

Contents

<i>Detailed Contents</i>	xvi
<i>List of Figures and Tables</i>	xix
1. Introduction: Starting with Neuroscience	i
2. Explanation and Causal Relevance	21
3. Causal Relevance and Manipulation	63
4. The Norms of Mechanistic Explanation	107
5. A Field-Guide to Levels	163
6. Nonfundamental Explanation	196
7. The Mosaic Unity of Neuroscience	228
<i>Bibliography</i>	272
<i>Index</i>	293

Detailed Contents

<i>List of Figures and Tables</i>	xix
1. Introduction: Starting with Neuroscience	I
1. Introduction	I
2. Explanations in Neuroscience Describe Mechanisms	2
3. Explanations in Neuroscience are Multilevel	9
4. Explanations in Neuroscience Integrate Multiple Fields	16
5. Criteria of Adequacy for an Account of Explanation	19
2. Explanation and Causal Relevance	21
1. Introduction	21
2. How Calcium Explains Neurotransmitter Release	22
3. Explanation and Representation	28
4. The Covering-Law Model	34
5. The Unification Model	40
6. But What About the Hodgkin and Huxley Model?	49
7. Conclusion	61
3. Causal Relevance and Manipulation	63
1. Introduction	63
2. The Mechanism of Long-Term Potentiation	65
3. Causation as Transmission	72
3.1. Transmission and causal relevance	78
3.2. Omission and prevention	80
4. Causation and Mechanical Connection	86
5. Manipulation and Causation	93
5.1. Invariance, fragility, and contingency	99
5.2. Manipulation and criteria for explanation	100
5.3. Manipulation, omission, and prevention	104
6. Conclusion	105

4. Causal Powers at Higher Levels of Mechanisms	211
5. Causal Relevance at Higher Levels of Realization	217
6. Conclusion	227
7. The Mosaic Unity of Neuroscience	228
1. Introduction	228
2. Reduction and the History of Neuroscience	233
2.1. LTP's origins: not a top-down search but intralevel integration	237
2.2. The mechanistic shift	240
2.3. Mechanism as a working hypothesis	243
3. Intralevel Integration and the Mosaic Unity of Neuroscience	246
3.1. The space of possible mechanisms	247
3.2. Specific constraints on the space of possible mechanisms	248
3.2.1. Componency constraints	249
3.2.2. Spatial constraints	251
3.2.3. Temporal constraints	253
3.2.4. Active constraints	254
3.3. Reduction and the intralevel integration of fields	255
4. Interlevel Integration and the Mosaic Unity of Neuroscience	256
4.1. What is interlevel integration?	256
4.2. Constraints on interlevel integration	258
4.2.1. Accommodative constraints	259
4.2.2. Spatial and temporal interlevel constraints	261
4.2.3. Interlevel manipulability constraints	264
4.3. Mosaic interlevel integration	266
5. Conclusion: The Epistemic Function of the Mosaic Unity of Neuroscience	267
<i>Bibliography</i>	272
<i>Index</i>	293

List of Figures and Tables

Figures

1.1.	A phenomenon and its mechanism	7
2.1.	The action potential	50
2.2.	Predicted and observed action potentials	52
2.3.	Predicted and observed rising phases of action potentials	53
3.1.	Potentiation displayed	67
3.2.	A sketch of the synaptic mechanism of LTP	71
3.3.	Two aspects of causal-mechanical explanation	74
3.4.	An ideal intervention on X with respect to Y	97
4.1.	The equivalent circuit model of the neuronal membrane	115
4.2.	The action potential superimposed on a graph of changes in the membrane's conductance for Na^+ and K^+	116
4.3.	Hille's how-possibly mechanisms for gating channels	118
4.4.	Transmembrane regions of the Na^+ channel	120
4.5.	A plausible mechanism for activating Na^+ channels	120
4.6.	A phenomenon and its mechanism	121
4.7a.	Abstract representation of an experiment for testing etiological (causal) relevance	145
4.7b.	Abstract representation of experiments for testing constitutive (or componential) relevance	146
5.1.	Levels of spatial memory	166
5.2.	A textbook depiction of LTP	168
5.3.	A taxonomy of levels	171
5.4.	Wimsatt's branching diagram of levels	174
5.5.	Churchland and Sejnowski's classic diagram of levels in neuroscience	180
5.6.	Levels as local maxima of regularity and predictability	181
5.7.	Three levels of mechanisms	189

5.8. Levels are defined locally within decomposition hierarchies	194
7.1. Integrating levels of mechanisms	257

Tables

4.1. Common filler terms in neuroscience	113
7.1. Intralevel and interlevel constraints on multilevel mechanisms	249