LANDOLT-BÖRNSTEIN

Zahlenwerte und Funktionen aus Naturwissenschaften und Technik

Neue Serie

Gesamtherausgabe: K.-H. Hellwege · O. Madelung

Gruppe II: Atom- und Molekularphysik

Band 12

Ergänzungsband 4 (1973, 1974) zu Band 2

Magnetische Eigenschaften der Koordinationsund metallorganischen Verbindungen der Übergangselemente

Teilband b Paramagnetische Elektronenresonanz

E. König und G. König

Herausgeber: K.-H. Hellwege und A.M. Hellwege



Springer-Verlag Berlin · Heidelberg · New York · Tokyo 1984

Subvolume II/12a (Part 1): Magnetic susceptibilities Subvolume II/12b (Part 2): Electron paramagnetic resonance

	pa	.ge
	Part 1	Part 2
Introduction	. 1	1
List of symbols		1
General remarks		$\frac{1}{2}$
Theoretical basis		_
Definitions and fundamental relations	. 3	_
Diamagnetism and diamagnetic corrections	. 5	_
Paramagnetic susceptibility of polycrystalline substances	. 6	_
Paramagnetic anisotropy		_
Ligand field effects, high-spin and low-spin compounds and crossover situations		_
More detailed theory of magnetic susceptibilities and magnetism diagrams		_
Dimers and clusters, linear chain and planar magnetic systems	. 13	_
Long-range order: ferromagnetism, antiferromagnetism and ferrimagnetism	. 18	_
Basic theory		2
Definitions and fundamental concepts		2
The spin Hamiltonian		3
Description of individual ions		3
Molecular orbital MO theory of EPR parameters		11
Influence of the host lattice on EPR spin Hamiltonian parameters and bonding		13
The EPR of radical ion complexes		14
Diamagnetic ion substitution in exchange coupled complexes		14
Arrangement of tables	. 20	14
Compounds listed, their designation and order	. 20	14
Presentation of experimental results	. 23	14
Selection and accuracy of data	. 23	17
Experimental methods	. 23	
References		15
Literature coverage	. 24	15
Abbreviations		1 1
Selected diamagnetic ionic susceptibilities, Pascal constants, and one-electron spin-orbi		1
coupling constants		
Theoretical nomograms; calculated average magnetic moments as function of temperature	. 20	_
spin-orbit coupling, axial field splitting and orbital reduction	. 31	_
References for the introduction	. 41	16
Standard reference texts on magnetochemistry	. 41	10
Standard reference texts on hagnetoenemistry	. 71	16
General references to ligand field theory of magnetism	. 41	10
Additional references to the introduction	. 41	16
Tables of magnetic data on transition metal compounds	43	10
Tables of electron paramagnetic resonance data on transition metal compounds	. 43	17
Reviews on magnetochemistry of coordination compounds published in 1973 and 1974	 i 44	1 /
Reviews on inaghetochemistry of coordination compounds published in 1973 and 1974 Reviews on electron paramagnetic resonance of transition metal compounds published	1 11	_
in 1973 and 1974		17
Selected references on theory and experimental methods in the magnetism of transition	. – n	1 /
metal compounds (1973 and 1974)	. 44	1
Selected references on theory of electron paramagnetic resonance of transition metal com	. 44	_
pounds (1973 and 1974)	ı -	17
Pounts (17/3 and 17/4)	. – . 44	1/
Ligand field and MO theory of magnetism	. 44	_
Experimental methods in magnetism	. 44	_
Experimental methods in magnetism	4.5	19
References to crystal structure	41	1 19

	pa	_
	Part 1	Part 2
Titanium Ti	. 46	20
Ti(0)		_
Ti(II)		_
Ti(III)		20
Simple compounds		20
With fluoride		
With oxygen		20
With chloride		20
With bromide		
With cyanide		_
With sulfate		22
Coordination compounds with neutral and chelating ligands	. 47	22
With water		22
With heterocyclic ligands or compounds	. 47	23
With amino ketones	. 48	_
With Schiff bases and related compounds	. 48	~
With acid amides and acid hydrazides	. 48	_
With urea and related compounds	. 48	
With ligands containing sulfur	. 50	
With ligands containing phosphorus	. 51	
With phosphoric acids	. 51	-
With phosphonic acids	. 51	- 1
With ligands containing silicon	. 52	23
With ligands containing boron	. 52	-
Organometallic compounds	. 52	23
With cyclopentadienyl		23
With cyclooctatetraenyl		23
Ti(III) Exchange coupled bimolecular units with $S=1$		24
Organometallic compounds		24
Ti(IV)	. 55	
Coordination compounds with neutral and chelating ligands		~
With alcohols	. 55	-
With Schiff bases and related compounds	. 56	-
Zirkonium Zr	. 56	
Zr(III)	. 56	_
Vanadium V	. 56	25
V(0)		
V(II)		-
Simple compounds		_
Coordination compounds with neutral and chelating ligands		_
With amines	. 57	_
With heterocyclic ligands	. 58	_
With pyridine and derivatives	. 58	_
With pyridine		_
With alkyl pyridines	. 58	-
With quinoline and derivatives	. 59	
With bipyridyl		_
With phenanthroline and derivatives		_
With other heterocyclic ligands		_
Organometallic compounds	. 59	-
V(III)	. 60	-
Simple compounds		-
With fluoride		-
With chloride		-
With carboxylates and dicarboxylates	. 60	_
With other simple anions	. 61	-
Coordination compounds with neutral and chelating ligands		-
With amines	. 61	_
With heterocyclic ligands	. 61	-

	p	age
	Part 1	Part 2
V(III) continued		
V(III) continued With bipyridyl	61	
		_
With phenanthroline	62	_
With ligands containing sulfur		_
With ligands containing phosphorus	63	_
With phosphoric acids		
With phosphonic acids	63	
With ligands containing silicon	64	_
Organometallic compounds	64	_
V(IV)		25
Simple compounds		25
With oxygen		25
With thiocyanate	04	25
With fluoride, chloride, bromide	65	
With poly wolframates		26
With carboxylates	65	26
With other simple anions		
Coordination compounds with neutral and chelating ligands		27
With amines		27
With heterocyclic ligands	66	27
With porphyrins and related ligands		27
With porphin		27
With tetraphenyl porphin	–	28
With pyridine		_
With bipyridyl	66	_
With quinoline and derivatives		28
With heterocyclic N-oxides		_
With quinoline N-oxides		_
With other heterocyclic ligands		_
With ethers		_
With ketones	67	29
With diketones	–	29
With aliphatic diketones		29
With acetylacetone	–	29
With heterocyclic diketones	–	30
With other polyketones	–	30
With amino ketones	68	_
With amine-N-polycarboxylic acids	–	30
With Schiff bases and related ligands	68	31
From hydroxy arylaldehydes and aliphatic hydroxy monamines	68	_
From hydroxy arylaldehydes and aliphatic monamines		31
From hydroxy arylaldehydes and aromatic monamines	. : -	31
From hydroxy arylaldehydes and aliphatic diamines	73	33
From ketones and aliphatic diamines		34
From hydroxy arylaldehydes and aromatic hydroxy monamines	73	-
From heteroaromatic aldehydes and monamines		_
From hydroxy aryl dialdehydes and aromatic hydroxy monamines		_
From hydroxy aryl aldehydes and amino acids		-
From aromatic aldehydes and hydrazines		_
From aromatic ketones and aliphatic diamines	81	-
From aliphatic diketones and hydrazines	82	_
With azo compounds	82	
With oximes and nitroso compounds		34
With nitroso compounds		34
With acid amides	82	_
With cyanides and isocyanides	82	_
With ligands containing sulfur		36
With sulfoxides		_
With thiols	83	36
With heterocyclic thiols		36
With dithiolates	–	36

