# Contents

Philosophical Reflections and Syntheses
Annotation by Gérard G. Emch ..... 1

## PART I

### Epistemology of Quantum Mechanics

Discussion: Comments on Professor Putnam's Comments (with H. Margenau) ..... 31
Two Kinds of Reality ..... 33
Epistemology of Quantum Mechanics ..... 48
Epistemological Perspective on Quantum Theory ..... 55
Reality and Quantum Mechanics / Realität und Quantenmechanik ..... 72
Interpretation of Quantum Mechanics ..... 78
The Limitations of Determinism ..... 133
The Nonrelativistic Nature of the Present Quantum Mechanical Measurement Theory ..... 139

## PART II

### Quantum-Mechanical Measuring Process

The Measurement of Quantum-Mechanical Operators / Die Messung quantenmechanischer Operatoren ..... 147
Theory of Quantum-Mechanical Measurement / Theorie der quantenmechanischen Messung ..... 155
The Problem of Measurement ..... 163
Some Comments Concerning Measurements in Quantum Mechanics (with J.M. Jauch and M.M. Yanase) ..... 181
On the Change of the Skew Information in the Process of Quantum-Mechanical Measurements (with A. Frenkel and M. Yanase) 189
The Subject of Our Discussions ..... 199
The Philosophical Problem ..... 218
Questions of Physical Theory ..... 221

On Bub's Misunderstanding of Bell's Locality Argument (with S. Freedman) ..... 223
Review of the Quantum-Mechanical Measurement Problem ..... 225

## PART III

### Consciousness

Remarks on the Mind-Body Question ..... 247
The Place of Consciousness in Modern Physics ..... 261
New Dimensions of Consciousness ..... 268
The Existence of Consciousness ..... 274

## PART IV

### Symmetries

Invariance in Physical Theory ..... 283
On the Law of Conservation of Heavy Particles ..... 294
Symmetry and Conservation Laws ..... 297
The Role of Invariance Principles in Natural Philosophy ..... 311
Events, Laws of Nature, and Invariance Principles (Nobel address) ..... 321
Events, Laws of Nature, and Invariance Principles ..... 334
Violations of Symmetry in Physics ..... 343
Symmetry Principles in Old and New Physics ..... 359
Symmetry in Nature ..... 382

## PART V

### Relativity

Relativistic Invariance and Quantum Phenomena ..... 415
Relativistic Equations in Quantum Mechanics ..... 446

## PART VI

### Nuclear Physics

On the Development of the Compound Nucleus Model ..... 459
Summary of the Conference (Properties of Nuclear States, Montreal 1969) 476
Summary of the Conference (Polarization Phenomena, Madison 1971) .. 487
Introductory Talk (Statistical Properties of Nuclei) ..... 494
Concluding Remarks (Symmetry Properties of Nuclei, Solvay Conference 1970) ..... 508

# PART VII

## Broader Philosophical Essays

The Limits of Science ..... 523
The Unreasonable Effectiveness of Mathematics in the Natural Sciences ..... 534
The Growth of Science – Its Promise and Its Dangers ..... 550
Physics and the Explanation of Life ..... 564
On Some of Physics' Problems ..... 578
Physics and Its Relation to Human Knowledge ..... 584
The Problems, Future and Limits of Science ..... 594
The Extension of the Area of Science ..... 603
The Glorious Days of Physics ..... 610
Some Problems of Our Natural Sciences ..... 616

**Bibliography** ..... 627