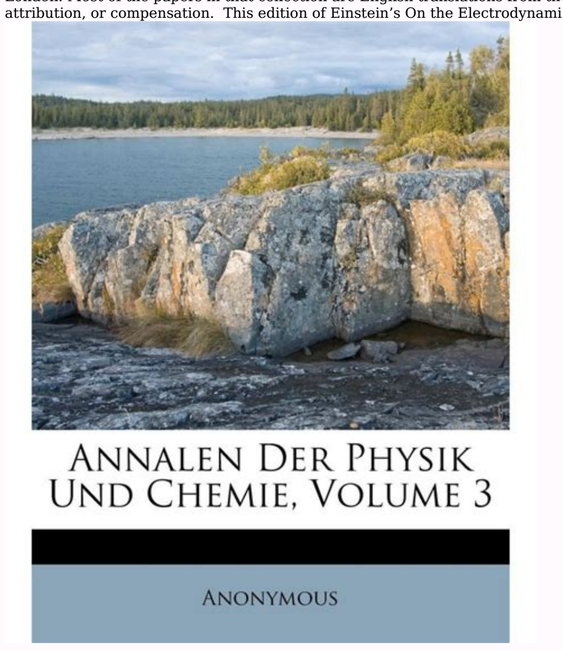


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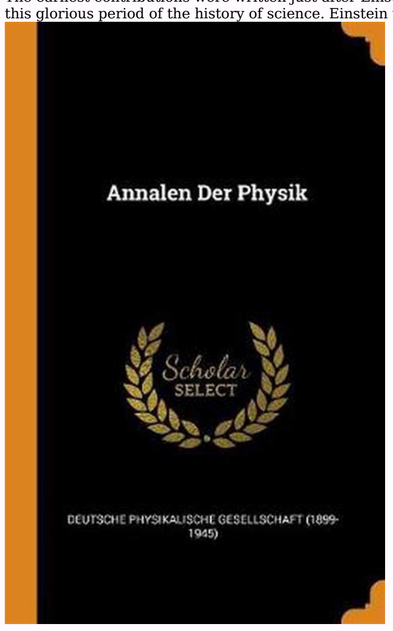
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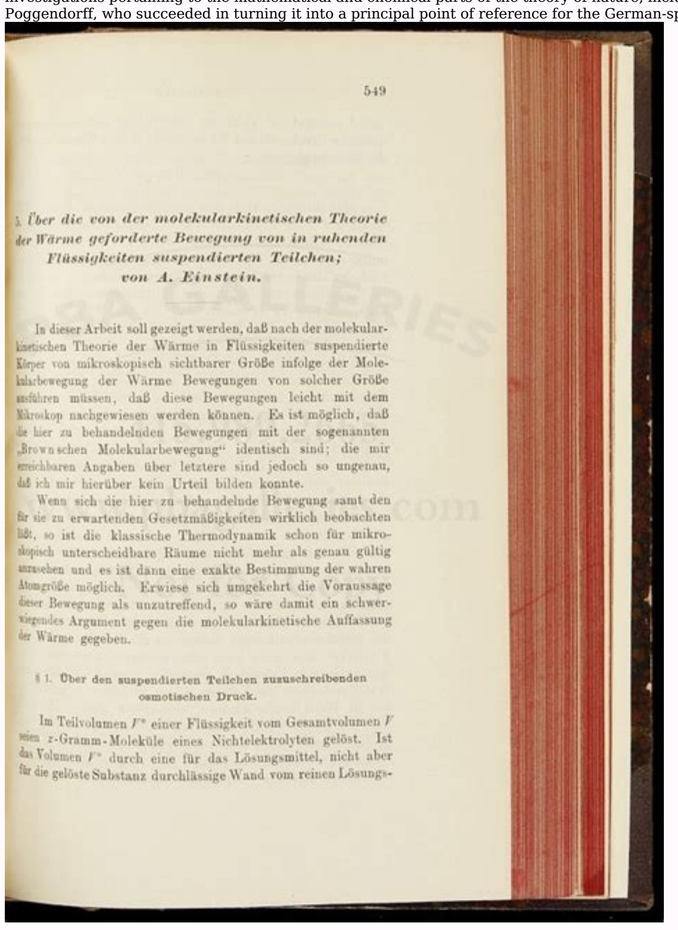
This edition of Einstein’s On the Electrodynamics of Moving Bodies is based on the English translation of his original 1905 German-language paper (published as Zur Elektrodynamik bewegter K¨orper, in Annalen der Physik. 17:891, 1905) which appeared in the book The Principle of Relativity, published in 1923 by Methuen and Company, Ltd. of London. Most of the papers in that collection are English translations from the German Das Relativatsprinzip, 4th ed., published by in 1922 by Tuebner. All of these sources are now in the public domain; this document, derived from them, remains in the public domain and may be reproduced in any manner or medium without permission, restriction, attribution, or compensation. This edition of Einstein’s On the Electrodynamics of Moving Bodies is based on the English translation of his original 1905 German-language paper (published as Zur Elektrodynamik bewegter K¨orper, in Annalen der Physik.



