

Contents

Preface to the first edition	<i>xi</i>
Preface to the second edition	<i>xiii</i>
Preface to the third edition	<i>xv</i>
Preface to the fourth edition	<i>xvii</i>
Introduction	<i>xix</i>

1. Science as knowledge derived from the facts of experience 1

A widely held commonsense view of science	1
Seeing is believing	4
Visual experiences not determined solely by the object viewed	5
Observable facts expressed as statements	9
Why should facts precede theory?	12
The fallibility of observation statements	14
Further reading	17

2. Observation as practical intervention 18

Observation: passive and private or active and public?	18
Galileo and the moons of Jupiter	20
Observable facts objective but fallible	23
Further reading	24

3. Experiment 25

Not just facts but relevant facts	25
The production and updating of experimental results	26
Transforming the experimental base of science: historical examples	29
Experiment as an adequate basis for science	34
Further reading	37

4. Deriving theories from the facts: induction 38

Introduction	38
Baby logic	39
Can scientific laws be derived from the facts?	40
What constitutes a good inductive argument?	42
Further problems with inductivism	45

The appeal of inductivism 49

Further reading 54

5. Introducing falsificationism 55

Introduction 55

A logical point in favour of falsificationism 56

Falsifiability as a criterion for theories 57

Degree of falsifiability, clarity and precision 60

Falsificationism and progress 64

Further reading 68

6. Sophisticated falsificationism, novel predictions and the growth of science 69

Relative rather than absolute degrees of falsifiability 69

Increasing falsifiability and ad hoc modifications 70

Confirmation in the falsificationist account of science 73

Boldness, novelty and background knowledge 75

Comparison of the inductivist and falsificationist view of confirmation 77

Advantages of falsificationism over inductivism 78

Further reading 80

7. The limitations of falsificationism 81

Problems stemming from the logical situation 81

Falsificationism inadequate on historical grounds 84

The Copernican Revolution 86

Inadequacies of the falsificationist demarcation criterion and

Popper's response 94

Further reading 96

8. Theories as structures I: Kuhn's paradigms 97

Theories as structures 97

Introducing Thomas Kuhn 100

Paradigms and normal science 101

Crisis and revolution 104

The function of normal science and revolutions 109

The merits of Kuhn's account of science 111

Kuhn's ambivalence on progress through revolutions 113

Objective knowledge 115

Further reading 119

9. Theories as structures II: research programs 121

Introducing Imre Lakatos 121

Lakatos's research programs 122

Methodology within a program and the comparison of programs 126

Novel predictions 128

Testing the methodology against history 131

Problems with Lakatos's methodology 134

Further reading 137

10. Feyerabend's anarchistic theory of science 138

The story so far 138

Feyerabend's case against method 139

Feyerabend's advocacy of freedom 144

Critique of Feyerabend's individualism 145

Further reading 147

11. Methodical changes in method 149

Against universal method 149

Telescopic for naked-eye data: a change in standards 151

Piecemeal change of theory, method and standards 155

A light-hearted interlude 158

Further reading 160

12. The Bayesian approach 161

Introduction 161

Bayes' theorem 162

Subjective Bayesianism 164

Applications of the Bayesian formula 167

Critique of subjective Bayesianism 173

Further reading 177

13. The new experimentalism 179

Introduction 179

Experiment with life of its own 180

Deborah Mayo on severe experimental testing 184

Learning from error and triggering revolutions 187

The new experimentalism in perspective 190

Appendix: happy meetings of theory and experiment 194

Further reading 196

14. Why should the world obey laws? 197

Introduction 197

Laws as regularities 198

Laws as characterisations of powers or dispositions 201

Thermodynamic and conservation laws 204

Further reading 208

15. Realism and anti-realism 209

Introduction 209

Global anti-realism: language, truth and reality 210

Anti-realism 214

Some standard objections and the anti-realist response 216

Scientific realism and conjectural realism 219

Idealisation 222

Unrepresentative realism or structural realism 224

Further reading 226

16. Epilogue to the third edition 227

Further reading 232

17. Postscript 233

Introduction 233

Confirmation by arguments from coincidence 235

Philosophical versus scientific knowledge of atoms 239

Independent evidence and the 'theory-dependence of observation': Perrin's experiments on Brownian motion 244

Partitioning of theories: atomism in nineteenth-century chemistry 251

Realism versus anti-realism again 257

Strongly confirmed theories are never completely discarded 258

Approximate truth is all we have 260

Levels of reality 264

Further reading 266

Notes 267

Bibliography 269

Index of names 278