

Contents

Preface	ix
Acknowledgements	xiv
Remarks on the Development of the Gravitational and Yang–Mills Fields, and Accelerated Frames	xix
Chapter 1	The Dawn of Gravitation
A	The Mathematical Principles of Natural Philosophy (Extract) 2
	Rules of Reasoning in Philosophy Phenomena, or Appearances
	<i>I. Newton</i> (Transl. <i>A. Motte</i>)
B	On the Dynamics of the Electron (Extract) 13
	Introduction, Hypotheses Concerning Gravitation
	<i>H. Poincaré</i> (Transl. <i>G. Pontecorvo</i> , Commentary by <i>A. A. Logunov</i>)
C	On the Relativity Principle and the Conclusions Drawn from It (Extract) 33
	<i>A. Einstein</i> (Transl. <i>A. Beck</i>)
Chapter 2	Einstein's Deepest Insight and Its Early Impacts
A	Outline of a Generalized Theory of Relativity and of a Theory of Gravitation (Extract) 48
	<i>A. Einstein and M. Grossmann</i> (Transl. <i>A. Beck</i>)
B	The Foundation of the General Theory of Relativity 65
	<i>A. Einstein</i> (Transl. <i>W. Perrett and G. B. Jeffery</i>)
C	The Foundation of Physics 120
	<i>D. Hilbert</i> (Transl. <i>D. Fine</i>)
D	On a Generalization of the Concept of Riemann Curvature and Spaces with Torsion 132
	<i>E. Cartan</i> (Transl. <i>A. Fine</i>)
Chapter 3	The Scalar-Tensor Theory of Gravity
A	Formation of the Stars and Development of the Universe 136
	<i>P. Jordan</i>
B	On the Physical Interpretation of P. Jordan's Extended Theory of Gravitation (Extract) 140
	<i>von M. Fierz</i> (Transl. <i>D. Fine</i>)
C	Mach's Principle and a Relativistic Theory of Gravitation (Extract) 142
	<i>C. Brans and R. H. Dicke</i>
Chapter 4	Yang–Mills' Deepest Insight and Its Relation to Gravity
A	Conservation of Isotopic Spin and Isotopic Gauge Invariance 150
	<i>C. N. Yang and R. L. Mills</i>
B	Conservation of Heavy Particles and Generalized Gauge Transformations 155
	<i>T. D. Lee and C. N. Yang</i>
C	Invariant Theoretical Interpretation of Interaction 157
	<i>R. Utiyama</i>
D	Lorentz Invariance and the Gravitational Field 168
	<i>T. W. B. Kibble</i>

Chapter 5	Accelerated Frames: Generalizing the Lorentz Transformations	
A	On Homogeneous Gravitational Fields in the General Theory of Relativity and the Clock Paradox <i>C. Møller</i>	180
B	Physical Consequences of a Co-ordinate Transformation to a Uniformly Accelerating Frame <i>T. Fulton, F. Rohrlich and L. Witten</i>	204
C	The Clock Paradox in the Relativity Theory <i>T. Y. Wu and Y. C. Lee</i>	223
D	Four-dimensional Symmetry of Taiji Relativity and Coordinate Transformations Based on a Weaker Postulate for the Speed of Light (Extract) <i>J. P. Hsu and L. Hsu</i>	240
E	Generalized Lorentz Transformations for Linearly Accelerated Frames with Limiting Four-Dimensional Symmetry <i>J. P. Hsu and L. Hsu</i>	247
F	Generalizing Lorentz Transformations for Accelerated Frames and Their Physical Implications <i>D. T. Schmitt and T. Kleinschmidt</i>	258
Chapter 6	Quantum Gravity and ‘Ghosts’	
A	Quantum Theory of Gravitation <i>R. P. Feynman</i>	272
B	Quantum Theory of Gravity. II The Manifestly Covariant Theory (Extract) <i>B. S. DeWitt</i>	298
C	Quantum Theory of Gravity, III Applications of the Covariant Theory <i>B. S. DeWitt</i>	307
D	Feynman Diagrams for the Yang–Mills Field <i>L. D. Faddeev and V. N. Popov</i>	325
E	Feynman Rules for Electromagnetic and Yang–Mills Fields from the Gauge-Independent Field-Theoretic Formalism (Extract) <i>S. Mendelstam</i>	327
F	<i>S</i> Matrix for Yang–Mills and Gravitational Fields (Extract) <i>E. S. Fradkin and I. V. Tyutin</i>	339
G	Missed Opportunities (Extract, with a brief comment of the author) Introduction, General Coordinate Invariance <i>F. J. Dyson</i>	347
Chapter 7	Gauge Theories of Gravity	
A	Extended Translation Invariance and Associated Gauge Fields <i>K. Hayashi and T. Nakano</i>	354
B	Gravitational Field as a Generalized Gauge Field <i>R. Utiyama and T. Fukuyama</i>	371
C	Integral Formalism for Gauge Fields (with a brief comment) <i>C. N. Yang</i>	387
D	Yang’s Gravitational Field Equations <i>W. T. Ni</i>	391

E	Einstein Lagrangian as the Translational Yang–Mills Lagrangian <i>Y. M. Cho</i>	393
F	De Sitter and Poincaré Gauge-Invariant Fermion Lagrangians and Gravity <i>J. P. Hsu</i>	398
Chapter 8 Alternate Approaches to Gravity: Roads Less Traveled By		
A	Fixation of Coordinates in the Hamiltonian Theory of Gravitation <i>P. A. M. Dirac</i>	402
B	New General Relativity (with Addendum) <i>K. Hayashi and T. Shirafuji</i>	409
C	Relativistic Theory of Gravitation <i>A. A. Logunov and M. A. Mestvirishvili</i>	442
D	Yang–Mills Gravity: A Union of Einstein–Grossmann Metric with Yang–Mills Tensor Fields in Flat Spacetime with Translation Symmetry <i>J. P. Hsu</i>	462
Chapter 9 Experimental Tests of Gravitational Theories		
A	Empirical Foundations of the Relativistic Gravity <i>W. T. Ni</i>	476
B	Binary Pulsars and Relativistic Gravity <i>J. H. Taylor, Jr.</i>	494
Chapter 10 Other Perspectives		
A	Concept of Nonintegrable Phase Factors and Global Formulation of Gauge Fields (Extract) <i>T. T. Wu and C. N. Yang</i>	504
B	Gauge Fields <i>R. L. Mills</i>	512
C	Magnetic Monopoles, Fiber Bundles, and Gauge Fields <i>C. N. Yang</i>	527
D	Gauge Theory: Historical Origins and Some Modern Developments <i>L. O’Raifeartaigh and N. Straumann</i>	539
E	String Theory as a Generalization of Gauge Symmetry <i>P.-M. Ho</i>	562
F	The Cosmological Constant Problem <i>S. Weinberg</i>	569
G	The Cosmological Constant and Dark Energy (Extract) <i>P. J. E. Peebles and B. Ratra</i>	592
Appendices		
A	Marcel Grossmann (1878–1936) <i>J. P. Hsu and D. Fine</i>	618
B	Remembering Robert L. Mills <i>S. L. Marateck</i>	622