				pag		.ge
					Part 1	Part 2
V(IV) continued						
V(IV) continued With monothio 1,3-diketones					_	37
With monothio 1,3-diketones	 • •			•	. –	37
With heterocyclic monothio 1,3-diketones	 • •			•	. –	38
With dithio carbamic acids						38
With diethyl dithiocarbamic acid	 • •			•	. 65	38
With thio carboxylic acids	 			•	. 83	36
With thio carboxylic acids						
With thiourea and derivatives						39
With ligands containing phosphorus						39
With phosphines						_
With phosphoric acids	 •			•	. 84	39
With dithio phosphoric and dithio phosphinic acids						40
With diethyl dithiophosphoric acid						40
With phosphor amides	 			•	. 84	40
With other dithiophosphoric acids	 			•	. 04	42
With dithiophosphonic acids	 			•	. –	43
With dithiophosphinic acids	 			•	. –	44
With alighetic distinguished and	 			•	. –	
With aliphatic dithiophosphinic acids	 			٠	. –	44
With alicyclic dithiophosphinic acids	 			•	. –	46
With aromatic dithiophosphinic acids	 			•	. –	46
With ligands containing selenium	 			•	. 84	-
With ligands containing arsenic	 			•	. –	47
Organometallic compounds	 			•	. 85	47
Biological compounds	 				. –	51
V(IV) Exchange coupled bimolecular units with $S=1$						51
Simple compounds	 		٠.	• .	. –	51
With carboxylates	 				. –	51
Coordination compounds with neutral and chelating ligands	 					52
With ketones	 				. –	52
With polyketones	 					52
With Schiff bases and related ligands	 				. –	53
From hydroxy arylaldehydes and aliphatic monamines	 					53
From hydroxy arylaldehydes and aromatic monamines	 					53
With ligands containing sulfur	 					54
With thio carboxylic acids	 				. –	54
V(V)	 				. 85	-
V (uncertain oxydation state, mixed oxydation state)	 				. 85	54
Niobium Nb	 				. 86	55
Nb(II)	 				. 86	55
Nb(III)	 				. 86	_
Nb(IV)	 				. 86	55
Simple compounds						55
Coordination compounds with neutral and chelating ligands						55
With heterocyclic ligands						55
With pyridine and derivatives						55
Organometallic compounds	 				. –	56
Nb(V)						_
Tantalum Ta	 				. 87	57
Ta(IV)						57
Ta(V)					~ -	_
14(*)	 • •			•	. 0,	
Chromium Cr	 				. 88	58
Cr(0)						_
Cr(I)						58
Coordination compounds with neutral and chelating ligands					•	58
With heterocyclic ligands						58
With Schiff bases and related compounds						59
From ketones and hydrazines	 • •	• •	•	•		59
With oximes and nitroso compounds	 • •	• •		•	. –	59
TITLE OATHES and introso compounds	 					1 37

	pa	ige
	Part 1	Part 2
Cr(I) continued	-	
With oximes		59
With nitroso compounds		60
With ligands containing sulfur		61
With ligands containing phosphorus		62
With ligands containing arsenic		63
Cr(II)		_
Simple compounds		_
With fluoride	. 88	_
With chloride	0.0	_
With bromide		_
With sulfide		_
Coordination compounds with neutral and chelating ligands		_
Organometallic compounds		_
Cr(II) High-spin $S=2$		64
Cr(III)	. 90	65
Simple compounds	. 90	65
With fluoride	. 90	_
With chloride	. 90	65
With sulfate		66
With phosphates		67
With nitride and nitrate	. 90	-
With selenide and selenate		-
Coordination compounds with neutral and chelating ligands	. 91	68
With ammonia		68
With amines		70
With aliphatic and aromatic monamines	. 91	-
With aliphatic diamines	. 91	-
With heterocyclic ligands		70
With pyridine		70
With carboxylic acids	. 96	72
With aliphatic carboxylic acids	. 96	_
With monocarboxylic acids	. –	72
With dicarboxylic acids		72
With ketones		_
With alicyclic ketones		_
With diketones		_
With amino ketones	. 98	-
With amino acids		72
With simple amino acids		-
With amino acids containing sulfur	. 99	-
With amine-N-polycarboxylic acids		_
With Schiff bases and related compounds	100	_
From hydroxy arylaldehydes and amines		_
From ketones and diamines		_
With oximes and nitroso compounds		73
		74
		'4
With sulfons, thiols and sulfonic acids		_
		-
With trithio carbonic acids		_
With thio carboxylic acids		
With ligands containing selenium		
With ligands containing phosphorus		74
With phosphoric acids		'-
With phosphonic acids and derivatives		
With dithiophosphinic acids		
With phosphor amides		_
With ligands containing silicon		74
Organometallic compounds		'-
CINCHIC COMPONING IIIII IIII IIII IIII IIII IIII III		

	pa	ıge
	Part 1	Part 2
Cr(IV)	105	75
Organometallic compounds		75
With alkyls		75
With cyclo alkyls		75
With cyclo arkyls		76
With silyl alkyls		76
Cr(V)	 106	77
Simple compounds	_	77
With fluoride	_	77
Coordination compounds with neutral and chelating ligands	_	77
With carboxylic acids	_	77
With aldehydes	 _	78
With ligands containing sulfur	 _	78
With ligands containing phosphorus		78
With dithio phosphoric acids	 . –	78
With dithio phosphonic acids	 	79
With dithio phosphinic acids	 	80
With ligands containing selenium		80
With ligands containing antimony		80
Cr(VI)		-
Cr (uncertain oxydation state)	 . 106	-
26.1.1	405	0.4
Molybdenum Mo		81
Mo(0)		_
Mo(II)		_
Mo(III)		81
Simple compounds	 . 107	_
With chloride		_
With bromide		-
With iodide		_
With cyanide and cyanate	4 4 0	_
Coordination compounds with neutral and chelating ligands		_
With amines and diamines	 . 110	_
With heterocyclic ligands		_
With acid amides and acid hydrazides		_
Mo(IV)	 . 112	81
Mo(V)	 	82
Simple compounds		82
With oxygen		82
With fluoride	440	82
With chloride	. 114	82
With bromide	 . 115	83
With cyanide and thiocyanate	. 115	_
With thiocyanate and selenocyanate		83
With polywolframates		84
With other simple anions	 . 117	_
Coordination compounds with neutral and chelating ligands	 . 117	84
With hydrazine	 . 117	_
With heterocyclic ligands		84
With amino acids		-
With ligands containing sulfur	 . 118	84
With thiols		84
With dithiocarbamates		85
With dimethyl dithiocarbamate		85
With diethyl dithiocarbamate		85
With thiocarboxylic acids		
With ligands containing phosphorus		86
With phosphinic acids	 . –	86
With dithio phosphoric acids	 . –	86

	pa	ge
	Part 1	Part 2
Mo(V) continued		
With dithio phosphonic acids		87
With monothio phosphinic acids		88
With dithio phosphinic acids	. –	88
With ligands containing selenium	. –	88
$Mo(VI) \ \ldots \ $. 119	-
Mo (uncertain oxydation state, mixed oxydation state)	. 119	89
Wolfram (Tungsten) W	. 120	89
$\mathrm{W}(0)$. 120	_
$W(\Pi I)$. 120	_
W(IV)	. 120	_
$W(V)^{'}$. 122	89
Simple compounds	. –	89
With oxygen	. –	89
With fluoride	. –	90
With chloride and bromide	. –	90
With cyanide and thiocyanate		90
Coordination compounds with neutral and chelating ligands		91
With ligands containing phosphorus		91
With dithio phosphoric acids		91
With dithio phosphonic acids		92
With dithio phosphinic acids		92
With ligands containing selenium		92
W (uncertain oxydation state)		
w (uncertain oxydation state)	. 123	_
Manganese Mn	. 123	93
$Mn(-I) \dots \dots \dots \dots \dots \dots \dots \dots \dots $		_
Mn(0)		93
$Mn(II)$ (Part 2: High-spin $S=\frac{5}{2}$)	. 124	93
Simple compounds $\ldots \ldots \ldots$. 124	93
With oxygen	. 124	73
	. 124	_
******	. 124	93
	. 124	93
	. 127	93
With sulfate	. – . 127	9 4 96
With carboxylates		90
With cyanide and cyanate	. 128	
With other simple anions	. 128	96
Coordination compounds with neutral and chelating ligands	. 129	97
With hydrazines		_
With amines	. 129	_
With aliphatic amines	. 129	_
With aromatic amines		-
With heterocyclic ligands		97
With dipyrromethene and derivatives		
With porphyrins		97
With phthalocyanine and derivatives		-
With pyridine and derivatives		_
With 2,2-bipyridyl		_
With 4,4-bipyridyl		_
With phenanthroline and derivatives		97
With phenanthroline		_
With phenanthroline derivatives		- 1
With quinoline and derivatives	. 133	_
With isoquinoline		_
With heterocyclic N-oxides		97
With pyridine N-oxide and derivatives	. –	97
With pyridine N-oxide	. –	97
With nitro pyridine N-oxides	. –	98