17:891, 1905) which appeared in the book The Principle of Relativity, published in 1923 by Methuen and Company, Ltd. of London. Most of the papers in that collection are English translations from the German Das Relativatsprinzip, 4th ed., published by in 1922 by Tuebner. All of these sources are now in the public domain; this document, derived from them, remains in the public domain and may be reproduced in any manner or medium without permission, restriction, attribution, or compensation. Numbered footnotes are as they appeared in the 1923 edition; editor’s notes are marked by a dagger (†) and appear in sans serif type. The 1923 English translation modified the notation used in Einstein’s 1905 paper to conform to that in use by the 1920’s; for example, c denotes the speed of light, as opposed the V used by Einstein in 1905. This edition was prepared by John Walker. The current version of this document is available in a variety of formats from the editor’s Web site: Introduction Scope of the present volume This volume presents Einstein's 49 contributions to Annalen der Physik, together with four introductory essays based on recent historical studies. The first three essays, by David Cassidy, Jürgen Renn, and Robert Rynasiewicz, discuss key aspects of the scientific revolution triggered by the pathbreaking papers of Einstein's annus mirabilis 1905, which changed our understanding of space, time, matter, and radiation.Various ramifications of these papers are worked out in Einstein's subsequent contributions to the Annalen. These papers document Einstein's further exploration of the quantum hypothesis and the triumphs of statistical physics as well as various stages of Einstein's journey from special to general relativity. General relativity is the subject of the fourth historical essay, by Michel Janssen.
The earliest contributions were written just after Einstein graduated with a teacher's diploma from the Swiss Federal Polytechnic School in Zurich; the latest while Einstein was working in Berlin as a member of the Prussian Academy of Sciences and as director of the Kaiser-Wilhelm Institute of Physics. The rise of Nazism in Germany put an end to this glorious period of the history of science. Einstein was forced to emigrate from Germany in 1933 and was never to return again.



This volume, published in the centenary of Einstein's annus mirabilis, offers the reader a comprehensive overview of the breathtaking scope and depth of the investigations of the towering figure of 20th-century physics, focusing on his most productive years. The dramatically changing historical circumstances under which these papers were written may also serve as a reminder of the fragility of the scientific enterprise and the need both to reflect on its contexts and to strengthen it by civil courage, just as Einstein has taught us. 1 Foundation and role of the Annalen The Annalen der Physik, one of the most influential journals in the history of physics, was founded in 1790 by Friedrich Albert Carl Gren, a professor of physics and chemistry at Halle University. As is described in the masterful account of the rise of theoretical physics by Christa Jungnickel and Russel McCormmach (Intellectual Mastery of Nature, University of Chicago Press), the original mission of the Annalen was to familiarize its German-speaking readership with the results of investigations pertaining to the mathematical and chemical parts of the theory of nature, including reports from other journals, foreign as well as German. From the outset, the spirit of the journal was international and integrative and continued to be so under the subsequent editors, in particular Ludwig Wilhelm Gilbert and Johann Christian Poggendorff, who succeeded in turning it into a principal point of reference for the German-speaking scientific community in physics and chemistry, which included not only university professors, but also teachers, doctors, and apothecaries. Original contributions published in the Annalen were soon translated or reported in foreign journals.



