

TABLE OF CONTENTS

CHAPTER	PAGE
CHAPTER I. THE OLDER AND THE NEWER CHEMISTRY	1
CHAPTER II. LINE SPECTRA	11
1. <i>Introductory</i>	11
2. <i>Balmer's Law</i>	13
3. <i>The Rydberg Constant</i>	14
4. <i>The Ritz Combination Principle</i>	16
5. <i>The Bohr Theory of the Hydrogen Line Spectrum</i>	19
6. <i>The Spectrum of Ionised Helium</i>	28
7. <i>Principal and Azimuthal Quantum Numbers</i>	31
8. <i>Selection Principles</i>	37
9. <i>The Bohr Correspondence Principle</i>	42
10. <i>Conclusion</i>	43
CHAPTER III. X-RAY SPECTRA AND ATOMIC NUMBERS	46
1. <i>The Phenomena of Crookes Tubes</i>	46
2. <i>The Method of Measuring X-Ray Spectra</i>	48
3. <i>The Nature of the X-Ray Spectra</i>	49
4. <i>The Gaps in the Periodic Table</i>	55
5. <i>The Anomalies of the Periodic Table</i>	56
6. <i>The X-Ray Spectrum of Hydrogen</i>	57
9. <i>Conclusion</i>	57
CHAPTER IV. THE PHENOMENA OF RADIOACTIVITY	59
1. <i>Historical</i>	59
2. <i>Radium</i>	60
3. <i>The Becquerel Rays</i>	63
CHAPTER V. THE DISINTEGRATION THEORY AND THE RADIOACTIVE SERIES	73
1. <i>The Disintegration Theory</i>	73
2. <i>Multiple Disintegration</i>	76
3. <i>The Radioactive Series</i>	77
4. <i>Potassium and Rubidium</i>	81
5. <i>Radioactive Recoil</i>	82
CHAPTER VI. RADON, THORON, AND ACTINON	84
1. <i>The Emanations of Thorium and Actinium</i>	84
2. <i>Radon</i>	86
3. <i>The Production of Helium</i>	93
4. <i>The Disintegration Theory and the Age of Minerals</i>	95
CHAPTER VII. THE ISOTOPES	98
1. <i>The Recognition of Isotopy</i>	98
2. <i>The α-Ray Change</i>	100

CHAPTER	PAGE
CHAPTER VII. THE ISOTOPES.— <i>continued</i>	
3. <i>Fleck's Investigation of the Chemistry of the Radio-elements</i>	101
4. <i>The β-Ray Change</i>	103
5. <i>The Group Displacement Law</i>	103
6. <i>The Atomic Weight of Lead</i>	107
7. <i>The Properties of Isotopes</i>	110
8. <i>Radioactive Indicators</i>	114
9. <i>Conclusion</i>	117
CHAPTER VIII. THE ISOBARS	119
1. <i>The Recognition of the Isobars</i>	119
2. <i>β-Ray Electrons and Ionic Charges</i>	120
3. <i>The β-Ray Change and its Ionic Parallel</i>	122
4. <i>The Complete Classification of Atoms</i>	124
CHAPTER IX. THE ANALYSIS OF POSITIVE RAYS	126
1. <i>The Original Apparatus</i>	126
2. <i>The Theory of the Parabola Method</i>	128
3. <i>The Interpretation of the Photographs</i>	130
4. <i>The Mass Spectrograph</i>	134
5. <i>The Hot-Anode Apparatus</i>	136
CHAPTER X. THE RESULTS OBTAINED WITH THE MASS SPECTROGRAPH.	138
1. <i>Isotopy and Isobarism among the Non-radioactive Elements</i>	138
2. <i>Mass Numbers and the Packing Effect</i>	140
3. <i>The Revision of Atomic Weights</i>	147
4. <i>Some General Relationships</i>	148
5. <i>Conclusion</i>	151
CHAPTER XI. THE SEGREGATION OF ISOTOPES.	153
1. <i>Introductory</i>	153
2. <i>The Mass Spectrograph</i>	154
3. <i>Other Methods of Separation</i>	155
CHAPTER XII. DEUTERIUM	165
1. <i>Introductory</i>	165
2. <i>Separation</i>	168
3. <i>Properties</i>	170
4. <i>The Impact of Deuterium on Chemistry</i>	173
5. <i>Tritium</i>	174
CHAPTER XIII. THE DISINTEGRATION OF THE ATOMIC NUCLEUS	177
1. <i>Introductory</i>	177
2. <i>The Scattering of α-Rays</i>	178
3. <i>The Disruption of Nitrogen</i>	180
4. <i>Other Disintegrations with α-Particles</i>	183
5. <i>Nuclear Reactions</i>	185
6. <i>Proton Bombardment</i>	188
7. <i>Deuteron Bombardment</i>	192
8. <i>The Behaviour of Beryllium</i>	193
9. <i>Neutron Bombardment</i>	195
10. <i>Non-Capture Disintegration</i>	196