	Pα	ıgc
	Part 1	Part 2
Mn(II) continued		
With cyano pyridine N-oxides	–	98
With alkyl pyridine N-oxides		/ 98
With other N heterocyclic ligands		_
With other heterocyclic ligands		99
With pyrazole and derivatives		99
With imidazole and derivatives		100
With pyrazine and derivatives		100
With ketones		101
With diketones		101
With amino ketones		101
With amine-N-polycarboxylic acids		_
With Schiff bases and related compounds		_
From hydroxy arylaldehydes and aromatic monamines	136	
From hydroxy arylaldehydes and aliphatic diamines		
From heterocyclic aldehydes and aromatic diamines	136	_
From aromatic aldehydes and hydrazine	130	_
Cyclic Schiff bases from heterocyclic diketones and diamines		_
With oximes and nitroso compounds	137	_
With acid amides and acid hydrazides	137	_
		_
With urea		_
With dimethyl urea		_
With dietnyl urea	138	_
With other acid amides		_
With ligands containing sulfur		_
With sulfuric acids		_
With sulfinic acids		_
With this carboxylic acids		101
With ligands containing phosphorus		101
With phosphine oxides		_
With phosphoric acids		_
With phosphonic acids		404
With phosphor amides		101
With hexamethyl phosphoramide		101
With pyrophosphor amides		102
With imido diphosphor amides		103
With ligands containing arsenic		104
Biological compounds	–	104
Mn(II) (Part 2: Low-spin $S=\frac{1}{2}$)		104
Organometallic compounds	140	104
Mn(III)	141	_
Simple compounds		_
With fluoride		_
With chloride		_
With cyanide and cyanate	141	_
Coordination compounds with neutral and chelating ligands		_
With N heterocyclic ligands	142	-
With dipyrromethene and derivatives	142	_
With phthalocyanine	142	_
With porphyrins	142	_
With heterocyclic N-oxides	143	-
With ketones		-
With carboxylic acids	143	-
With Schiff bases and related compounds	143	-
From hydroxy arylaldehydes and aliphatic monamines		_
From hydroxy arylaldehydes and aromatic monamines		_
From hydroxy arylaldehydes and aliphatic diamines	145	_
From simple substituted hydroxy arylaldehydes and ethylenediamine	145	_
From sec-butyl hydroxy arylaldehydes and ethylenediamine	148	_
From hydroxy arylaldehydes and other aliphatic diamines	150	_

	pa	ge
	Part 1	Part 2
Mn(III) continued		
From hydroxy arylaldehydes and aromatic diamines	. 151	_
From hydroxy arylaldehydes and hydrazines	. 152	_
From ketones and diamines	. 152	_
With ligands containing sulfur		_
With ligands containing phosphorus	. 153	_
With ligands containing arsenic		_
Mn(IV)		105
Simple compounds		105
Coordination compounds with neutral and chelating ligands	. 153	105
With heterocyclic ligands		_
With carboxylic acids	. 154	_
With Schiff bases and related compounds	. 154	_
With ligands containing sulfur	. 154	105
With dithiocarbamates		105
$\operatorname{Mn}(\operatorname{VI})$		106
Mn(VII)	. 155	_
Mn (mixed oxydation state)	. 156	_
Technetium Tc	. 156	_
Tc(III)		
Tc(IV)		_
$\operatorname{Tc}(V)$		
$\operatorname{Tc}(V)$		
Tc (mixed oxydation state)		_
	. 137	
Rhenium Re	. 157	106
Re(I)		_
Re(II)		106
Simple compounds		_
Coordination compounds with neutral and chelating ligands	. 157	_
With heterocyclic ligands	. 157	_
With ligands containing phosphorus		_
Re(III)		_
Simple compounds	. 158	_
Coordination compounds with neutral and chelating ligands		_
Re(IV)		_
Simple compounds		_
Re(V)		
Simple compounds		_
Coordination compounds with neutral and chelating ligands		_
Re(VI)		107
· /		
Iron Fe	. 160	107
Fe(0)	. –	107
Fe(I)		107
Simple compounds		107
With bromide		107
With iodide		108
With cyanide and thiocyanate		108
Coordination compounds with neutral and chelating ligands		109
With amines		109
With heterocyclic ligands		109
With bipyridyl		109
With triangle and derivatives		109
With triazole and derivatives		110
With amino acids		110
With acid amides and acid hydrazides		110 110
with acid affilides	. –	110

	pa	ıge
	Part 1	Part 2
Fe(I) continued		
With urea		110
With acid hydrazides		110
With ligands containing sulfur	. –	111
With thiols		111
With aliphatic thiols		111
With aromatic and heterocyclic thiols	_	112
With dithiocarbamates		112
With thiourea and derivatives		113
With thiosemicarbazides and thiosemicarbazones		114
With this acid amides and this acid hydrazides		114
With light desired and tho acid hydrazides		114
With places times		
With phosphines	. –	114
With ligands containing antimony		115
Fe(II)		116
Simple compounds		_
With chloride		_
With bromide	. 161	_
With iodide	. 161	_
With sulfide and selenide		_
With other simple anions	. 162	_
With cyanide and cyanate		_
Coordination compounds with neutral and chelating ligands	. 163	_
With hydrazines		_
With N heterocyclic ligands	. 163	
With dipyrromethene and derivatives		
With porphyrins and related ligands	. 164	_
with porphyrins and related figures	. 104	_
With tetraphenyl porphins	. 164	_
With other porphyrins		_
With pyridine	. 165	_
With 2,2'-bipyridyl	. 166	_
With 4,4'-bipyridyl	. 166	_
With phenanthroline and derivatives	. 166	_
With phenanthroline	. 166	_
With phenanthroline derivatives		_
With terpyridyl		_
With heterocyclic N-oxides	. 169	_
With other heterocyclic ligands	. 170	_
With pyrazoles and derivatives	. 170	_
With imidazole and derivatives	. 170	
With benzimidazole and derivatives	. 170	_
With Delizinidazole and derivatives	. 171	_
Wth purine and derivatives		_
With oxadiazole and derivatives		_
With naphthyridine		_
With triazines	. 173	_
With diquinoline and derivatives		_
With aldehydes		_
With esters	. 174	_
With ketones		_
With alicyclic ketones	. 174	_
With heterocyclic ketones		_
With Schiff bases and related compounds		_
From hydroxy arylaldehydes and aromatic amines		_
From hydroxy arylaldehydes and aliphatic diamines		_
From hydroxy arylaldehydes and aromatic diamines	. 176	_
From hydroxy arylaldehydes and amino acids		
From hydroxy arylaidehydes and annino acids		-
From hydroxy arylaldehydes and carboxy arylamines		_
From heteroaromatic aldehydes and aliphatic amines		_
From heteroaromatic aldehydes and aromatic amines		_
From aromatic and heteroaromatic aldehydes and hydrazines	. 179	-

		I	bage
		Part 1	Part 2
Ea(II) continued			
Fe(II) continued From diketones and monamines		. 181	
With azo compounds			
With oximes and nitroso compounds		. 181	
With acid amides and acid hydrazides	 		
With ligands containing sulfur	 	 . 182	-
With thiols			_
With thiones			_
With aliphatic thiones		. 182	
With heterocyclic thiones			-
With dithio carbonic acids	 	 . 184	
With dithiocarbamic acids	 	 . 184	-
With thio acid amides	 	 . 185	
With sulfinates	 	 . 186	
With ligands containing phosphorus	 	 . 186	_
With phosphines	 	 . 186	_
With phosphines	 	 . 186	\ _
With phosphine oxides	 	 . 187	
With amino phosphines			
With diphenylphosphino aliphatic monamines			
With diethylphosphino heterocyclic amines			
With phosphoric acids	 	 . 187	
With phosphoric acids	 	 . 188	
With dithiophosphinic acids			-
With ligands containing colonium	 	 . 188	-
With ligands containing selenium	 	 . 188	-
Organometallic compounds	 		117
Fe(III) (Part 2: High-spin $S = \frac{5}{2}$)	 	 . 188	117
			111/
With oxygen			_
			117
With chloride			117
With cyanide and thiocyanate	 	 . 189	_
With sulfide and sulfate	 	 . 189	110
With other simple anions	 	 . 189	118
Coordination compounds with neutral and chelating ligands			118
With heterocyclic ligands	 	 . 190	_
With dipyrromethene and derivatives			_
With prophyrins			_
With porphins	 		_
With porphyrins			_
With quinoline and derivatives			_
With 2,2'-bipyridyl		. 192	_
With 4,4'-bipyridyl		. 192 . 192	_
With phononth poline and derivatives	 	 . 192	_
With phenanthroline and derivatives	 		-
With heterocyclic N-oxides			_
With other heterocyclic ligands			_
With benzimidazole and derivatives			_
With purine and derivatives	 	 . 193	110
With carboxylic acids			118
With aliphatic carboxylic acids			_
With aromatic carboxylic acids	 	 . 196	_
Trinuclear complexes with aliphatic carboxylic acids.			. –
Trinuclear complexes with aromatic carboxylic acids	 	 . 200	_
With ketones	 	 . 201	_
With monoketones			_
With diketones			_
With activations			_
With ording leatenes			_
With amino ketones			140
Vith amino acids	 	 . 203	119

