, or -benzenediols	29
35.1.4 With 1,1-Dithiols or 1,1-Dimercapto Compounds	31
35.1.5 With 1,2- or 1,3-Dithiols or Polythiols	33
Survey	33
Complexes in Solution	34
Stability Data	34
Electronic Spectra. Structure	34
Magnetic Data	35
IR Spectra	36
Electrochemistry	36
Chemical Reactions	37

	Page
Isolated Compounds	38
$M_2[MnL_2]$ Complexes and Their Solvates	38
Mixed Valence Complex $[P(C_6H_5)_4]_2[Mn_3(C_3H_6S_2)_5]$	41
$M_2[Mn_2L_4]$ and $M_2[Mn_2L_2]$ Complexes	42
$[N(C_2H_5)_4]_2[MnL_2NO]$ Complexes	44
$M[MnL_2L']$ and $M_3[Mn_2L_4L'']$ Complexes	45
$M_2[MnL_3]$ Complexes	48
Polymeric Manganese Dithiolato Complexes	49
35.1.6 With Mercapto Sulfonic Acids	49
35.1.7 With Mercapto Carboxylic Acids or Their Esters	50
35.1.8 With Mercaptoacetamides	54
35.1.9 With Thiodiketones or Mercapto Ketones	55
35.1.10 With Heterocyclic Thiols or Thiones	58
With Derivatives of Imidazole	58
With Derivatives of Pyrazole or Oxazole	59
With Derivatives of Thiazole	61
With Derivatives of 1,2,4-Triazole or 1,3,4-Oxadiazole	63
With Derivatives of Pyridine	64
With 8-Quinolinethiol and Its Derivatives	66
Survey	66
Complexes in Solution	67
Isolated Compounds	69
With Derivatives of Quinoxaline or Pyrazino[2,3-g]quinoxaline	75
With Derivatives of Pyrimidine or Purine	75
35.2 Complexes with Sulfanes or Related Compounds	80
35.2.1 With Diorganysulfanes	80
35.2.2 With Sulfanediylbisalkanols or -phenols	81
35.2.3 With Sulfanylacetic Acids or 2-Ethylsulfanylbenzoic Acid	82
35.2.4 With Sulfanediyl Dicarboxylic Acids	84
35.2.5 With Bis(sulfanylacetic Acids)	86
35.2.6 With Sulfanediyl Tri- or Tetracarboxylic Acids	88
35.2.7 With Tetrakis(sulfanylalkanoic Acids)	89
35.2.8 With Disulfanediyl Compounds	90
35.2.9 With Polysulfides	91
35.3 Complexes with Sulfoxides	93
General Reference	93
General	93
35.3.1 With Dimethyl Sulfoxide	94
$[Mn^{II}(C_2H_5OS)_6]X_2$ and $[Mn^{II}(C_2H_5OS)_6]MnX_4$ Compounds	94
$Mn^{II}(C_2H_5OS)_4X_2$ Compounds	97
Other Manganese(II) Compounds	98
Mixed Ligand Compounds	99
Manganese(III) Compound	99

	Page
35.3.2–35.3.4 With Other Dialkyl Sulfoxides	100/1
35.3.5 With Dibenzyl Sulfoxide	101
35.3.6–35.3.7 With Diphenyl Sulfoxide or Methyl Phenyl Sulfoxide	102/3
35.3.8 With Tetrahydrothiophene 1-Oxide or Tetrahydrothiopyran 1-Oxide	103
35.3.9 With 1,3-Dithiane 1-Oxide or Its 2-Phenyl Derivative	104
35.3.10 With 1,4-Dithiane 1-Oxide	104
35.3.11 With 1,4-Oxathiane 4-Oxide	106
35.3.12 With Alkylsulfinylpyridine 1-Oxides	106
35.3.13 With Other Monosulfinyl Compounds	107
35.3.14 With Disulfinyl Compounds	108
35.4 Complexes with Arenesulfinic Acids or N,N-Dimethylmethanesulfonamide	109
35.5 Complexes with Sulfur Dioxide	111
35.6 Complexes with Sulfonyl Compounds	112
35.6.1 With Tetrahydrothiophene 1,1-Dioxide	112
35.6.2 With Other Sulfonyl Compounds	113
35.7 Complexes with Sulfonic Acids	114
35.8 Complexes with Sulfonamides or 2-Sulfobenzoic Imide	115
Introduction	115
35.8.1 With Sulfanilamide or Its N-Substituted Derivatives	116
Complexes in Solution	117
Isolated Compounds	119
35.8.2 With an N,N'-Disubstituted Derivative of Sulfanilamide	123
35.8.3 With N,N'-Ethanediylbis(2-aminobenzenesulfonamide)	123
35.8.4 With Derivatives of p-Toluenesulfonamide	124
35.8.5 With N-Cyclohexyl-benzothiazolesulfonamide	125
35.8.6 With Other Sulfonamides	126
35.8.7 With 2-Sulfobenzoic Imide (= Saccharin)	128
35.9 Complexes with Xanthic Acids	130
35.9.1 With Monoxanthic Acids	130
35.9.2 With Dixanthic Acids	133
35.10 Complexes with Dithiocarbamic Acids or N-Heterocyclic N-Carbodithioic Acids	134
General Aspects	134
35.10.1 With Monosubstituted Dithiocarbamic Acids	136

