

EINSTEIN'S THEORY OF RELATIVITY

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649569526

Einstein's Theory of Relativity by Max Born & Henry L. Brose

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Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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MAX BORN & HENRY L. BROSE

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A. Einstein.

EINSTEIN'S THEORY OF RELATIVITY

BY
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WITH 135 DIAGRAMS AND A PORTRAIT

NEW YORK
E. P. DUTTON AND COMPANY
PUBLISHERS

Printed in Great Britain

PHYSICS
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FROM THE PREFACE TO THE FIRST EDITION

THIS book is an elaboration of certain lectures which were given last winter to a somewhat considerable audience. The difficulty which persons not conversant with mathematics and physics experience in understanding the theory of relativity seems to me to be due for the most part to the circumstance that they are not familiar with the fundamental conceptions and facts of physics, in particular of mechanics. During the lectures I therefore showed some quite simple qualitative experiments to serve as an introduction to such conceptions as velocity, acceleration, mass, force, intensity of field, and so forth. In my endeavour to find a similar means, adapted to book purposes, the semi-historical method of representation here chosen occurred to me, and I hope I have succeeded in avoiding the uninspiring method of the elementary text books of physics. But it must be emphasised that the historical arrangement has been selected only as a cloak which is to bring into stronger relief the outline of the main theme, the logical relationship. Having once started this process I found myself compelled to continue, and in this way my undertaking increased to the dimensions of this book.

The reader is assumed to have but little mathematical knowledge. I have attempted to avoid not only the higher mathematics but even the use of elementary functions, such as logarithms, trigonometrical functions, and so forth. Nevertheless, proportions, linear equations, and occasionally squares and square roots had to be introduced. I advise the reader who is troubled with the formulæ to pass them by on the first reading and to seek to arrive at an understanding of the mathematical symbols

from the text itself. I have made abundant use of figures and graphical representations. Even those who are unpractised in the use of co-ordinates will learn to read the curves easily.

The philosophical questions to which the theory of relativity gives rise will only be touched on in this book. Nevertheless a definite logical point of view is maintained throughout. I believe I am right in asserting that this view agrees in the main with Einstein's own opinion. Moritz Schlick takes up a similar view in his valuable work "Allgemeine Erkenntislehre" (The General Theory of Knowledge).

Of the other books which I have used I should like to quote, above all, Ernst Mach's classical "Mechanics" (which has appeared in English), and then the very lucidly written volume by E. T. Whittaker, "A History of the Theories of Aether and Electricity" (London, Longmans, Green & Co., 1910), and the comprehensive account of the Theory of Relativity given by Hermann Weyl in his "Space, Time, Matter" (English translation published by Messrs. Methuen & Co., Ltd., 1922). Anyone who wishes to penetrate further into Einstein's doctrines must study the latter work. It is impossible to enumerate the countless books and essays from which I have drawn more or less directly. In conformity with the character of the book I have refrained from giving references.

MAX BORN

FRANKFURT ON THE MAIN

June, 1920

PREFACE TO THE THIRD EDITION

A PART from a number of minor alterations, this edition differs from its two predecessors in that the chapter on Einsteinian dynamics has been revised. Previously, in forming the acceleration, we did not distinguish sharply between time and proper time, and we used Minkowski's covariant force-vector in place of ordinary force; this of course increased the difficulty of understanding a chapter which was, from the outset, not easy. Dr. W. Pauli, jun., called my attention to a method of deriving the relativistic formula of mass proposed by Lewis and Tolman, which fitted in admirably with the scheme of this book, as it linked up with the conception of momentum in the same way as the account of mechanics here chosen. The chapter on Einsteinian dynamics was revised in conformity with this point of view; this also entailed some alterations in the manner of presenting ordinary mechanics. It is hoped that these changes will simplify the reading.

I should not like to lose this opportunity of thanking Dr. W. Pauli for his advice. His great work on the theory of relativity which has appeared as Article 19 in the fifth volume of the "Enzyklopädie der mathematischen Wissenschaften," which appeared recently, has been of great service to me. It is to be recommended foremost of all to those who wish to become intimately acquainted with the theory of relativity.

MAX BORN

GÖTTINGEN

6th March, 1922