	ра	.gc
	Part 1	Part 2
Fe(III) continued		
With amine-N-polycarboxylic acids		_
With Schiff bases and related compounds		119
From hydroxy arylaldehydes and aliphatic monamines	. 204	_
From hydroxy arylaldehydes and aromatic monamines	. 204	_
From hydroxy arylaldehydes and aliphatic diamines	. 204	_
From hydroxy arylaldehydes and aromatic diamines	. 205	_
From hydroxy arylaldehydes and aliphatic triamines	205	_
From monoketones and diamines	206	_
From diketones and diamines	. 206	
		_
With azo compounds	. 200	
With oximes and nitroso compounds	. 207	_
With aldoximes		_
With ketoximes		_
With acid amides and acid hydrazides		-
With ligands containing sulfur		119
With thiols	. 208	_
With dithiolates		_
With maleonitrile dithiolate	. 208	_
With other dithiolates		_
With sulfides		_
With heterocyclic thiones	. 209	110
With dithiocarbamates	. 210	119
With aliphatic dithiocarbamates	. 210	_
With alicyclic and aromatic dithiocarbamates		_
With carbo thioic acids	. 211	120
With thio carboxylic acids	. 211	_
With thioethers	. 211	_
With dithiobiuret and derivatives	. 212	_
With thiosemicarbazides and thiosemicarbazones	. 212	_
With thiosemicarbazides		_
With thiosemicarbazones	. 212	_
With thio acid amides and thioacid hydrazides	. 212	
With line de containing administration	. 210	
With ligands containing selenium	. 217	_
With thio seleno carbamates	. 217	_
With selenosemicarbazides and selenosemicarbazones	. 217	_
With ligands containing phosphorus		-
With phosphoric acids	. 217	_
With phosphonic acids	. 217	_
With dithio phosphinic acids	. 218	_
With ligands containing silicon		120
Organometallic compounds	. 219	_
Biological compounds	. –	120
Fe(III) (Part 2: Intermediate-spin $S=\frac{3}{2}$)		120
Fe(III) (Part 2: Low-spin $S=\frac{1}{2}$)		121
	•	121
	. –	121
With cyanide and thiocyanate	. –	
Coordination compounds with neutral and chelating ligands	. –	121
With amines	. –	121
With heterocyclic ligands	. –	122
With porphyrins and related ligands	. –	122
With porphin	. –	122
With alkyl porphyrins	. –	122
With aryl porphyrins		123
With tetraphenyl porphin		123
With halogeno phenyl porphyrins	. –	124
With other tetraphenyl porphyrins		125
With chlorins	. –	126
With tetrange manufactions	. –	
With tetraaza porphyrins	. –	127
With protoporphyrin IX and derivatives		127
With phthalocyanine and derivatives	. –	127

	pa	ge
	Part 1	Part 2
Fe(III) continued		
With bipyridyl		128
With phenanthroline and derivatives		128
With terpyridyl		128
With amino acids		129
With ligands containing sulfur		129
With carbo thioic acids		129
With thiosemicarbazide and thiosemicarbazones		129
With aldehyde thiosemicarbazones		129
With ligands containing phosphorus		130
With phosphines		130
With ligands containing arsenic		131
Organometallic compounds		131
Organometatic compounds		
Fe(II, III) (mixed oxydation state)		131
Organometallic compounds		131
Fe(IV)		-
Coordination compounds with neutral and chelating ligands		-
With N heterocyclic ligands		-
With porphyrins and related ligands	. 220	_
With phthalocyanine and derivatives	. 220	-
With ligands containing sulfur	. 221	_
With thiols	. 221	l _
With dithiolates	. 221	_
With dithiocarbamates		
Fe (uncertain oxydation state)	. 221	_
Fe (III IV) (mind and and the factor)	. 221	
Fe(III, IV) (mixed oxydation state)		133
Ruthenium Ru	. 223	133
Ru(III)		133
		133
Coordination compounds with neutral and chelating ligands		133
With heterocyclic ligands		422
With ammonia		133
With amines		134
With ketones		134
With carboxylic acids	. 223	134
With amino acids		_
With ligands containing sulfur	. 224	135
With sulfides		_
With dithiocarbamates		_
With ligands containing phosphorus		135
With ligands containing arsenic		135
With arsines		135
	•	133
Osmium Os	. 225	136
Os(III)	. 225	136
Os(IV)	. 225	_
Cobalt Co	. 226	137
Co(0)	. 226	137
Co(I)		_
$Co(II)$ (Part 2: High-spin $S=\frac{3}{2}$)		137
Simple compounds		137
With oxygen		137
		_
		_
With bromide		_
With sulfide and sulfate		_
With carboxylates		_
With cyanides		_
With cyanate and thiocyanate		-
With phosphates	. 230	_
With other simple anions		-

	pa	ge
	Part 1	Part 2
Co(II) continued		
Coordination compounds with neutral and chelating ligands	. 231	138
With amines		138
With aliphatic hydroxy amines		_
With aromatic amines	. –	138
With aromatic monamines	. 231	-
With aromatic diamines		_
With phenylene diamines		-
With diamino biphenyls	. 232	-
With other aromatic diamines		_
With dicyano amine	. 233	_
With hydrazine and derivatives		_
With alicyclic heteroring compounds	. 234	_
With piperidine and derivatives		_
With piperidine		_
With 1,2-dipiperidinoethane		_
With piperazine and derivatives	. 235	_
With morpholine and derivatives		_
With morpholine	. 235	_
With diagonal chartens		_
With diaga cycloheptane		_
With diaza cyclooctane	. 236 . 236	_
With other alicyclic heteroring compounds		_
With spartein		_
With quinine		_
With heterocyclic ligands		138
With porphyrins	. 238	150
With phthalocyanine		_
With pyrroline and derivatives		_
With pyridine and derivatives		_
With halogeno pyridines	. 239	_
With alkyl pyridines	. 240	_
With amino pyridines and derivatives		_
With 2-(2-aminoethyl) pyridine		_
With tri(pyridyl) amines and derivatives		_
With pyridine carboxylic acids		_
With pyridine 2-carboxylic acids		_
With pyridine 3-carboxylic acids	. 242	_
With pyridine 4-carboxylic acids		_
With pyridine dicarboxylic acids	. 242	_
With quinoline and derivatives	. 243	_
With quinoline carboxylic acid and derivatives	. 243	_
With quinoxaline and derivatives	. 243	_
With 2,2′-bipyridyl	. 244	_
With 4,4′-bipyridyl		_
With phenanthroline and derivatives		_
With heterocyclic N-oxides		_
With 2,4,4,5,5-pentamethyl-1-pyrroline 1-oxide		_
With pyridine N-oxides and derivatives		
		_
With phenanthroline N-oxide		_
		138
With pyrazole and derivatives		130
With ethylimidazole		_
With propylimidazole		_
With pyridyl imidazoles		
With other imidazole derivatives		_
With benzimidazole and derivatives		_

	pa	ge
	Part 1	Part 2
Co(II) continued		
With pyridyl benzimidazole	. 248	_
With benzene sulfonamidomethyl benzimidazole		_
With purines	. 248	_
With pyridazine and derivatives	. 249	_
With pyrazine and derivatives		_
With naphthyridine and derivatives	. 249	_
With phthalazine and derivatives	. 250	_
With triazines		_
With S heterocyclic ligands		_
With thiazole and derivatives		_
With benzothiazole and derivatives	. 251	_
With thiazolidine and derivatives		_
With O heterocyclic ligands	. 252	-
With benzoxazole and derivatives		_
With isoxazole	. 252	_
With other O heterocyclics	. 252	_
With Se heterocyclic ligands	. 253	_
With alcohols		_
With esters	. 254	_
With carboxylic acids		_
With aldehydes	. 254	_
With ketones	. 255	_
With monoketones	. 255	_
With aromatic monoketones	. 255	-
With heterocyclic monoketones	. 255	-
With diketones		_
With acetylacetone and derivatives	. 256	_
With acetylacetone		_
With trifluoro acetylacetone	. 256	_
With hexafluoro acetylacetone		_
With benzoyl acetone	. 257	_
With dibenzoyl methanate	. 258	_
With benzoquinone and derivatives		_
With triketones		_
With amino acids		_
With amine-N-polycarboxylic acids	. 259	_
With Schiff bases and related compounds		139
From hydroxy arylaldehydes and aliphatic monamines		_
From hydroxy arylaldehydes and aromatic monamines	. 260	_
From hydroxy arylaldehydes and aliphatic diamines	. 261	_
From hydroxy arylaldehydes and ethylene diamine	. 261	_
From hydroxy arylaldehydes and propylene diamine		_
From hydroxy arylaldehydes and other aliphatic diamines		_
From arylaldehydes and alicyclic diamines	. 265	_
From hydroxy arylaldehydes and aromatic diamines	. 266	_
From hydroxy arylaldehydes and aliphatic triamines		_
From hydroxy arylaldehydes and amino acids		_
From hydroxy arylaldehydes and triamines		139
From salicylaldehyde and amino acids		_
From hydroxy naphthaldehyde and amino acids		_
Cyclic Schiff bases		_
From aromatic aldehydes and hydrazines		_
From amino aldehydes and monamines		- 1
From amino aldehydes and diamines		_
From heterocyclic aldehydes and monamines	. 271	_
From pyridyl aldehydes and monamines	. 271	_
From 1,10-phenanthroline aldehyde and monamines		_
From S heterocyclic aldehydes and amines		_
From heterocyclic aldehydes and diamines	. 274	_