	Page
35.10.2 With Dialkyl- or Diaryldithiocarbamic Acids	139
Manganese(II) Compounds	139
Manganese(III) Compounds	146
Formation in Solution	146
Isolated $[\text{MnL}_3]$ Compounds	146
Preparation	146
Molecular Structure	147
Magnetic Properties	149
Infrared Spectra	151
Electronic Absorption and Mass Spectra	152
Electrochemistry	153
Chemical Reactions	155
Analytical Chemistry	156
Other Manganese(III) Compounds	161
Manganese(IV) Compounds	161
35.10.3 With Other Disubstituted Dithiocarbamic Acids	164
35.10.4 With N-Heterocyclic N-Carbodithioic Acids	166
Manganese(II) Compounds	166
Manganese(III) Compounds	169
$[\text{MnL}_3]$ and $[\text{MnL}_3] \cdot \text{S}$ Complexes	169
$[\text{MnL}_2\text{X}]$ and $[\text{MnLX}_2]$ Complexes	177
Manganese(IV) Compounds	178
35.10.5 With Alkylene- or Azaalkylenebis(dithiocarbamic Acids) or 1,4-Piperazinebis(carbodithioic Acid)	180
35.11 Complexes with Hydrazinecarbothioic Acids and Derivatives	184
35.11.1 With O-Ethyl Thiocarbazate	184
35.11.2 With Dithiocarbazic Acid or Benzyl Dithiocarbazate	185
35.11.3 With Other Hydrazinecarbothioates	185
35.12 Complexes with Thiourea or Related Compounds	186
General Reference	186
General Aspects	186
35.12.1 With Thiourea	186
Complexes in Solution	186
$\text{Mn}^{\text{II}}(\text{CH}_4\text{N}_2\text{S})_4\text{X}_2$ and $\text{Mn}^{\text{II}}(\text{CH}_4\text{N}_2\text{S})_4\text{X}_2 \cdot n\text{H}_2\text{O}$ Compounds	187
$\text{Mn}^{\text{II}}(\text{CH}_4\text{N}_2\text{S})_2\text{X}_2$ and $\text{Mn}^{\text{II}}(\text{CH}_4\text{N}_2\text{S})_2\text{X}_2 \cdot \text{H}_2\text{O}$ Compounds	191
$\text{Mn}^{\text{II}}(\text{CH}_4\text{N}_2\text{S})\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$	192
Mixed Ligand Compounds	192
35.12.2 With N-Methyl- or N,N'-Dimethylthiourea	194
35.12.3–35.12.5 With N-Phenylthiourea or Derivatives	195
35.12.6 With N-Thiocarbamoylbenzamides or -ethylcarbamates	198
35.12.7 With 1-Amidinothiourea, 1-Amidino-2-ethylisothiourea, or Dithiobiuret	199
35.12.8 With 1,2-Hydrazinebis(carbothioamide) or Its N,N'-Diphenyl Derivative	200

	Page
35.13 Complexes with Thiosemicarbazides or Related Compounds	202
35.13.1 Complexes in Solution	202
35.13.2 Manganese(II) Compounds	202
35.13.3 Manganese(III) Compounds	206
35.14 Complexes with Thiocarbonohydrazide and Derivatives	207
35.15 Complexes with Carbonotrithioic or -perthioic Acids and Derivatives	209
35.16 Complexes with Carbothioic Acids	211
35.17 Complexes with Thioamides or Thiohydrazides and Related Compounds	212
35.17.1 With N,N-Dimethylmethanethioamide	212
35.17.2 With Pyridinecarbothioamides or Derivatives	212
35.17.3 With 4,4-Dimethyl-2,6-dioxo-N-phenyl-1-cyclohexanecarbothioamide	213
35.17.4 With N-Phenyl-2-benzimidazolecarbothioamide	214
35.17.5 With Dithiooxamide or Its Tetraethyl Derivative	214
35.17.6 With Thiohydroxamic Acids	215
35.17.7 With 2-Furancarbothiohydrazides or Related Compounds	218
35.18 Complexes with Thiazyl Trifluoride or Imidosulfuryl Fluorides	220
35.19 Complexes with S-Heterocycles or Their Derivatives	222
35.19.1 With Derivatives of Thiophene	222
35.19.2 With Tetrahydrothiophene or Tetrahydro-2-thiophenecarboxylic Acid	225
35.19.3 With Derivatives of 1,2-Dithiolane	226
35.19.4 With Biotin or Related Compounds	227
35.19.5 With Derivatives of Thiazole or Isothiazole	228
35.19.6 With Derivatives of 4,5-Dihydro-thiazole or Thiazolidine	230
35.19.7 With Penicillins	232
35.19.8 With Benzothiazole or Its Derivatives	233
35.19.9 With Derivatives of 2,3-Dihydro-benzothiazole	237
35.19.10 With Derivatives of Thiadiazole	237
35.19.11 With 1,4-Oxathiane	239
35.19.12 With Thiomorpholin-3-one	240
35.19.13 With 10H-Phenothiazine	241
35.19.14 With a Macrocyclic Ligand	241
36 Complexes with Ligands Containing Selenium or Tellurium	242
36.1 With Diphenylselane or Diphenyltellane	242
36.2 With 8-Quinolineselenol	242

	Page
36.3 With Dimethyl Selenoxide	243
36.4 With Diphenyl Selenoxide or Diphenyl Telluroxide	243
36.5 With Benzeneseleninic Acid or Its Derivatives	244
36.6 With Selanyl or Tellanyl Carboxylic Acids and Their Derivatives	246
36.6.1 With Arylselanylacetic Acids	246
36.6.2 With Selanediyl or Tellanediyl Dicarboxylic Acids	246
36.7 With O-Pentyl Carbonodiselenoate	247
36.8 With N,N-Dialkylselenothiocarbamic Acids or -diselenocarbamic Acids	247
36.9 With Selenourea	248
36.10 With the Selenosemicarbazone of 2-Acetylpyridine	248
36.11 With 1,5-Diphenylselenocarbazone	249
36.12 With 1-(Selenophene-2-yl)-1,3-alkanediones	249
 Ligand Formula Index	 251
 Physical Constants and Conversion Factors	 288