CONTENTS

Preface and Acknowledgements x

1. INTRODUCTION AND OVERVIEW 1

- 1.1. Computers as toys to stretch our minds 1
- 1.2. The revolution in philosophy 3
- 1.3. Themes from the computer revolution 6
- 1.4. What is Artificial Intelligence? 17
- 1.5. Conclusion 20

PART ONE

Methodological Preliminaries

2. WHAT ARE THE AIMS OF SCIENCE? 22

Part one: overview 22

- 2.1.1. Introduction 22
- 2.1.2. First crude subdivision of aims of science 23
- 2.1.3. A further subdivision of the factual aims: form and content 24

Part two: interpreting the world 26

- 2.2.1. The interpretative aims of science sub divided 26
- 2.2.2. More on the interpretative and historical aims of science 29
- 2.2.3. Interpreting the world and changing it 30

Part three: elucidation of subgoal (a) 32

- 2.3.1. More on interpretative aims of science 32
- 2.3.2. The role of concepts and symbolisms 33
- 2.3.3. Non-numerical concepts and symbolisms 34
- 2.3.4. Unverbalised concepts 35
- 2.3.5. The power of explicit symbolisation 36
- 2.3.6. Two phases in knowledge acquisition: understanding and knowing 36

- 2.3.7. Examples of conceptual change 37 2.3.8. Criticising conceptual systems 39 Part four: elucidating subgoal (b) 41 2.4.1. Conceivable or representable vs. really possible 41 2.4.2. Conceivability as consistent representability 41 2.4.3. Proving real possibility or impossibility 43 2.4.4. Further analysis of 'possible' is required 44 Part five: elucidating subgoal (c) 45 2.5.1. Explanations of possibilities 45 2.5.2. Examples of theories purporting to explain possibilities 46 2.5.3. Some unexplained possibilities 48
- 2.5.4. Formal requirements for explanations of possibilities 49
- 2.5.5. Criteria for comparing explanations of possibilities 51
- 2.5.6. Rational criticism of explanations of possibilities 53
- 2.5.7. Prediction and control 55
- 2.5.8. Unfalsifiable scientific theories 57
- 2.5.9. Empirical support for explanations of possibilities 58
- Part six: concluding remarks 60
- 2.6.1. Can this view of science be proved correct? 60

3. SCIENCE AND PHILOSOPHY 63

- 3.1. Introduction 63
- 3.2. The aims of philosophy and science overlap 64
- 3.3. Philosophical problems of the form 'how is X possible?' 65
- 3.4. Similarities and differences between science and philosophy 69
- 3.5. Transcendental deductions 71
- 3.6. How methods of philosophy can merge into those of science 73
- 3.7. Testing theories 75
- 3.8. The regress of explanations 76
- 3.9. The role of formalisation 77
- 3.10. Conceptual developments in philosophy 77
- 3.11. The limits of possibilities 78
- 3.12. Philosophy and technology 80
- 3.13. Laws in philosophy and the human sciences 81
- 3.14. The contribution of artificial intelligence 82
- 3.15. Conclusion 82

4. WHAT IS CONCEPTUAL ANALYSIS? 84

- 4.1. Introduction 84
- 4.2. Strategies in conceptual analysis 86
- 4.3. The importance of conceptual analysis 99

5. ARE COMPUTERS REALLY RELEVANT? 103

- 5.1. What is a computer? 103
- 5.2. A misunderstanding about the use of computers 105
- 5.3. Connections with materialist or physicalist theories of mind 106
- 5.4. On doing things the same way 108