	pa	ge
	Part 1	Part 2
Co(II) continued		
From heterocyclic aldehydes and triamines	. 275	_
From arylketones and aliphatic diamines	. 276	_
From aromatic ketones and hydrazines	. 276	_
From heterocyclic ketones and triamines	. 277	_
From diketones and amines	. 277	_
From monothio diketones and diamines	. 278	_
With azo compounds	. 278	_
With aromatic and heteroaromatic azo compounds	. 278	_
With aldazines	. 278	_
With triazenes	. 279	_
With oximes and nitroso compounds	. 279	-
With aldoximes	. 279	_
With ketoximes		_
With nitroso compounds	. 280	_
With acid amides and acid hydrazides	. 280	_
With biguanide and derivatives	. 280	_
With aromatic acid amides	. 280	_
With heteroaromatic acid amides	. 281	_
With pyridine carboxamides	. 281	_
With pyrazine carboxamides	. 281	_
With acid hydrazides	. 281	_
With blood a containing sulfur		_
With ligands containing sulfur	. 283	_
With sulfoxides	. 283	_
7771 4 4774	. 283	_
With sulfides	. 284	
With thiones		
With aliphatic and aromatic thiones	. 284	
With heterocyclic thiones		_
With this carbamic acids		_
With dithio carbamic acids	. 285	_
With this carboxylic acids		_
With thiourea and derivatives		_
With dithio biuret and derivatives		_
With thiosemicarbazides and thiosemicarbazones	• • •	_
With thioacid amides	. 287	_
With aliphatic thioacid amides	. 287	_
With heterocyclic thioacid amides	. 287	_
With aromatic mercapto acid amides		_
With Schiff bases containing sulfur	. 289	_
From mercapto arylaldehydes and aliphatic monamines		-
From mercapto arylaldehydes and aromatic monamines	. 290	-
From mercapto arylaldehydes and aliphatic diamines	. 291	_
From arylaldehydes and aromatic mercapto amines		_
From mercapto heterocyclic aldehydes and amines		_
With sulfuric acids		_
With sulfonic acids		_
With sulfinic acids		_
With ligands containing colonium		_
With ligands containing selenium		_
With seleno ketones		_
With selenourea and derivatives		
With Schiff bases containing selenium	. 293	_
With seleno semicarbazones		
With ketones		139
With ligands containing boron		139
With ligands containing phosphorus		13,

						page
					Part 1	Part2
Co(II) continued						
With phosphines					. 294	_
With monophosphines						1
With fluoro phosphines						
With oxy phosphines						
With diphosphines						
With triphosphines						
With tetraphosphines			•		. 296	
With phosphine oxides						
With phosphine amines			•	• •	. 296	1
With diphenyl phosphino aliphatic diamines						- 1
With diethyl phosphino heterocyclic amines		• •	•		. 297	
With aza phosphorinium cation			•		. 297	
With phosphonates						1
With phosphinates						. _
With phosphor amides						_
With phosphine sulfides and selenides			•			
With phosphoric acids						
With phosphonic acids						
With phosphinic acids						1
With dithio phosphinic acids						1
With Schiff bases containing phosphorus			•	• •	. 300	I
With ligands containing arsenic			•		. 301	
With arsino phosphines			•		. 301	I
With arsine oxides			•		. 301	- I
With Schiff bases containing arsenic						I
From arylaldehydes and arsino amines						
From heterocyclic aldehydes and arsino amines						1
From pyridine aldehyde and arsino amines			•		. 302	1
From 6-methylpyridine aldehyde and arsino amines			•		. 304	
From pyrrol aldehyde and arsine amines						1
From ketones and arsanilic acid			•		. 306	1
With ligands containing boron			•		. 306	
Organometallia compounds					. 306	
Organometallic compounds					. 300	140
Simple compounds \dots			•		•	140
Coordination compounds with neutral and chelating ligands			•			140
With heterocyclic ligands			•			1 7.4
With porphyrins and related ligands			٠.			140
With tetraphenyl porphin			•			140
With other phenyl porphyrins						143
With mesoporphyrin IX and derivatives			•			143
						1 7 7 7
With protoporphyrin IX and derivatives			•			143
With protoporphyrin IX dimethylester			٠			143
With cobalamins						
With corrins and corrols			•			140
With Schiff bases and related compounds	• •		•			7.12
From hydroxy arylaldehydes and aliphatic diamines						147
From hydroxy arylaldehydes and ethylenediamine						147
From hydroxy arylaldehydes and ethylenediamine			•			1 7 11
From hydroxy arylaldehydes and other aliphatic diamines . From hydroxy arylaldehydes and aromatic diamines						151
From amino arylaldehydes and aliphatic or alicyclic diamines			•			
From letones and diamines			•			1
From ketones and diamines						1
						153
From aliphatic diketones and aliphatic diamines			•			
From aromatic diketones and aliphatic diamines						155
With triangers						1 100
With triazenes			٠			1 100
with oximes and nitroso compounds						158

	pa	age
	Part 1	Part 2
Co(II) continued		
With aliphatic oximes	_	158
With dimethylglyoxime		158
With alicyclic oximes		160
With 1,2-cyclohexanedione dioxime		160
With aromatic oximes		160
With α-benzil dioxime		160
With ligands containing phosphorus		162
With phosphines	•	162
With diphosphines		162
With phosphine oxides	. –	163
With phosphonates	. –	163
With phosphinates		167
		167
Organometallic compounds		
Biological compounds		168
Co(III)		169
Simple compounds		1.00
Coordination compounds with neutral and chelating ligands		169
With heterocyclic ligands		169
With N heterocyclic ligands		-
With porphyrins	. 307	169
With tetraphenyl porphin	. –	169
With other phenyl porphyrins		170
With mesoporphyrin IX and derivatives		171
With protoporphyrin IX and derivatives		171
With protoporphyrin IX dimethylester	. –	171
With other porphyrins		172
With phthalocyanine and derivatives	. –	172
With pyridine and derivatives		-
With di-2-pyridylamine and derivatives	. 308	
With bipyridyl	. 308	~
With alcohols	. 309	-
With amine-N-polycarboxylic acids		~
With Schiff bases and related compounds		172
From hydroxy arylaldehydes and aliphatic diamines	. 309	172
From hydroxy arylaldehydes and ethylenediamine		172
From hydroxy arylaldehydes and other aliphatic diamines		174
From hydroxy arylaldehydes and aromatic diamines	. –	174
From amino arylaldehydes and aliphatic diamines		174
From ketones and diamines	. 310	175
From aromatic monoketones and aliphatic diamines		175
From aliphatic diketones and aliphatic diamines		177
With azo compounds	. 311	-
With triazenes		_
With acid amides and acid hydrazides	. 311	-
With biuret and derivatives	. 311	-
With ligands containing sulfur	. 312	_
With thiols	. 312	_
With dithiolates		_
With thioacid amides		_
Co(IV)		178
Simple compounds		
With oxygen	. 314	-
Coordination compounds with neutral and chelating ligands		178
With heterocyclic ligands		178
With phthalocyanine and derivatives		178
With ligands containing phosphorus		178
With phosphines		178
With phosphonates		178
Organometallic compounds		179
Co (mixed oxydation state)	. 315	

	pa	ge
	Part 1	Part 2
Rhodium Rh	. 315	179
Rh(II)		179
Rh(III)		1/9
Rh(IV)		
Rh (uncertain oxydation state)		_
Kii (uncertain oxydation state)	. 317	
Iridium Ir	. 318	179
Ir(II)	. 318	_
$\overline{\operatorname{Ir}(\operatorname{IV})}$		179
Ir (mixed oxydation state)		-
Nickel Ni		180
$\mathrm{Ni}(\mathrm{I})$. 319	180
Coordination compounds with neutral and chelating ligands	. 319	180
With heterocyclic ligands	. –	180
With tetraazacyclotetradecane and derivatives	. –	180
With tetraazabicyclo[11.3.1]heptadecane and derivatives		181
With ligands containing sulfur	. 319	182
With thio acid amides and thio acid hydrazides		182
With ligands containing phosphorus	. 319	182
With phosphines	. –	182
With alkyl phosphines		182
With aryl phosphines		183
With ligands containing arsenic		_
$\operatorname{Ni}(\operatorname{II})$		184
Simple compounds		184
With oxygen		_
With fluoride	. 320	_
With chloride		_
With iodide		_
With cyanide and cyanate		_
With carboxylic acids		_
With carbonate	. 323	_
With other simple anions	. 324	405
Coordination compounds with neutral and chelating ligands	. 325	185
With ammonia		_
With amines		-
With alighatic monamines	. 325	_
With aliphatic hydroxy monamines	. 326	_
		_
With aliphatic diamines	. 328	_
With athylana diamina	. 328	_
With ethylene diamine	. 328	_
With anomatic ethylene diamine derivatives		_
With 1,3-propane diamine and derivatives		
With alicyclic diamines		
With aromatic diamines		
With aliphatic triamines		_
With aliphatic tetramines		_
With aliphatic pentamines		
With hydrazine and derivatives		_
With dicyano amine		
With alicyclic heteroring compounds		_
With piperidine and derivatives		_
With piperidine		_
With 1,2-dipiperidinoethane		_
With piperazine and derivatives		-
With morpholine and derivatives		_
morphomic and derivatives	. 555	I

