

# Contents

Preface	vii
1. Introduction	1
2. Steps Towards a New Theory of Gravitation	2
2.1 The Principles of Equivalence and Relativity	2
2.2 Abraham's Objections	4
2.3 Nordström's Theory	
2.4 Einstein and Grossmann: Search for the Mathematical Tools of General Relativity	6
2.5 The Foundation of General Relativity	13
3. Physics and Geometry	17
3.1 The Role of Axiomatization in Hilbert's Work	17
3.2 Concepts of Space and Geometry	18
3.3 Space-Time and Invariants	20
3.4 Mie's Field Theory of Matter	23
3.5 Hilbert's Communication to the Göttingen Academy	24
3.6 Axioms of Hilbert's Theory of Matter	26
3.7 Hilbert's Fundamental Theorem, Energy Conservation and the World Function	27
4. Completion of the Theory of Gravitation	31
4.1 General Covariance and the Equivalence Principle	31
4.2 Theory of the Gravitational Field	33
4.3 Consequences and Applications of the Theory of Gravitation	35
4.4 The Cosmological Term	37
5. Physical Interpretation of General Covariance	39
5.1 Axiom of Physical Interpretability	39
5.2 Restrictions due to Causality	40
5.3 Hilbert's Conclusion	41
6. Hamilton's Principle and the Conservation Laws	42
6.1 Lorentz and the Hamilton Principle in Einstein's Theory	43
6.2 Einstein and the Hamilton Principle	44
7. General Covariance and Conservation Laws	45
7.1 Energy Conservation and the Theory of Invariants	46
7.2 Identities from General Covariance	48
7.3 Bianchi Identities and Hilbert's Constraint Conditions	49

8. Extension of General Relativity	50
8.1 Generalization of Riemannian Geometry	50
8.2 Weyl's Unified Theory	51
8.3 Five-Dimensional Relativity	52
9. 'Ein Bleibender Kern' – An Enduring Core	53
References and Notes	56
Appendix	82
Index of names	87