

THE DEVIL IN THE DETAILS

Asymptotic Reasoning in Explanation,
Reduction, and Emergence

Robert W. Batterman

OXFORD
UNIVERSITY PRESS

2002

Contents

1	Introduction	3
2	Asymptotic Reasoning	9
2.1	The Euler Strut	9
2.2	Universality	13
2.3	Intertheoretic Relations	17
2.4	Emergence	19
2.5	Conclusion	22
3	Philosophical Theories of Explanation	23
3.1	Different Why-Questions	23
3.2	Hempelian Explanation and Its Successors	25
3.3	Conclusion	35
4	Asymptotic Explanation	37
4.1	The Renormalization Group (RG)	37
4.2	The General Strategy	42
4.3	"Intermediate Asymptotics"	44
4.4	Conclusion: The Role of Stability	57
5	Philosophical Models of Reduction	61
5.1	Nagelian Reduction	62
5.2	Multiple Realizability	65
5.3	Kim's "Functional Model of Reduction"	68
5.4	A Metaphysical Mystery	71
5.5	Multiple Realizability as Universality	73
5.6	Conclusion	76
6	Intertheoretic Relations—Optics	77
6.1	"Reduction ₂ "	78
6.2	Singular Limits	80
6.3	Wave and Ray Theories	81
6.4	Universality: Diffraction Catastrophe Scaling Laws	93

6.5	Conclusion	95
7	Intertheoretic Relations—Mechanics	99
7.1	Classical and Quantum Theories	100
7.2	The WKB Method	104
7.3	Semiclassical “Emergents”	109
7.4	Conclusion	110
8	Emergence	113
8.1	Emergence and the Philosophy of Mind	114
8.2	The Rainbow Revisited: An Example of Emergence?	115
8.3	A New Sense of Emergence	121
8.4	Tenet 5: Novel Causal Powers?	126
8.5	Conclusion	128
9	Conclusions	131
	Bibliography	137
	Index	141