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Über die von der molekularkinetischen Theorie der Wärme geforderte Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen;
von A. Einstein.

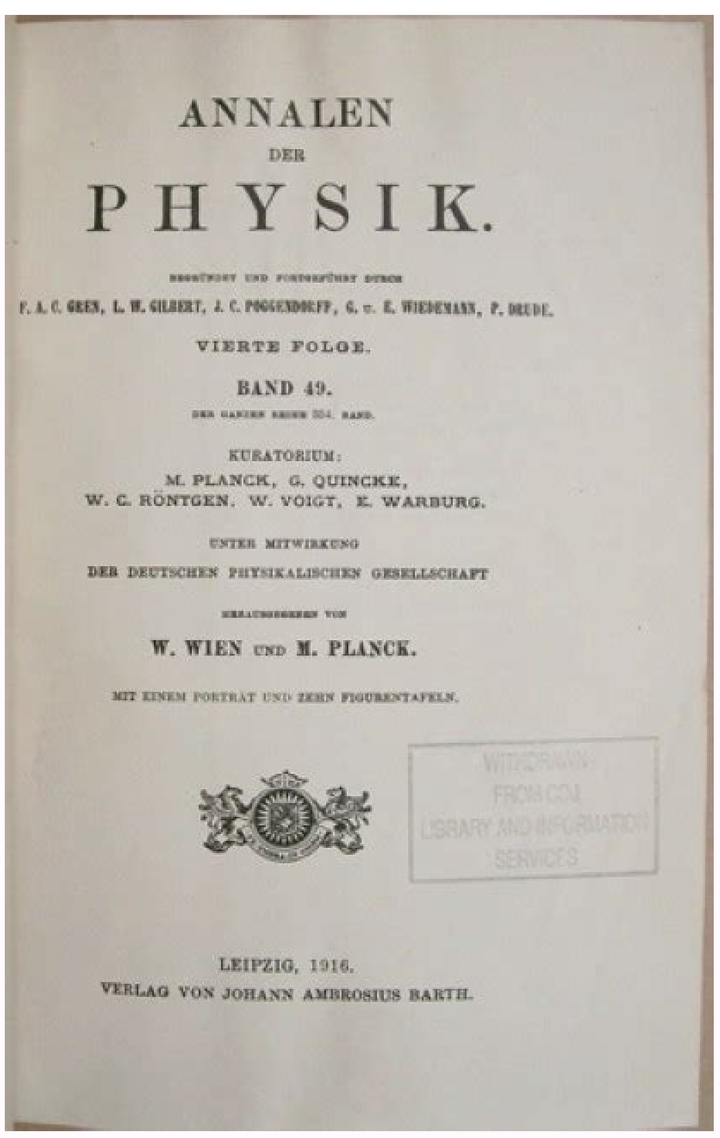
In dieser Arbeit soll gezeigt werden, daß nach der molekularkinetischen Theorie der Wärme in Flüssigkeiten suspendierte Körper von mikroskopisch sichtbarer Größe infolge der Molekularbewegung der Wärme Bewegungen von solcher Größe ausführen müssen, daß diese Bewegungen leicht mit dem Mikroskop nachgewiesen werden können. Es ist möglich, daß die hier zu behandelnden Bewegungen mit der sogenannten „Brownschen Molekularbewegung“ identisch sind; die mir erreichbaren Angaben über letztere sind jedoch so ungenau, daß ich mir hierüber kein Urteil bilden konnte.

Wenn sich die hier zu behandelnde Bewegung samt den für sie zu erwartenden Gesetzmäßigkeiten wirklich beobachten läßt, so ist die klassische Thermodynamik schon für mikroskopisch unterscheidbare Räume nicht mehr als genau gültig anzusehen und es ist dann eine exakte Bestimmung der wahren Atomgröße möglich. Erwiese sich umgekehrt die Voraussage dieser Bewegung als unzutreffend, so wäre damit ein schwerwiegendes Argument gegen die molekularkinetische Auffassung der Wärme gegeben.