PART TWO

Mechanisms

6. SKETCH OF AN INTELLIGENT MECHANISM 112

- 6.1. Introduction 112
- 6.2. The need for flexibility and creativity 113
- 6.3. The role of conceptual analysis 113
- 6.4. Components of an intelligent system 114
- 6.5. Computational mechanisms need not be hierarchic 115
- 6.6. The structures 117
 - (a) the environment 117
 - (b) a store of factual information (beliefs and knowledge) 118
 - (c) a motivational store 119
 - (d) a store of resources for action 120
 - (e) a resources catalogue 121
 - (f) a purpose-process (action-motive) index 122
 - (g) temporary structures for current processes 124
 - (h) a central administrator program 124
 - (i) perception and monitoring programs 127
 - (j) retrospective analysis programs 132
- 6.7. Is such a system feasible? 134
- 6.8. The role of parallelism 135
- 6.9. Representing human possibilities 135
- 6.10. A picture of the system 136
- 6.11. Executive and deliberative sub-processes 137
- 6.12. Psychopathology 140

6.13. Conclusion: what is a mind? 141

7. INTUITION AND ANALOGICAL REASONING 144

- 7.1. The problem 144
- 7.2. Fregean (applicative) vs analogical representations 145
- 7.3. Examples of analogical representations and reasoning 147
- 7.4. Reasoning about possibilities 154
- 7.5. Reasoning about arithmetic and non-geometrical relations 155
- 7.6. Analogical representations in computer vision 156
- 7.7. In the mind or on paper? 157
- 7.8. What is a valid inference? 158
- 7.9. Generalising the concept of validity 159
- 7.10. What are analogical representations? 162
- 7.11. Are natural languages Fregean (applicative)? 167
- 7.12. Comparing Fregean and analogical representations 168
- 7.13. Conclusion 174

8. ON LEARNING ABOUT NUMBERS: SOME PROBLEMS AND SPECULATIONS 177

- 8.1. Introduction 177
- 8.2. Philosophical slogans about numbers 179
- 8.3. Some assumptions about memory 181
- 8.4. Some facts to be explained 183
- 8.5. Knowing number words 184
- 8.6. Problems of very large stores 186
- 8.7. Knowledge of how to say number words 187
- 8.8. Storing associations 188
- 8.9. Controlling searches 190
- 8.10. Dealing with order relations 191
- 8.11. Control-structures for counting games 196
- 8.12. Problems of co-ordination 197
- 8.13. Interleaving two sequences 200
- 8.14. Programs as examinable structures 201
- 8.15. Learning to treat numbers as objects with relationships 202
- 8.16. Two major kinds of learning 203
- 8.17. Making a reverse chain explicit 205
- 8.18. Some properties of structures containing pointers 210
- 8.19. Conclusion 212

9. PERCEPTION AS A COMPUTATIONAL PROCESS 217

- 9.1. Introduction 217
- 9.2. Some computational problems of perception 218
- 9.3. The importance of prior knowledge in perception 219
- 9.4. Interpretations 223
- 9.5. Can physiology explain perception? 224
- 9.6. Can a computer do what we do? 226
- 9.7. The POPEYE program 228
- 9.8. The program's knowledge 230
- 9.9. Learning 233
- 9.10. Style and other global features 234
- 9.11. Perception involves multiple co-operating processes 235
- 9.12. The relevance to human perception 237
- 9.13. Limitations of such models 239

10. CONCLUSION: AI AND PHILOSOPHICAL PROBLEMS 242

- 10.1. Introduction 242
- 10.2. Problems about the nature of experience and consciousness 242
- Problems about the relationships between experience and behaviour 252
- 10.4. Problems about the nature of science and scientific theories 254
- 10.5. Problems about the role of prior knowledge and perception 255
- 10.6. Problems about the nature of mathematical knowledge 258
- 10.7. Problems about aesthetic experience 259
- 10.8. Problems about kinds of representational systems 260
- 10.9. Problems about rationality 261
- 10.10. Problems about ontology, reductionism, and phenomenalism 262
- 10.11. Problems about scepticism 263
- 10.12. The problems of universals 264
- 10.13. Problems about free will and determinism 266
- 10.14. Problems about the analysis of emotions 267
- 10.15. Conclusion 268

Epilogue 272 *Bibliography* 274 *Postscript* 285 *Index* 288 Footnotes will be found at the end of each chapter.