

# { CONTENTS }

Preface	xi
<b>1. Empirical Analysis and the Metaphysics of Causation</b>	<b>1</b>
1.1. Empirical Analysis	2
1.1.1. <i>The Distinctive Features of Empirical Analysis</i>	9
1.2. Empirical Analysis of the Metaphysics of Causation	13
1.2.1. <i>Effective Strategies</i>	14
1.3. Empirical Analysis of the Non-metaphysical Aspects of Causation	17
1.4. Causation as Conceptually Tripartite	20
1.5. A Sketch of the Metaphysics of Causation	22
1.6. Fundamental and Derivative	24
1.6.1. <i>The Kinetic Energy Example</i>	25
1.6.2. <i>Some Constitutive Principles of Fundamentality</i>	30
1.7. Abstreduction	34
1.8. STRICT Standards and RELAXED Standards	37
1.9. Limitations on the Aspirations of Empirical Analysis	44
1.10. Comparison of Empirical and Orthodox Analysis	45
1.11. Summary	48

## PART I The Bottom Conceptual Layer of Causation

<b>2. Fundamental Causation</b>	<b>53</b>
2.1. Preliminaries	57
2.1.1. <i>Events</i>	58
2.1.2. <i>Laws</i>	64
2.2. Terminance	67
2.2.1. <i>Causal Contribution</i>	75
2.2.2. <i>Trivial Terminance</i>	76
2.3. The Space-time Arena	79
2.4. Classical Gravitation	82
2.4.1. <i>Galilean Space-time</i>	82
2.4.2. <i>Terminants in Classical Gravitation</i>	83
2.4.3. <i>Overdetermination in Classical Gravitation</i>	85
2.4.4. <i>Instantaneous Causation</i>	87
2.5. Relativistic Electromagnetism	89
2.5.1. <i>Minkowski Space-time</i>	89
2.5.2. <i>Terminants in Relativistic Electromagnetism</i>	91
2.5.3. <i>Classical Unified Field Theory</i>	92

- 2.6. Content Independence 94
- 2.7. Continuity and Shielding 98
- 2.8. Transitivity 100
- 2.9. Determinism 101
- 2.10. Stochastic Indeterminism 104
  - 2.10.1. *Stochastic Lattices* 104
  - 2.10.2. *A Toy Theory of Particle Decay* 105
- 2.11. Non-stochastic Indeterminism 107
  - 2.11.1. *Newtonian Indeterminism* 107
  - 2.11.2. *Contribution Extended* 109
- 2.12. General Relativity 109
  - 2.12.1. *Spatio-temporal Indeterminism* 110
  - 2.12.2. *Closed Time-like Curves* 111
- 2.13. Quantum Mechanics 112
  - 2.13.1. *The Quantum Arena and its Contents* 112
  - 2.13.2. *Bohmian Mechanics* 113
  - 2.13.3. *Spontaneous Collapse Interpretations* 114
  - 2.13.4. *Other Interpretations of Quantum Mechanics* 116
- 2.14. Summary 116

## PART II The Middle Conceptual Layer of Causation

- 3. Counterfactuals and Difference-making 121
  - 3.1. General Causation 121
  - 3.2. Counterfactuals 123
  - 3.3. Goodman's Account of Counterfactuals 124
  - 3.4. The Nomic Conditional 128
  - 3.5. Comparison to Ordinary Language Conditionals 134
  - 3.6. Prob-dependence 135
  - 3.7. Contrastive Events 136
  - 3.8. Summary 138
  
- 4. Derivative Causation 140
  - 4.1. Influence 140
  - 4.2. Prob-influence 142
  - 4.3. General Causation 144
  - 4.4. Temporally Extended Events 150
  - 4.5. Idiomatic Differences between Promotion and Causation 152
  - 4.6. Aspect Promotion 154
  - 4.7. Promotion by Omission 155
  - 4.8. Contrastivity 155
  - 4.9. Transitivity 157
  - 4.10. Continuity 160
  - 4.11. Shielding 161
  - 4.12. Partial Influence 162
  - 4.13. Summary 167

<b>5. The Empirical Content of Promotion</b>	<b>168</b>
5.1. The Promotion Experiment	169
5.2. Insensitivity Considerations	171
5.3. Thermodynamics and Statistical Mechanics	175
5.4. The Asymmetry of Bizarre Coincidences	184
5.5. The Analogy to Thermal and Mechanical Energy	186
5.6. Broad and Narrow Promotion	187
5.7. Inferences from Empirical Data to Promotion	193
5.7.1. <i>Simpson's Paradox</i>	194
5.8. Why There Are Effective Strategies	197
5.9. Mechanistic Theories of Causation	199
<b>6. Backtracking Influence</b>	<b>203</b>
6.1. The Direction of Influence	205
6.2. Proof of Causal Directness	207
6.3. A Search for Empirical Phenomena	214
6.4. 'Past-directed then Future-directed' Influence	219
<b>7. Causal Asymmetry</b>	<b>225</b>
7.1. The Empirical Content of the Causal Asymmetry	226
7.2. Causation and Advancement	230
7.3. An Explanation of the Advancement Asymmetry	232
7.3.1. <i>Prob-influence through Backtracking</i>	234
7.3.2. <i>Directly Past-directed Prob-influence</i>	236
7.3.3. <i>Summary</i>	238
7.4. Pseudo-backtracking Prob-influence	239
7.5. The Entropy Asymmetry and Causal Directionality	244
7.6. Recent Alternative Explanations of Causal Asymmetry	249
7.6.1. <i>The Albert-Kutach-Loewer Approach</i>	250
7.6.2. <i>The Price-Weslake Approach</i>	252
7.6.3. <i>The Fork Asymmetry Approach</i>	254
7.7. Fundamental Influence Asymmetry	257
7.7.1. <i>Fundamental Influence Asymmetry by Fiat</i>	258
7.7.2. <i>Fundamental Influence Asymmetry by Happenstance</i>	260
7.8. Summary	262

### PART III The Top Conceptual Layer of Causation

<b>8. Culpable Causation</b>	<b>265</b>
8.1. The Empirical Insignificance of Culpability	270
8.1.1. <i>Part I: Singular Causation</i>	271
8.1.2. <i>Part II: General Causation</i>	272
8.2. Culpability as a Heuristic for Learning about Promotion	275
8.3. Culpability as an Explanatory Device	277
8.4. Culpability as a Proxy for Termination and Promotion	277
8.5. Commentary	281

<b>9. The Psychology of Culpable Causation</b>	<b>282</b>
9.1. The Toy Theory of Culpable Causation	284
9.2. Culpability <sub>1</sub>	287
9.2.1. <i>Saliency</i>	287
9.2.2. <i>Irreflexivity</i>	289
9.2.3. <i>Asymmetry</i>	289
9.2.4. <i>Significant Promotion</i>	290
9.3. Shortcomings of Culpability <sub>1</sub>	291
9.3.1. <i>Precise Character of the Effect</i>	291
9.3.2. <i>Overlapping Causation</i>	291
9.3.3. <i>Probability-Lowering Causes</i>	292
9.4. Culpability <sub>2</sub>	292
9.5. Shortcomings of Culpability <sub>2</sub>	297
9.5.1. <i>Saved Fizzles</i>	298
9.5.2. <i>Early Cutting Preemption</i>	298
9.5.3. <i>Late Cutting Preemption</i>	298
9.6. Culpability <sub>3</sub>	299
9.7. Culpability <sub>4</sub>	300
9.8. Summary	305
<b>10. Causation in a Physical World</b>	<b>307</b>
10.1. Summary	307
10.2. Future Directions	312
References	321
Index	329