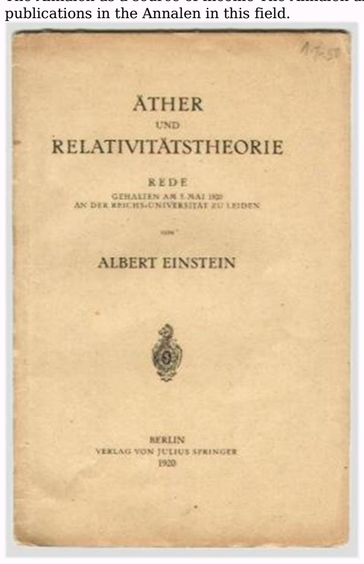
§ 1. Über den suspendierten Teilchen zuzuschreibenden osmotischen Druck.

Im Teilvolumen V^* einer Flüssigkeit vom Gesamtvolumen V seien z-Gramm-Moleküle eines Nichtelektrolyten gelöst. Ist das Volumen V^* durch eine für das Lösungsmittel, nicht aber für die gelöste Substanz durchlässige Wand vom reinen Lösungs-

In spite of the rising specialization, the editors paid close attention to the interconnections between the broad variety of subjects treated in the articles. While the emphasis was on experimental work, the rising significance of theoretical contributions was acknowledged as well. The wide distribution of the Annalen, whichwas available not only in university libraries, but also in secondary and technical schools, furthered the formation of a broadly accessible scientific culture. Accordingly, the Annalen remained open to contributions not only from established physicists and institute directors, but also to articles submitted by students, assistants, and teachers. Its role as an intellectual reference point was reinforced by the foundation of the Beiblätter, which offered brief reports on work not published in the Annalen. The subjects treated in the Annalen over the years reflect the development of research in 19th century physics and chemistry. Under the editorship of Gustav Wiedemann, who took office after Poggendorff's death in 1877, the broad perspective of the journal was maintained and occasionally even included articles on the history of science. All in all, the journal was transformed into a means of communication oriented towards the increasingly professionalized community of physicists. Yet the growing hints at the existence and relevance of a microworld of atoms and molecules for the understanding of nature kept alive the promise of unity in the dispersive multitude of results published in the Annalen. The Annalen as food for thought This was roughly the situation when the young Einstein began to avidly study the Annalen, which had been edited since 1900 by Paul Drude. Drude's work on an atomistic theory of conduction in metals was of special interest to Einstein and the precocious young student even entered into a controversy with Drude.


ANNALEN
DER
PHYSIK.
BEGRÜNDET UND FORTGEFÜHRT DURCH
F. A. C. GREN, L. W. GILBERT, J. C. POGGENDORFF, G. v. E. WIEDEMANN, P. DRUDE.
VIERTE FOLGE.
BAND 49.
DER GANZEN REIHE 354. BAND.
KURATORIUM:
M. PLANCK, G. QUINCKE,
W. C. RÖNTGEN, W. VOIGT, E. WARBURG.
UNTER MITWIRKUNG
DER DEUTSCHEN PHYSIKALISCHEN GESELLSCHAFT
HERAUSGEGEBEN VON
W. WIEN UND M. PLANCK.
MIT EINEM PORTRÄT UND ZEHN FIGURENTAFELN.
LEIPZIG, 1916.
VERLAG VON JOHANN AMBROSIUS BARTH.
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Einstein's originality is often attributed to his autodidactic training. But the possibility to learn independently obviously very much depends on the availability of appropriate reading material.
Although academically isolated, it was the Annalen that offered Einstein an up-to-date overview of contemporary physics, stimulating many of the original ideas he pursued during his student days and his time at the Swiss patent office in Bern. His contemporary correspondence suggests that he often believed he just had to put the pieces of a puzzle together in order to achieve a breakthrough, pieces he often found in papers he read in the Annalen. Apart from Drude's work on the electron theory of metals, which eventually stimulated Einstein's development of statistical mechanics, he also read Max Planck's work on black-body radiation and Philipp Lenard's studies of the photoelectric effect, which triggered his work on the light quantum hypothesis. Also Wien's report on the problematic attempts to detect the translatory motion of the ether offered an important stepping stone towards the rejection of the ether and the formulation of the special theory of relativity.
The Annalen as a source of income The Annalen also served as a source of modest additional income for Einstein, who wrote more than twenty reports for its Beiblätter - mainly on the theory of heat - thus demonstrating an impressive mastery of the contemporary literature. This activity started in 1905 and probably resulted from his earlier publications in the Annalen in this field.