	pa	ge
	Part 1	Part 2
Ni(II) continued		
With morpholine	. 335	_
With 1,2-dimorpholinoethane	. 336	
With other alicyclic heteroring compounds		
With pseudothiohydantoin	. 336	
With quinuclidinone and derivatives	. 336	_
With spartein		_
With 1,5-benzodiazepine and derivatives	. 338	_
With N-chloromethyl-dabconium cation		_
		_
With quinine	. 339	_
		_
With pyridine		_
With pyridine derivatives		_
With halogeno pyridines	. 339	_
With monoalkyl pyridines	. 340	_
With amino pyridines	. 341	_
With pyridine carboxylic acids	. 341	_
With pyridine dicarboxylic acids		_
With quinoline and derivatives	. 342	_
With 8-hydroxyquinoline	. 342	_
With alkyl quinolines and derivatives	. 342	_
With amino quinolines	. 342	_
With quinoline carboxylic acids		-
With quinoxaline and derivatives	. 343	_
With diquinoline and derivatives	. 343	_
With bipyridyl	. 343	_
With 4,4'-bipyridyl	. 343	-
With phenanthroline and derivatives		-
With heterocyclic N-oxides	. 344	-
With pyridine N-oxides	. 344	_
With bipyridine N-oxides	. 344	_
With phenanthroline N-oxide	. 344	_
With other N heterocyclic ligands	. 345	_
With pyrazole and derivatives	. 345	-
With imidazole and derivatives	. 345	_
With benzimidazole and derivatives	. 346	_
With pyridyl benzimidazole	. 346	_
With benzene sulfonamido benzimidazoles	. 347	_
With pyrazine and derivatives	. 348	_
With purines		_
With triazines		_
With naphthyridine and derivatives	. 349	_
With tetraazacyclotetradecane and derivatives	. 349	_
With S heterocyclic ligands	. 351	_
With thiazole and derivatives	. 351	_
With O heterocyclic ligands		_
With isoxazole and derivatives		_
With coumarin and derivatives		_
With alcohols		_
With aldehydes		_
With esters		_
With ketones		_
With monoketones		_
With alicyclic monoketones		_
With aromatic monoketones		_
With heterocyclic monoketones		-
		-
With diketones		_
		-
		-
With heterocyclic diketones	. 356	-

	pa	ge
	Part 1	Part 2
I.(II) continued		
Vi(II) continued	257	
With triketones	. 357	_
With amino ketones		_
With amino acids		_
With amine-N-polycarboxylic acids		_
Schiff bases and related compounds		_
From hydroxy arylaldehydes and aliphatic monamines		_
From hydroxy arylaldehydes and aromatic monamines	. 361	_
From hydroxy arylaldehydes and phenylamines	. 361	_
From hydroxy arylaldehydes and 2,6-dimethylphenylamine		_
From hydroxy arylaldehydes and 2,6-diethylphenylamine	. 365	_
From hydroxy arylaldehydes and carboxy phenylamines		_
From carboxy salicylaldehyde and aliphatic monamines		_
From hydroxy arylaldehydes and aliphatic diamines		_
From hydroxy arylaldehydes and dimethylamino ethylene diamine		_
From hydroxy arylaldehydes and diethylamino ethylene diamine		_
From hydroxy arylaldehydes and dibutylamino ethylene diamine	. 370	_
From hydroxy arylaldehydes and aromatic diamines	. 370	_
From hydroxy arylaldehydes and amino acids	. 370	_
From amino aldehydes and monamines		_
From aromatic aldehydes and hydrazines		_
From heterocyclic aldehydes and monamines		_
From pyridine aldehydes and monamines		_
From 1,10-phenanthroline aldehyde and monamines	. 373	_
From heterocyclic aldehydes and diamines	. 375	_
From heterocyclic aldehydes and triamines	. 377	_
From heterocyclic aldehydes and hydrazines		_
From pyridyl aldehydes and hydrazines		_
From phenanthroline carbaldehyde and hydrazines		_
From aliphatic ketones and aliphatic diamines	. 378	_
From arylketones and aliphatic monamines		_
From arylketones and aliphatic diamines	. 379	_
From heterocyclic ketones and triamines	. 381	_
From diketones and monamines	. 382	_
From diketones and triamines		_
Cyclic Schiff bases	. 384	_
Cyclic Schiff bases from diketones and aliphatic di- or polyamines		_
Cyclic Schiff bases from aminoketones and di- or polyamines		_
Cyclic Schiff bases from aminoketones and aromatic thioamines	. 385	-
Cyclic Schiff bases from selfcondensation of amino ketones	. 386	_
With azo compounds		_
With aromatic and heteroaromatic azo compounds	. 386	_
With triazenes	. 387	-
With oximes and nitroso compounds	. 388	_
With aldoximes	. 388	_
With ketoximes	. 388	_
With aliphatic ketoximes	. 388	_
With aromatic ketoximes	. 389	_
With heterocyclic ketoximes	. 390	_
With nitroso compounds	. 391	_
With acid amides and acid hydrazides		_
With aromatic acid amides		_
With heterocyclic acid amides		_
With pyridine acid amides	. 391	_
With pyrazine acid amides		_
With acid hydrazides		_
With benzoyl hydrazines		_
With semicarbazide and semicarbazones		_
With cyanides and isocyanides		_
With ligands containing sulfur		_

	Part 1	Part 2
Ni(II) continued		
With sulfoxides	. 395	_
With thiols	. 395	
With heterocyclic thiols		_
With dithiolates		_
With sulfides		_
With thiones		_
With aromatic thiones		_
With heterocyclic thiones		
With monothio carbamic acids		_
With dithio carbamic acids		_
With mercapto aromatic carboxylic acids		_
With aromatic thio carboxylic acids		_
With thiourea and derivatives	. 399	_
With dithio biuret and derivatives	. 400	_
With thiosemicarbazide and thiosemicarbazones	. 400	_
		_
With thiosemicarbazides		_
With thiosemicarbazones	. 401	_
With aromatic aldehyde thiosemicarbazones	. 401	_
With heterocyclic aldehyde thiosemicarbazones	. 401	_
With aliphatic and alicyclic ketones thiosemicarbazones		_
With thio acid amides	. 403	_
With aliphatic thio acid amides	. 403	-
With dithio malonamides	. 403	_
With dithio oxamides	. 404	_
With heterocyclic thio acid amides	. 404	_
With phenanthroline thio acid amides	. 404	_
With sulfuric acids		_
With sulfonic acids		_
With sulfinic acids		_
With thiocarbazic acids	. 405	_
With mercapto aromatic carboxamides	406	_
With mercapto ketones		_
With Schiff bases containing sulfur	. 407	_
From hydroxy arylaldehydes and mercapto aromatic monamines	407	_
From mercapto arylaldehydes and amines	407	_
From heterocyclic aldehydes and mercapto aromatic amines	. 407	_
From mercapto heterocyclic aldehydes and monamines	. 407	_
With ligands containing phosphorus	. 408	_
With monophosphines	. 408	
With aliphatic and alicyclic monophosphines	. 408	_
With aromatic monophosphines	. 408	_
With diphosphines	. 408	_
With organic dish against	. 409 . 409	_
With aromatic diphosphines	. 409 . 409	_
With mosphines	. 409	_
With aromatic triphosphines	. 409	_
With phosphino methyl pyridine and derivatives		_
With phosphine oxides	. 411	_
With thio phenyl phosphines		_
With mercapto phenyl phosphines		-
With phosphine sulfides	. 412	-
With Schiff bases containing phosphorus	. 412	_
With phosphoric acid amides		-
With phosphoric acids		_
With phosphonic acids	. 412	-
With phosphinic acids	. 413	_
With dithio phosphinic acids	. 413	_
With diphenyl dithiophosphinic acid	. 413	-
With diphenyl dithiophosphinic acid derivatives	. 414	-
With ligands containing arsenic		_

