CONTENTS

Master Symbol List, xiii

Chapter 1. Introduction

1.1 Historical Perspective, 2
1.2 The Profusion of Separation Methods, 3
1.3 About the Book, 5

PART ONE FUNDAMENTALS

Chapter 2. Separation Equilibria

2.1 Thermodynamics of Separation, 12
2.2 The Molecular Basis of Equilibrium Separations, 33

Chapter 3. Diffusion and Mass Transport

3.1 Introduction, 63
3.2 Diffusion, 64
3.3 Diffusion Rates in Various Media, 73
3.4 Thermal Diffusion, 82
3.5 Mass Transfer through Interfaces, 83
3.6 Fluid Flow, 85

Chapter 4. Operational Aspects of Separation

4.1 Terminology and Classification, 97
4.2 Single-Contact (Cocurrent) Processes, 100

4.3 Differential Processes, 101
4.4 Crosscurrent Processes, 102
4.5 Countercurrent Processes, 103
4.6 Countercurrent Processes with Reflux, 104
4.7 Differential Migration Methods, 106
4.8 Craig Distribution and Chromatography, 110
4.9 Zone Melting, 118

Chapter 5. Chromatography

5.1 Introduction, 121
5.2 Retention and Equilibrium, 129
5.3 The Origin and Importance of Band Spreading, 135
5.4 Resolution, 146
5.5 Multicomponent Separations, 155

Chapter 6. Characteristics of Individual Separation Methods

6.1 Adaptability, 170
6.2 Load Capacity, 171
6.3 Fraction Capacity, 171
6.4 Selectivity, 174
6.5 Speed and Convenience of Separation, 178

PART TWO METHODS BASED ON PHASE AND DISTRIBUTION EQUILIBRIA

Chapter 7. Distillation (R. H. McCormick)

7.1 Introduction, 181
7.2 Theory, 183
7.3 Experimental Techniques, 192
7.4 Other Types of Distillation, 199

Chapter 8. Gas-Liquid Chromatography

8.1 Theory, 212
8.2 Experimental Gas-Liquid Chromatography, 229
8.3 Typical Applications, 239

Chapter 9. Solvent Extraction (H. Freiser)

9.1 Introduction, 247
9.2 Process of Extraction, 248

9.3 Classification of Inorganic Extraction Systems, 250
9.4 Fundamental Extraction Parameters, 255
9.5 Methods of Extraction, 256
9.6 Quantitative Treatment of Extraction Equilibria, 257

Chapter 10. Liquid-Liquid Chromatography

10.1 Theory, 268
10.2 Column Chromatography, 285
10.3 Paper Chromatography, 290
10.4 Some Related Methods, 294
10.5 Applications, 296

Chapter 11. Crystallization (W. R. Wilcox)

11.1 Introduction, 303
11.2 Crystallization Phenomena, 306
11.3 Separation by Crystallization, 311
11.4 Phenomena Influencing Separation, 318
11.5 Related Processes, 333

Chapter 12. Ion-Exchange Separation Processes (H. L. Rothbart)

12.1 Introduction, 337
12.2 Structure, 338
12.3 Properties of Ion Exchangers, 341
12.4 Applications, 351
12.5 Chromatography, 353

Chapter 13. Liquid-Solid Adsorption Chromatography

13.1 Theory, 378
13.2 Experimental Aspects, 395
13.3 Some Related Methods, 400
13.4 Affinity Chromatography, 402
13.5 Applications, 406

Chapter 14. Other Interfacial Processes

14.1 Gas-Solid Adsorption, 411
14.2 Adsorption Bubble Separation Processes, 423

Chapter 15. Exclusion Processes (J. Y. Chuang and J. F. Johnson)

15.1 Adsorption on Molecular Sieves (Zeolites), 437
15.2 Gel Chromatography, 444
15.3 Clathration, 461

PART THREE OTHER SEPARATION METHODS

Chapter 16. Barrier Separation Processes (R. A. Cross and H. Strathmann)

16.1 Introduction, 469
16.2 Structure and Transport Properties of Semipermeable Membranes, 470
16.3 Fluxes and Driving Forces in Membrane Separation Processes, 471
16.4 Theory and Practice of Selected Membrane Separation Processes, 472

Chapter 17. Electrophoresis (M. Bier)

17.1 Introduction, 497
17.2 Theory, 501
17.3 Techniques, 505

Chapter 18. Miscellaneous Separation Processes

18.1 Ultracentrifugation, 527
18.2 Particle Classification by Size, 539
18.3 Electromagnetic Separation (Mass Spectrometry), 548
18.4 Thermal Diffusion, 551
18.5 The Use of Enzymes for Separation, 552

Chapter 19. Multistep Separation Schemes for Complex Samples

19.1 Designing a Multistep Scheme, 557
19.2 Some Examples of Separation Schemes, 565
19.3 Conclusion, 577

Index 579