

Contents

1	What Are the Issues Raised by Quantum Mechanics?	1
1.1	Historical Background*	10
1.1.1	Pre-quantum Physics	10
1.1.2	Quantum Physics	12
1.2	Outline of the Book	14
2	The First Mystery: Interference	17
2.1	The Double-Slit Experiment	18
2.2	Delayed Choices	25
2.3	Summary	28
3	“Philosophical” Intermezzo I: What Is Determinism?	31
3.1	Definitions	31
3.1.1	Determinism and Randomness	31
3.1.2	Determinism and Predictability	34
3.2	Determinism and Physics	36
3.3	Determinism and Free Will	38
3.4	Probabilities and Determinism	41
3.4.1	The Law of Large Numbers*	42
3.5	Summary	46
4	How Do Physicists Deal with Interference?	49
4.1	The Wave Function	49
4.2	The Double-Slit Experiment	57

4.3	Einstein's Early Worries	61
4.4	Heisenberg's Inequality or "Uncertainty Principle"	63
4.5	Conclusions	65
4.6	Summary	65
5	Schrödinger's Cat and Hidden Variables	69
5.1	The Problem of Schrödinger's Cat	69
5.2	Hidden Variables	76
5.3	A Deeper Problem: What There Is	79
5.4	Conclusions	80
5.5	Summary	82
6	"Philosophical" Intermezzo II: What Is Wrong with "Observations"?	87
6.1	Realism Versus Idealism	88
6.2	Scientific Realism and "Observations"	91
6.3	Realism and Quantum Mechanics	95
6.4	Conclusions	98
6.5	Summary	99
7	The Second Mystery: Nonlocality	101
7.1	Introduction	101
7.2	Einstein's Boxes	102
7.3	What Is Nonlocality?	106
7.4	A Simple Proof of Nonlocality	108
	7.4.1 An Anthropomorphic Thought Experiment	108
	7.4.2 The Real Quantum Experiment	113
7.5	The Meaning of the EPR-Bell Argument	118
7.6	Applications of Quantum Mechanics and of EPR-Bell	121
	7.6.1 Quantum Cryptography	122
	7.6.2 Quantum Teleportation	124
	7.6.3 Quantum Computers	125
7.7	The Trouble with Relativity*	127
7.8	Summary	131

8	How to Do “The Impossible”, a Quantum Mechanics Without Observers: The de Broglie–Bohm Theory	137
8.1	Introduction	137
8.2	The de Broglie–Bohm Theory in a Nutshell	139
8.3	How Do “Measurements” Work in the de Broglie–Bohm Theory?	146
8.3.1	“Measurements” of Velocities in the de Broglie–Bohm Theory	147
8.4	Things Not Discussed in Detail	148
8.4.1	Why Isn’t the de Broglie–Bohm Theory Refuted by the No Hidden Variables Theorem?	149
8.4.2	Where Does “Randomness” Come from in the de Broglie–Bohm Theory?*	150
8.4.3	What About the Collapse of the Wave Function?*	154
8.5	Is It that Simple?*	157
8.6	A Last Look at Traditional Questions	158
8.6.1	So, Does God Play Dice After All?	158
8.6.2	Is Quantum Mechanics Complete?	160
8.7	Conclusion: The Merits of the de Broglie–Bohm Theory	161
8.8	Summary	164
9	Many Worlds?	173
9.1	Alternatives to the de Broglie–Bohm Theory	173
9.2	The Many-Worlds Interpretation	175
9.3	Critique of the Many-Worlds Interpretation	178
9.4	Summary	182
10	A Revised History of Quantum Mechanics	183
10.1	The Bohr–Einstein Debate	184
10.1.1	What Was the Debate Really About?	184
10.1.2	The “Bolt from the Blue”: The Einstein–Podolsky–Rosen Argument	188
10.2	Born and Schrödinger	191
10.3	Misunderstandings of Bell	195
10.4	The Non-reception of de Broglie’s and Bohm’s Ideas	199
10.4.1	The Tragic History of de Broglie	199
10.4.2	David Bohm: Dissident and Outcast	201
10.5	Summary and Conclusions	206

11	The Cultural Impact of Quantum Mechanics	209
11.1	Introduction	209
11.2	Quantum Mechanics and Pseudo-science	210
11.3	Quantum Mechanics and Eastern Mysticism	214
11.4	Quantum Mechanics and God	217
11.5	Quantum Mechanics and Philosophy	223
	11.5.1 Quantum Mechanics and the “Mind-Body Problem”	223
	11.5.2 Quantum Mechanics and “Positivism”	226
	11.5.3 Quantum Mechanics and “Postmodernism”	227
11.6	Quantum Mechanics, Ideology and Politics	229
	11.6.1 Quantum Mechanics and Marxism	229
	11.6.2 Quantum Mechanics and the Cold War Mentality	232
11.7	‘Abuses’ of Quantum Mechanics in the Human Sciences	235
11.8	A Plea for Modesty and for a Separation of Domains	238
12	Summary of the Main Theses of This Book	243
	Glossary	249
	Further Reading	261
	Bibliography	267
	Index	279



<http://www.springer.com/978-3-319-65270-2>

Quantum Sense and Nonsense

Bricmont, J.

2017, XII, 286 p. 50 illus., 18 illus. in color., Softcover

ISBN: 978-3-319-65270-2