	_	age
	Part 1	Part 2
Ni(II) continued		
With arsines	415	_
With diarsines		_
With triarsines	416	_
With arsine oxides	416	_
With Schiff bases containing arsenic	416	_
From aromatic aldehydes and arsino aromatic amines	416	_
From aromatic aldehydes and dimethylarsinophenylamine	416	_
From aromatic aldehydes and diethylarsinophenylamine	417	_
From heterocyclic aldehydes and arsino aromatic amines		_
From 2-pyridyl aldehyde and arsino aromatic amines		_
From 6-methylpyridine aldehyde and arsino aromatic amines		_
From pyrrol aldehyde and arsino aromatic amines		_
From ketones and arsanilic acids		_
With ligands containing antimony	422	_
With ligands containing selenium	422	_
With selenones	422	_
With seleninic acids		_
With Schiff have partaining administration		_
With Schiff bases containing selenium	423	_
With ligands containing boron	423	_
Organometallic compounds	424 424	185
Ni(III)		185
With fluoride		185
Coordination compounds with neutral and chelating ligands		186
With heterocyclic ligands		186
With tetrazacyclotetradecane and derivatives	423	186
With 2,3-dimethyl-1,4,8,11-tetraazacyclotetradecane		186
With other 1,4,8,11-tetraazacyclotetradecanes		187
With tetraazacyclotetradecadienes		187
With tetraazacyclotetradecatetraenes		188
With tetraazacyclohexadecine and derivatives		189
With amino acids		189
With ligands containing sulfur		190
With Schiff bases and related compounds		_
Ni (formal oxydation states intermediate between +1 and +2)	426	_
Coordination compounds with neutral and chelating ligands	426	_
With heterocyclic ligands	426	_
With ligands containing phosphorus	426	_
Ni (mixed oxydation state)		190
D-II-12 D.1	120	400
Palladium Pd	429	190
Pd(I)	–	190
Simple compounds	–	190
With chloride		190
With cyanide and thiocyanate		191
With nitrite and nitrate		191
With carboxylates		191
With monocarboxylates		191
With dicarboxylates		192
Coordination compounds with neutral and chelating ligands		192
With ammonia	–	192
With arthulamines		193
With buttlemines		193
With baters and is ligands	–	193
With heterocyclic ligands		194
With pyridine and derivatives	429	1 24
A WALKET	742	

	pa	ge
	Part 1	Part 2
Platinum Pt	. 430	194
Pt(II)	. 430	194 195
Pt(IV)	. – . 431	193
Pt (uncertain oxydation state, mixed oxydation state)		195
1 t (uncertain oxydation state, mixed oxydation state)	. 431	193
Copper Cu	. 431	195
$\tilde{\mathrm{Cu}}(0)$. –	195
Cu(I)	. 431	_
Coordination compounds with neutral and chelating ligands	. 431	_
With N heterocyclic ligands	. 431	_
With pyridine and derivatives	. 431	_
With ligands containing sulfur	. 432 . 432	_
With ligands containing sulfur	. 432	_
With dithiole thiones	. 432	_
With other heterocyclic thiones	. 433	_
Cu(II)	. 433	196
Simple compounds	. 433	196
With hydroxyde	. –	196
With fluoride		196
With chloride	. 433	196
With bromide	. 436	198
With cyanide	. 436	_
With sulfate	. –	198
With nitrate	. –	202 202
With perchlorate	. –	202
With sulfide and sulfate	. 437	203
With selenite	. 438	_
With aliphatic monocarboxylates		_
With acetate and halogeno acetates	. 438	_
With other aliphatic monocarboxylates	. 439	_
With aliphatic dicarboxylates	. 439	_
With oxalate	. 439	_
With malonates	. 440	_
With tartrate	. 440	_
With aromatic carboxylates		_
With salicyclic acid	. 441 . 441	_
With other aromatic carboxylates	. 441 . 441	_
With carbonate	. 442	
With phosphates		_
With other simple anions		203
Coordination compounds with neutral and chelating ligands	. 443	203
With water		203
With ammonia		204
With hydrazine		205
With hydrazine and derivatives		_
With amines		_
With aliphatic monamines		_
With simple aliphatic monamines		_
With aliphatic amines	. 443	206
With aliphatic diamines		206
With ethylenediamine and derivatives		206
With ethylenediamine		206
With tetramethyl ethylene diamine	. 447	_
With hydroxyethyl ethylene diamines	. 447	_
With ethylenediamine derivatives	. –	207

	pag	ge
	Part 1	Part 2
Cu(II) continued		
With trimethylene diamine	_	208
With propylene diamine and derivatives	449	_
With propylene diamine		_
With hydroxypropyl propylene diamine	449	_
With 1,3-propane diamine and derivatives	449	_
With 1,3-propane diamine		_
With hydroxyethyl 1,3-propane diamine	450	_
With hydroxy propyl 1,3-propane diamines	450	_
With 2-methyl propane 1,2-diamines	451	_
With aliphatic triamines	451	208
With aliphatic tetramines		208
With triethylenetetramine		
With triethylenetetramine and derivatives		208
With alicyclic amines		210
With alicyclic monamines		210
With tris(aminoethyl)amine		210
With aliphatic amine N-oxides		_
		210
With aromatic amines	454	210
		210
With anilines		211
With aromatic diamines		211
With benzyl ethylenediamine		_
With 1,2-phenylenediamine	. 456	211
With phenylenediamines	. –	
With diaminobiphenyls		211
With aromatic tetramines	. 456	212
With alicyclic heteroring compounds		212
With piperidine and derivatives		_
With piperidine	. 458	242
With piperidine and piperazine derivatives		212
With dipiperidinoethane		-
With dabconium		212
With terpenes		213
With tropine and derivatives		215
With piperazine and derivatives	. 458	_
With morpholine and derivatives	. 459	_
With morpholine	. 459	_
With dimorpholinoethane		_
With benzodiazepine and derivatives	. 460	_
With quinuclidinone and derivatives	. 460	_
With spartein		_
With 3-nitrocampher		_
With other alicyclic heteroring compounds	. 461	_
With N heterocyclic ligands	. 462	_
With heterocyclic ligands		215
With dipyrromethene derivatives		215
With porphyrins	. 462	_
With porphyrins and related ligands	. –	216
With pyridine and derivatives	. 462	217
With pyridine	. 462	217
With pyridine derivatives	. 464	219
With alkyl pyridines	. 464	_
With poly pyridyl ethylene	. 466	_
With pyridine carboxylic acids		_
With methylpyridines	. –	219
With pyridine carboxylic acids	. –	220
With quinoline and derivatives	. 467	221
With iso-quinoline		221
With diquinolines	468	_

	pa	ge
	Part 1	Part 2
Cu(II) continued		
With diquinoline and derivatives	_	221
With diquinoline	· -	221
With 3,3'-dimethylene, 2,2'-diquinoline and derivatives		222
With quinoxaline and derivatives		224
With bipyridyls	: 468	
With 2,2'-bipyridyl		224
With 4,4'-bipyridyl	. 469	_
With phenanthroline and derivatives		226
With phenanthroline		226
With phenanthroline derivatives		228
With terpyridyl		228
With heterocyclic N-oxides	. 470	_
With pyridine N-oxide and derivatives		_
With pyridine N-oxide		_
With chloro and nitro pyridine N-oxides		
With alkyl pyridine N-oxides	. 471	-
With quinoline N-oxide and derivatives	. 474	_
With bipyridine N-oxides	. 475	_
With phenanthroline N-oxide	. 476	_
With other heterocyclic ligands	. 476	229
With pyrazole and derivatives	. 476	_
With imidazole and derivatives		229
With alkyl imidazoles	. 478	_
With methylimidazoles		229
With benzimidazole and derivatives		230
With hydroxy alkyl benzimidazoles		-
With amino benzimidazoles	. 482	_
With pyridyl benzimidazole		-
With sulfonamido benzimidazole		_
With naphthyridine		-
With purines		_
With purine and derivatives		230
With pyrazine		
With pyrazine and derivatives		231
With triazines		_
With tetraaza cyclotetradecane		-
With tetraazacyclotetradecane and derivatives		231
With S heterocyclic ligands	. 487	_
With benzothiazole and derivatives		_
With thiophene and derivatives		224
With O heterocyclic ligands		231
With furan and derivatives		_
With isoxazole	. 488	_
With homosphareness with h	. 488 . 488	_
With benzoselenoazoles		232
With aldehydes		232
	400	232
With monoketones		232
With acetone and derivatives		232
With ethyl acetoacetate and derivatives		_
With nitroacetone		232
With 3,3-dimethyl-1-nitrobutan-2-one		234
With other aliphatic monoketones		234
With alicyclic monoketones		_
With aromatic monoketones		236
With 2-nitroacetophenone		236
With iminobenzoyl benzoylmethane		238
With heterocyclic monoketones	. 491	239
		,

