

Contents

Volume II

I. Introduction	
II. Radioactive Decay	2
1. Radioactive Decay Laws	2
A. Exponential Law of Decay and "Activity",	2
B. Half-Life.....	4
C. Growth–Decay Relationships.....	6
2. Modes of Decay	11
A. General Considerations of Unstable Nuclei.....	11
B. Alpha Decay	13
C. Beta Decay and Associated Phenomena.....	16
D. Gamma Radiation and Associated Processes.....	24
3. Nuclear Decay Schemes	26
III. Interaction of Radiations with Matter	27
1. Alpha Particles.....	28
A. Range.....	28
B. Energy Loss.....	30
2. Beta Particles.....	32
A. Energy Loss,	32
B. Absorption of Beta Particles.....	33
3. Gamma Rays.....	38
A. Photoelectric Effect.....	39
B. Compton Scattering	40
C. Pair Production.....	42
4. Biological Effects of Radiation.....	43

IV. Production of Radionuclides	47
1. Nuclear Reactions.....	47
A. Energetics of Nuclear Reactions.....	48
B. Cross Section.....	51
C. Mechanisms of Nuclear Reactions.....	51
2. Methods of Production.....	54
A. Types of Reactions.....	54
B. Devices for Inducing Nuclear Reactions: Accelerators and Nuclear Reactors.....	62
V. Separation Techniques	73
1. Unique Aspects of Tracer Separations.....	74
A. Isotope Effect.....	74
B. Low Concentration Effects.....	74
C. Chemical Effects of Nuclear Transformations.....	75
D. The Scale of Tracer Separations.....	79
E. Quantitative Separation Not Needed.....	79
2. Strategy of a Separation.....	79
3. Separation Procedures.....	80
A. Solvent Extraction.....	81
B. Chromatography.....	82
C. Precipitation.....	82
D. Electrochemical Methods.....	83
E. Physical Methods.....	84
VI. Detection and Measurement of Nuclear Radiation	85
1. Scintillation Techniques.....	86
A. Introduction.....	86
B. Electron Detection and Spectrometry.....	87
C. Gamma-Ray Counting and Spectrometry.....	96
D. Detection of Heavy Charged Particles.....	116
2. Ionization Chambers.....	117
A. Ionization in Gases.....	117
B. Current Chambers.....	118
C. Pulse-Type Chambers.....	120
D. Design Considerations.....	122
E. Counting and Assay Applications.....	124
F. Energy Spectra.....	126

3.	Semiconductor Radiation Detectors.....	126
	A. Principles and Description.....	126
	B. Fabrication Techniques.....	132
	C. Application to Spectrometry.....	133
4.	Gas Multiplication Counters.....	137
	A. Introduction.....	137
	B. Proportional Counters.....	138
	C. Geiger Counters.....	144
5.	Auxiliary Electronic Instrumentation.....	147
	A. General Introduction.....	147
	B. Amplifiers.....	148
	C. Trigger Circuits.....	154
	D. Scalers.....	154
	E. Counting-Rate Meters.....	157
	F. Pulse-Height Analyzers.....	157
	G. Coincidence Measurements.....	162
6.	Low-Level Counting.....	165
	A. General Remarks.....	165
	B. Apparatus.....	166
7.	Determination of the Disintegration Rate.....	168
	A. Absolute Alpha Counting.....	168
	B. Absolute Beta Counting.....	171
	C. Absolute Gamma Counting.....	174
VII. Source Mounting.....		175
1.	Introduction.....	175
2.	Desiccated Sources.....	175
	A. Evaporation from Solution.....	175
	B. Use of Slurries.....	176
	C. Filtration of Precipitates.....	177
3.	Sublimation.....	177
4.	Electrodeposition.....	178
5.	Sources Containing Gases.....	179
6.	Liquid Sources.....	179

<i>VIII. Other Areas of Research Involving Radioactivity</i>	180
<i>References</i>	180
<i>Subject Index</i>	<i>191</i>