TABLE OF CONTENTS

ix

CHAPTER	PAGE
CHAPTER XIV. THE DISCOVERY OF ARTIFICIAL RADIO- ACTIVITY	198
1. <i>Introductory</i>	198
2. <i>Radioactive Decay in Light Elements</i>	200
3. <i>Chemical Evidence</i>	202
4. <i>Radio-Sodium</i>	203
5. <i>Neutrons and Radioactivity</i>	204
 CHAPTER XV. THE NEW RADIOACTIVITY	 206
1. <i>Nuclear Isomerism</i>	206
2. <i>The Isotopes of Indium</i>	208
3. <i>The Separation of Nuclear Isomers</i>	212
4. <i>The Transmutation of Uranium</i>	213
5. <i>Nuclear Fission</i>	215
6. <i>Beyond Uranium</i>	217
7. <i>Radioactive Indicators</i>	217
8. <i>Atomic Energy</i>	219
 CHAPTER XVI. THE STRUCTURE OF THE NUCLEUS	 222
1. <i>Introductory</i>	222
2. <i>Pre-Neutron Ideas of the Nucleus</i>	222
3. <i>The New Particles</i>	224
4. <i>Some General Rules</i>	226
5. <i>Summary of Ultimate Particles</i>	230
6. <i>Conclusion</i>	231
 CHAPTER XVII. THE OUTER SPHERE OF THE ATOM.	 232
1. <i>Introductory</i>	232
2. <i>Polar and Non-Polar Compounds</i>	234
3. <i>Normal Valencies and Contra-Valencies</i>	235
4. <i>The Inert Gas Group</i>	236
5. <i>Kossel's Views</i>	238
6. <i>The Theory of G. N. Lewis</i>	241
7. <i>The Langmuir Model Atom</i>	248
8. <i>The Bury Model Atom</i>	253
9. <i>Isosterism</i>	256
10. <i>The Bohr Model Atom</i>	257
11. <i>The Four Quantum Numbers</i>	258
12. <i>The Periodic Classification</i>	260
13. <i>Conclusion</i>	267
 CHAPTER XVIII. X-RAYS AND THE STRUCTURE OF CRYSTALS	 269
1. <i>Introductory</i>	269
2. <i>The Nature of the Crystal Lattice</i>	271
3. <i>Interplanar Distances</i>	274
4. <i>Experimental Methods</i>	276
5. <i>Three Types of Bonds</i>	282
6. <i>The Electrovalent Bond</i>	284
7. <i>The Covalent Bond</i>	290
8. <i>The Metallic Bond</i>	292

