

CONTENTS

Chapter 1	
Cadmium	
1.1 Introduction	1
1.2 Environmental Chemistry	1
1.3 Concentrations in Field Collections	2
1.4 Lethal Effects	17
1.5 Sublethal Effects	19
1.6 Bioaccumulation	24
1.7 Teratogenesis, Mutagenesis, and Carcinogenesis	28
1.8 Recommendations	28
1.9 Summary	33
1.10 Literature Cited	34
Chapter 2	
Chromium	
2.1 Introduction	45
2.2 Environmental Chemistry	45
2.3 Concentrations in Field Collections	48
2.4 Beneficial and Protective Properties	60
2.5 Lethal Effects	61
2.6 Sublethal Effects	66
2.7 Field Investigations	76
2.8 Recommendations	78
2.9 Summary	82
2.10 Literature Cited	82
Chapter 3	
Copper	
3.1 Introduction	93
3.2 Sources and Uses	94
3.3 Chemical and Biochemical Properties	97
3.4 Carcinogenicity, Mutagenicity, and Tertogenicity	105
3.5 Concentrations in Field Collections	106
3.6 Copper Deficiency Effects	137
3.7 Lethal and Sublethal Effects	140
3.8 Proposed Criteria and Recommendations	173
3.9 Summary	179
3.10 Literature Cited	181

Chapter 4	
Lead	
4.1 Introduction	201
4.2 Sources and Uses	203
4.3 Chemical Properties	206
4.4 Mode of Action	207
4.5 Concentrations in Field Collections	211
4.6 Lethal and Sublethal Effects	252
4.7 Recommendations	280
4.8 Summary	289
4.9 Literature Cited	290
Chapter 5	
Mercury	
5.1 Introduction	313
5.2 Sources of Environmental Mercury	315
5.3 Chemical and Biochemical Properties	318
5.4 Mercury in Minamata, Japan	322
5.5 Concentrations in Field collections	326
5.6 Lethal Effects	366
5.7 Sublethal Effects	373
5.8 Recommendations	383
5.9 Summary	390
5.10 Literature Cited	391
Chapter 6	
Nickel	
6.1 Introduction	411
6.2 Sources and Uses	413
6.3 Chemical and Biological Properties	416
6.4 Carcinogenicity, Mutagenicity, and Teratogenicity	422
6.5 Concentrations in Field Collections	428
6.6 Nickel Deficiency Effects	453
6.7 Lethal and Sublethal Effects	455
6.8 Proposed Criteria and Recommendations	479
6.9 Summary	486
6.10 Literature Cited	487
Chapter 7	
Silver	
7.1 Introduction	499
7.2 Sources and Uses	500
7.3 Chemistry and Metabolism	503

7.4 Concentrations in Field Collections	509
7.5 Lethal and Sublethal Effects	521
7.6 Recommendations	534
7.7 Summary	542
7.8 Literature Cited	543
Chapter 8	
Tin	
8.1 Introduction	551
8.2 Chemical and Biochemical Properties	552
8.3 Sources and uses	557
8.4 Concentrations in Field Collections	560
8.5 Effects	572
8.6 Recommendations	591
8.7 Summary	594
8.8 Literature Cited	595
Chapter 9	
Zinc	
9.1 Introduction	605
9.2 Sources and Uses	606
9.3 Chemical and Biochemical Properties	608
9.4 Carcinogenicity, Mutagenicity, and Teratogenicity	616
9.5 Concentrations in Field Collections	618
9.6 Zinc Deficiency Effects	646
9.7 Lethal and Sublethal Effects	652
9.8 Recommendations	685
9.9 Summary	694
9.10 Literature Cited	696
Index	715