	pa	ge
	Part 1	Part 2
Cu(II) continued		
With diketones	. 492	240
With aliphatic diketones		240
With acetylacetone and derivatives	. 492	2-10
With acetylacetone and derivatives		240
With acetylacetone derivatives		240
With dipivaloyl methanate		
With benzoyl acetone		
With dibenzoyl methanide		
With hexafluoracetylacetone		242
With triketones		242
With amino ketones		
With aromatic diketones		246
		246
With aliphatic keto acids		246
With all plate managed and a said		
With alighatic monocarboxylic acids	. –	246 248
With aliphatic dicarboxylic acids		248
With alicyclic carboxylic acids	. –	
With aromatic carboxylic acids		249
With amino acids		250
With glycine and derivatives		250
With glycine		250
With glycine and derivatives		250
With alanine and derivatives		252
With α-alanine		252
With phenylalanine		253
With β -alanine and derivatives		253
With valine and derivatives		254
With leucine and derivatives		-
With asparagine and derivatives		254
With asparaginic and glutamic acids	. 499	_
With glutamic acid and derivatives		255
With methionine and derivatives		256
With proline and derivatives	. 500	_
With other amino acids		256
With alcohols	. 501	_
With aldehydes	. 502	-
With esters	. 502	_
With amine-N-polycarboxylic acids	. 502	-
With poly amino acids		259
With Schiff bases and related compounds		260
From hydroxy arylaldehydes and aliphatic or alicyclic monamines		260
From salicylaldehyde and aliphatic monamines	. 502	_
From salicylaldehyde derivatives and aliphatic monamines	. 506	_
From hydroxy arylaldehydes and hydroxy aliphatic monamines	. 509	<u> </u>
From salicylaldehyde and hydroxy aliphatic monamines		_
From salicylaldehyde derivatives and hydroxy aliphatic monamines	. 510	_
From hydroxy naphthaldehyde and hydroxy aliphatic monamines	. 513	_
From hydroxy arylaldehydes and hydroxyalkyl monamines		263
From hydroxy arylaldehydes and aromatic monamines		264
From carboxy salicylaldehyde and aliphatic amines		
From hydroxy arylaldehydes and aliphatic diamines		269
From hydroxy arylaldehydes and simple aliphatic diamines		207
From hydroxy arylaldehydes and dimethylamino ethylenediamine		_
From hydroxy arylaldehydes and mono- or diethylamino ethylenediamine		_
From hydroxy arylaldehydes and aromatic diamines		270
From hydroxy arylaldehydes and thio diamines		2,0
From hydroxy arylaldehydes and triamines		_
From hydroxy arylaldehydes and amino acids		271
From hydroxy arylaldehydes and hydrazines		2/1
i tom nyutony at yiaidenydes and nyutazines	. 543	

	pa	ge
	Part 1	Part 2
Cu(II) continued		
From hydroxy aliphatic aldehydes and hydroxy aliphatic amines	. 524	_
From amino aliphatic aldehydes and aliphatic and alicyclic amines		_
From amino aliphatic aldehydes and aromatic amines	. 525	_
From amino arylaldehydes and amines	. 526	_
From aryl dialdehydes and aliphatic amines	. 527	_
From aryl dialdehydes and aromatic amines	. 529	_
From alicyclic aldehydes and aromatic diamines		272
From heterocyclic aldehydes and amines	. 531	274
From pyridine aldehydes and amines	. 531	_
From pyrrole aldehyde and amines	. 531	_
From pyridine aldehyde and hydrazines	. 532	_
From aliphatic diketones and hydroxy aliphatic amines		_
From aliphatic diketones and aliphatic thiodiamines	. 533	_
From aliphatic diketones and aliphatic triamines	. 533	_
From aminoketones and aliphatic diamines	. 534	_
From amino arylaldehydes and aliphatic diamines		277
Cyclic Schiff bases from aromatic dialdehydes and aliphatic diamines		277
From aliphatic diketones and aliphatic diamines	. –	277
From aliphatic diketones and aromatic monamines	. –	279
From aliphatic diketones and aromatic diamines	. –	280
From aromatic monoketones and aliphatic diamines		280
From aromatic ketones and amines	. 535	_
From aromatic ketones and monamines	. 535	_
From diphenyl ketones and aliphatic monamines		_
From aromatic ketones and aliphatic diamines		_
From aromatic ketones and aromatic monamines	. 537	_
From heterocyclic ketones and amines	. 538	_
Cyclic Schiff bases		_
Cyclic Schiff bases derived from aromatic aminoaldehydes		_
Cyclic Schiff bases derived from aliphatic aminoketones		281
Cyclic Schiff bases derived from heterocyclic diketones and diamines	. 541	282
With azo compounds	. 541	283
With aromatic azo compounds	. 541	283
With benzene azo cresol and derivatives	. 511	283
With benzene 1-azo-2-naphthol and derivatives	· —	283
With triazenes	. 542	
With oximes and nitroso compounds	. 544	286
With aldoximes		286
With aromatic aldoximes	. 544	_
With heterocyclic aldoximes		_
With ketoximes		286
With aliphatic ketoximes	. 545	_
With aromatic ketoximes		_
With heterocyclic ketoximes	. 549	_
With nitroso compounds	. 549	_
With acid amides and acid hydrazides		286
With biguanide and derivatives		286
With aromatic acid amides		_
With aliphatic acid amides		288
With heterocyclic acid amides		288
With picoline amides		200
With pyridyl methyl acetamides		_
With nicotin amides		_
With pyridine dicarboxamides		_
With pyrazine 2-carboxamides		_
With bis pyridyl alkyl oxamides		_
With acid hydrazides		_
With amidines		1 _
With semicarbazones		289
With ligands containing sulfur		290
with agains containing summer	. 550	230

	pa	ıge
	Part 1	Part 2
Cu(II) continued		
With sulfoxides	. 558	290
With thiols	. 558	291
With heterocyclic thiols		291
With dithiolates		291
With mercapto aldehydes	. –	293
With monothio 1,3-diketones		292
With dithiocarbamates	. –	293
With diethyl dithiocarbamate	_	293
With dibutyl dithiocarbamate		294
With carbo dithioic acids		295
With thiourea and derivatives		295
With thio aryl hydroxylamines		296
With heterocyclic thiones	. 558	
With dithio carbamic acids	. 558	_
With thio carboxylic acids	. 559	
and a second	. 559	_
With thiourea and derivatives	. 559	297
With thiosemicarbazides		291
		_
With thiosemicarbazones	. 560	_
With ketone thiosemicarbazones	. 560	_
With aromatic aldehydes thiosemicarbazones		_
With heterocyclic aldehydes thiosemicarbazones		-
With thio acid amides		297
With aliphatic and alicyclic thioacidamides	. 562	_
With heterocyclic thioacidamides	. 562	_
With sulfuric acids	. 563	_
With sulfonic acids	. 563	_
With sulfinic acids	. 563	_
With thiocarbazates	. 563	_
With mercapto aryl aminoketones	. 566	_
With Schiff bases containing sulfur		298
With ligands containing selenium		299
With diselenocarbamic acids		299
With monoseleno thiocarbamic acids		300
With dicyanoethylene diselenolate		301
With dicyanoethylene thiolate selenolate		301
With ligands containing phosphorus		302
With phosphine oxides	. –	302
With phosphino amines	. 567	_
With phosphoric acids		_
With phosphonic acids		303
With dithio phosphoric acids		303
With cyclic dithio phosphoric acids		305
With dithio phosphonic acids		306
With phosphinic acids		500
With Schiff bases containing phosphorus		_
With dithio phosphinic acids	. 507	307
With phosphor amides		308
With cyclohexaphosphazene and derivatives	. –	308
With Exercise area and derivatives		300
With ligands containing arsenic		-
With Schiff bases containing arrapia	. 567	_
With Schiff bases containing arsenic		_
With ligands containing silicon		_
With ligands containing germanium		-
Organometallic compounds		-
Biological compounds	. –	309
Cu(II) (Part 2: Exchange coupled bimolecular units with $S=1$)		309
Simple compounds		309
Coordination compounds with neutral and chelating ligands		310
With amines	. –	310

	pa	ige
	Part 1	Part 2
Cu(II) continued		240
With tetramines		310
With heterocyclic ligands		311
With pyridine and derivatives		311
With quinoline and derivatives		311
With heterocyclic N-oxides		311
With other heterocyclic ligands		313
With pyrazole and derivatives		313
With pyrazolone and derivatives		313
With pyrazine and derivatives		315
With purine and derivatives		315
With S heterocyclic ligands		315
With O heterocyclic ligands		316
With aldehydes		316
With ketones		316
With diketones		316
With acetoacetic acid and derivatives		317
With carboxylic acids		317
		317
With monocarboxylic acids		
With dicarboxylic acids		319
With amino acids		319
With Schiff bases and related compounds		320
From hydroxy arylaldehydes and aliphatic monamines		320
From hydroxy arylaldehydes and hydroxy alkyl monamines		323
From hydroxy arylaldehydes and aromatic monamines		323
From hydroxy arylaldehydes and aliphatic diamines		324
From hydroxy arylaldehydes and aromatic diamines		326
From amino arylaldehydes and diamines		327
From aliphatic diketones and monamines		327
From aliphatic diketones and tetramines		328
From aromatic diketones and monamines		329
Cyclic Schiff bases derived from aliphatic aminoketones		330
With oximes and nitroso compounds		330
With ligands containing sulfur		330
Cu(III)		_
Cu(IV)		_
Cu (mixed oxydation state)		l _
Cu (mixeu oxyuanon state)	. 507	
Silver Ag	. 570	332
A ALID	. 570	332
Ag(II)		332
Simple compounds		1
Coordination compounds with neutral and chelating ligands		332
With N heterocyclic ligands		_
With pyridine derivatives	. 571	_
With other heterocyclic ligands	. 572	
With heterocyclic ligands		332
With bipyridyl		332
With pyrazine and derivatives		333
With tetraazacyclotetradecane and derivatives		333
With ligands containing sulfur		334
With dithiocarbamates		334
With Schiff bases and related compounds	. 572	_
		1
Gold Au		335
Au(II)		335
With ligands containing sulfur		335
With thiols		335
With dithiocarbamates		337
The defined canales	•	""
Diagrams	. 573	338
		344
References	. 001	1 277