CHAPTER.	PAGE
CHAPTER XIX. THE STRUCTURE OF SOLIDS	295
1. <i>Mixed Bond Types</i>	295
2. <i>The Heteropoly Acids and Their Salts</i>	296
3. <i>The Silicates</i>	298
4. <i>The Conception of Giant Molecules</i>	304
5. <i>Diamond and Graphite</i>	305
6. <i>Miscellaneous Giant Molecules</i>	309
7. <i>Organic Compounds</i>	311
8. <i>Fourier Analysis</i>	316
9. <i>Metallic Structures</i>	318
10. <i>Interstitial Compounds</i>	327
11. <i>Liquids and Amorphous Solids</i>	328
12. <i>Gases and Vapours</i>	330
13. <i>Industrial Applications</i>	331
14. <i>Conclusion</i>	332
CHAPTER XX. ELECTRON DIFFRACTION AND STRUCTURE	334
1. <i>Introductory</i>	334
2. <i>Experimental Methods</i>	338
3. <i>Comparison of X-Ray and Electron Diffraction Measurements</i>	344
4. <i>Some Thin Films</i>	345
5. <i>Configurations of Inorganic Gases and Liquids</i>	346
6. <i>Substitution of Halogens in Organic Compounds</i>	347
7. <i>Other Organic Problems</i>	349
8. <i>The Electron Microscope</i>	353
9. <i>Conclusion</i>	355
CHAPTER XXI. THE CONDUCTIVITY OF ELECTROLYTES	357
1. <i>Introductory</i>	357
2. <i>Electrolytes</i>	358
3. <i>The Theory of Arrhenius</i>	359
4. <i>The Kohlrausch Formula</i>	360
5. <i>The Assumptions of the Arrhenius Theory</i>	361
6. <i>Development from the Arrhenius Theory</i>	362
7. <i>The Theory of Complete Ionisation</i>	365
8. <i>The Solution of Salts</i>	367
9. <i>The Migration of Ions</i>	368
10. <i>Ion Association</i>	372
11. <i>Extreme Cases of the Ionic Atmosphere</i>	373
12. <i>Conclusion</i>	374
CHAPTER XXII. SOME NEW HYDRIDES	376
A. BORON HYDRIDES	376
1. <i>The Preparation of the Boron Hydrides</i>	376
2. <i>The Properties of the Boron Hydrides</i>	378
3. <i>The Structure of the Boron Hydrides</i>	383
B. SILICON HYDRIDES	385
1. <i>Nomenclature</i>	385
2. <i>The Preparation of the Silanes</i>	386
3. <i>The Properties of the Silanes</i>	387
C. GERMANIUM HYDRIDES	391

TABLE OF CONTENTS

xi

CHAPTER	PAGE
CHAPTER XXII. SOME NEW HYDRIDES.— <i>continued</i>	
D. TIN HYDRIDE	393
E. LEAD HYDRIDE	394
F. BISMUTH HYDRIDE	396
G. POLONIUM HYDRIDE	398
CHAPTER XXIII. THE HYDRIDES AND THE PERIODIC SYSTEM	400
1. <i>Introductory</i>	400
2. <i>The Preparation of the Hydrides</i>	403
3. <i>The Properties of the Hydrides</i>	405
4. <i>The Rôle of Hydrogen in the Hydrides</i>	411
CHAPTER XXIV. EMISSION BAND SPECTRA	413
1. <i>Introductory</i>	413
2. <i>Deslandres' Investigations</i>	414
3. <i>Energy Changes in Molecules</i>	417
4. <i>Rotation Spectra</i>	419
5. <i>Rotation-Vibration Spectra</i>	421
6. <i>Electronic Bands</i>	425
7. <i>The Isotope Effect</i>	434
8. <i>Raman Spectra</i>	439
9. <i>Conclusion</i>	441
CHAPTER XXV. CONTINUOUS EMISSION SPECTRA	443
1. <i>Some Types of Continuous Emission</i>	443
2. <i>Some Hypotheses about Continuous Spectra</i>	446
CHAPTER XXVI. TESLA-LUMINESCENCE SPECTRA	452
1. <i>The Production of Tesla-Luminescence Spectra</i>	452
2. <i>The Benzene Emission Spectrum</i>	455
3. <i>The Fraunhofer Effect</i>	458
4. <i>The Types of Tesla-Luminescence Spectra</i>	459
5. <i>Tesla-Luminescence Spectra and Chemical Constitution</i>	462
6. <i>The Origin of Tesla-Luminescence Spectra</i>	466
7. <i>Band Series and Fluorescence Spectra</i>	474
8. <i>Conclusion</i>	477
CHAPTER XXVII. CONCLUSION	479
NAME INDEX	499
SUBJECT INDEX	506