

Contents

1	Boundaries of Scientific Thought	1
	Ian T. Durham	
1.1	Introduction	1
1.2	Objective Reality	2
1.2.1	Relativity	2
1.2.2	Locality	4
1.2.3	Realism	6
1.2.4	Local Realism	8
1.2.5	Comprehensibility and Computability	9
1.3	Mathematics and Computation	10
1.3.1	Mathematical Formalism and Representability	11
1.3.2	Mathematical Platonism	14
1.3.3	Mathematics as Language	15
1.4	Physical Laws and the Nature of Scientific Discovery	18
1.4.1	Physical Laws as Relational Structures	19
1.4.2	The Evolution of Physical Laws	20
1.4.3	Further Considerations	22
1.5	Limits on Knowledge	24
1.5.1	Classical Measurement Limits	24
1.5.2	Quantum Measurement Limits	27
1.5.3	The Physical Universe	28
1.5.4	Interpretation and Extrapolation	30
1.6	Conclusion	31
	References	32
2	Eddington's Limits of Knowledge: The Role of Religion	35
	Matthew Stanley	
2.1	Thinking About Science and Religion	35
2.2	Types of Interactions	36
2.2.1	Restriction	36
2.2.2	Inspiration	37

2.2.3	Natural Theology.....	37
2.3	Science and Values.....	38
2.3.1	Pacifism and Internationalism.....	39
2.3.2	Seeking.....	40
2.4	Experience.....	41
2.5	Information and Interaction.....	43
2.6	Conclusion.....	44
	References.....	44
3	Eddington's Dream: A Failed Theory of Everything	45
	Helge Kragh	
3.1	Introduction.....	45
3.2	Warming up.....	46
3.3	Eddington Meets the Dirac Equation.....	47
3.4	Constants of Nature.....	49
3.5	Fundamental Theory.....	51
3.6	Cosmo-Physics.....	53
3.7	Nature as a Product of the Mind.....	54
3.8	Quantum Objections.....	55
	References.....	57
4	All Possible Perspectives: A (Partial) Defence of Eddington's Physics	59
	Dean Rickles	
4.1	Eddington's Tarnished Reputation.....	59
4.2	Eddingtonian <i>A Priori</i> and <i>A Posteriori</i> : <i>Quis Custodiet Ipsos Custodes?</i>	60
4.3	Going Soft on Truth?.....	62
4.4	Eliminating All Possible Perspectives: The Epistemological Purge?.....	63
4.5	Postulates of Impotence.....	64
4.6	From Pure Numbers to Eddington's Principle.....	65
4.7	How Do the Deductions Work?.....	67
4.8	<i>Real</i> Observability and Measurability Analysis.....	68
4.9	Conclusion.....	71
	References.....	72
5	Tracing the Arrows of Time	73
	Friedel Weinert	
5.1	Introduction.....	73
5.2	Cosmic Arrows.....	76
5.3	Eddington and the Arrow of Time.....	79
5.4	Phase Space and Typicality.....	82
5.4.1	Kinematics I: Phase Space Arguments.....	84
5.4.2	Kinematics II: Typicality Arguments.....	87

5.5	Dynamic Considerations	89
5.5.1	Local Arrows	90
5.5.2	The Global Arrow of Time	93
5.5.3	A Master Arrow of Time?	97
5.6	Conclusion	98
	References	99
6	Constructor Theory of Information	103
	Chiara Marletto	
	References	110
7	On Participatory Realism	113
	Christopher A. Fuchs	
7.1	“QBism as Realism,” to Steve Weinberg, 7 August 2015	116
7.2	“Realisms,” to Adán Cabello, 28 July 2015	117
7.3	“Slicing the Euglena’s Tail,” to Adán Cabello, 28 July 2015	126
7.4	“Denouement,” to Johannes Kofler, 6 October 2014	127
	Appendix: Transcription from John Wheeler’s Notebook	128
	References	129
8	Toward Physical Realizations of Thermodynamic Resource Theories	135
	Nicole Yunger Halpern	
8.1	Introduction	135
8.2	Technical Introduction	136
8.2.1	Resource Theories	136
8.2.2	Thermodynamic Resource Theories	137
8.2.3	One-Shot Statistical Mechanics	138
8.3	Opportunities in Physically Realizing Thermodynamic Resource Theories	141
8.3.1	What Merits Realization? How, in Principle, Can We Realize It?	142
8.3.2	Enhancing TRTs’ Realism	148
8.3.3	More-Out-of-the-Way Opportunities	159
8.4	Conclusions	162
	References	163
9	Merging Contradictory Laws: Imagining a Constructive Derivation of Quantum Theory	167
	William K. Wootters	
9.1	Introduction	167
9.2	Quantum Theory of Preparations and Measurements	169
9.3	The Toy Model: Merging Contradictory Classical Laws	170
9.3.1	The Case $n = 3$	173
9.3.2	The Case $n = m$	174

9.4	Discussion	177
	References.	180
10	Understanding the Electron	181
	Kevin H. Knuth	
10.1	Introduction	181
10.2	Electron Properties	182
10.3	Influence.	183
10.4	Coarse-Grained Picture of Influence	186
	10.4.1 Intervals: Duration and Directed Distance	186
	10.4.2 Motion and Velocity	189
	10.4.3 Rates: Energy, Momentum and Mass	191
10.5	Fine-Grained Picture of Influence	193
	10.5.1 Zitterbewegung	193
	10.5.2 Influence Sequences: Further Quantum Effects	196
	10.5.3 The Feynman Checkerboard Model and the Dirac Equation.	201
10.6	Discussion	203
	References.	205
Index		209