

08	The Calcium Cycle	147
18	Other Geochemical Elements and Toxic Substances	147
18	Chemicals	149
18	Radiation	150
18	The Disturbance of Geochemical Balances	151
18	Conclusion	152
18	Use of Underground Space	152
18	Ground Storage	153
18	Waste Disposal	153
18	Conclusion	154
18	References	154
18	Notes	155
18	Answers	155
18	Further Reading	155
18	Geological Glossary	156
18	Index	156

Contents

Preface

Introduction

1.	Introducing the Earth	1
	Basic Facts	2
	The Lithosphere	3
	The Composition of the Crust	3
	Igneous Rocks	5
	Sedimentary Rocks	6
	Metamorphic Rocks	7
	Structure and Distribution of Continental and Oceanic Rocks	7
	The Natural Geological Processes	9
	The Atmosphere and the Hydrosphere	13
	The Biosphere	17
	References	18
2.	The Natural Systems of the Environment	19
	Rock and Water Cycles	20
	Major Geochemical Cycles	23
	Geophysical Fields	25
	Radiation	26
	Energy Systems	27
	Natural Systems and the Environment	28
	References	30
3.	The Pursuit of Geology	31
	The Geological Map	32
	The Roles of Geophysics	35
	The Roles of Geochemistry	38
	The Earth Science Laboratories	41
	The Conclusion	41
4.	Man's Impact on the Geosphere	43
	Population Growth and Development Needs	44
	The Impact of Towns	47
	Man's Effects	49
	The Impact of the Minerals Industry	50
	Impact of Water Use	53
	Impact of the Use of Energy	54
	The Effect of Chemicals	60
	A Synoptic View and the Future	61
	References	62
5.	Mineral Resources	63
	Introduction	64
	Consumption and Production	69
	Resources and Reserves	71
	Accessibility, Lifetime	73
	The Geography of Mineral Production	75
	Integrated Use of Raw Materials	79

Future Trends	80
References.....	81
6. Energy Resources	83
Introduction.....	84
The Non-Renewable Resources	85
The Renewable Resources.....	88
Fuel Consumption 	93
The Resources	94
Resources in Developing Countries	96
Future Strategy	97
Oil and Natural Gas.....	98
Tar Sands and Bituminous Shale.....	98
Hard Coal.....	98
Lignite.....	99
Peat	99
Uranium	99
Thorium	99
Geothermal Energy	99
Solar Energy	100
Wind Power.....	100
Water Power.....	100
Biomass.....	100
References.....	101
7. Groundwater Resources	103
The Groundwater Regime	104
Groundwater and the Hydrological Cycle.....	106
Groundwater and its Significance	109
Groundwater Quality.....	111
The Assessment and Management of Groundwater Resources.....	113
References.....	115
8. Soil Resources	117
The Background	118
Some Basic Soil Properties	119
Some Major Soil Types	122
Production of Crops.....	123
Soil Improvement: Fertility.....	125
Soil Improvement: Drainage.....	126
Soil Improvement: Irrigation	128
Soil Deterioration: Erosion.....	129
Soil Deterioration: Desertification	130
Soil Deterioration: Salinization	131
Soil Deterioration: Compaction	131
Urbanization.....	132
Soil Pollution.....	133
Conclusions	134
References.....	134
9. Geochemical Aspects	137
The Geochemical Environment	138
Basic Processes.....	140
The Carbon Cycle.....	143
The Nitrogen Cycle	144
The Sulphur Cycle	145
The Free Oxygen Cycle.....	145
The Phosphorus Cycle.....	146

The Calcium Cycle	147
Minor Chemical Elements and Toxic Substances	147
Organic Chemicals	150
Ionizing Radiation	151
Pollution: The Disturbance of Geochemical Balances	152
Acidification	152
References	154
10. The Use of Underground Space	157
Underground Storage	158
Underground Waste Disposal	159
Radioactive Waste	161
References	167
11. Human Health	169
Introduction	170
Pathological Effects of Mineral Dusts	173
Analytical Methods	178
Practical Applications of Analytical Methods	183
Regulation	183
Conclusion	184
References	185
12. Geology and Land-Use Planning	187
Some Problems of Land-Use Planning	188
Geological Maps, the Land-Use Planner's Pre-Requisite	190
What the Land-Use Planner Needs to Know	191
The Role of the Geologist	193
References	199
13. Future Changes, Natural and Man-Made	201
The Minimization of Man's Adverse Impact	205
Protection Against Natural Disasters	209
Environmental Protection and Land-Use Planning	209
The Role of the United Nations	210
References	211