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UND
RELATIVITÄTSTHEORIE
REDE
GEHALTEN AM 5. MAI 1920
AN DER REICHS-UNIVERSITÄT ZU LEIDEN
VON
ALBERT EINSTEIN
BERLIN
VERLAG VON JULIUS SPRINGER
1920

Going by his publications between 1900 and early 1905, one would conclude that Einstein's specialty was thermodynamics. Beginners' papers The collection begins with what Einstein later designated his two "worthless beginners' papers," one on capillarity published in early 1901 and the other on dilute salt solutions published in 1902. Both are dedicated to an investigation of the nature of molecular forces through the effect of such forces on phenomena in liquids, a subject Einstein also planned to investigate for his dissertation, a plan he then abandoned. His early exploration of a molecular theory of solutions nevertheless helped shape many of the techniques used in the dissertation he did complete in 1905. It dealt with the determination of molecular dimensions. It was published in the Annalen in 1906 and is included in this collection. The investigations documented by Einstein's first papers also provided a motivation for generalizing the methods of the kinetic theory, and for establishing statistical mechanics independently from Josiah Gibbs. Statistical mechanics The pivotal role of statistical mechanics in Einstein's early work is clearly visible in this collection. While its development was obviously driven by his early atomistic speculations, the statistical framework he established between 1902 and 1904 provided the backbone for his papers on the light quantum and on Brownian motion of 1905. It pointed to the crucial role of fluctuations in discerning the non-classical character of heat radiation, and revealed atomic dimensions in his analysis of Brownian motion. The annus mirabilis 1905 Without detracting from the singularity of Einstein's 1905 papers in the history of science, this collection may help to frame these contributions in the context of his intellectual development, as is discussed in the historical essays opening this volume. The 1905 papers deal with subjects as diverse as heat radiation, Brownian motion, and the electrodynamics of moving bodies. How were these topics related in Einstein's mind? In viewof his earlier publication record and of insights gained from his contemporary correspondence, it seems plausible to assume that one unifying theme goes back to Einstein's early pursuit of atomistic ideas, which includes both the quest for evidence for the existence of atoms and speculative ideas such as that of a corpuscular constitution of light.
Later these speculations turned into the exploration of the limits of classical physics, as Einstein encountered them when critically reading the Annalen. His perception of these limits was sharpened by the philosophical acumen he had developed through his reading of authors such as Hume, Kant, Mach, and Poincaré. All three of the revolutions that Einstein initiated in 1905 originated from problems at the borders between the major conceptual domains of classical physics; mechanics, electrodynamics, and thermodynamics. Special relativity emerged from the electrodynamics of moving bodies, an area at the intersection of electrodynamics and mechanics; the light quantum hypothesis can be seen as an attempt to cope with the problem of heat radiation, a problem at the intersection of electrodynamics and thermodynamics; while Einstein's work on Brownian motion deals with a borderline problem of mechanics and thermodynamics. The year 1905 was just the beginning of Einstein's career and of the scientific revolution triggered by his pathbreaking contributions. This becomes evident from his own subsequent publications, which show that Einstein's contributions should not be seen a series of isolated achievements, but as integrated in a lively scientific context, involving collaborative efforts and discussions - polemics even - with his colleagues.
Electrodynamics in moving media Einstein's 1908 paper with Jakob Laub on the electrodynamics of moving media was, for instance, a direct continuation of his 1905 work on the electrodynamics of moving bodies, which focused on microscopic electron theory, extending it, following prior work by Minkowski, to the macroscopic theory of electromagnetic and optical phenomena in polarizable and magnetizable material media in motion. It was in this context that Einstein was first confronted with the four-dimensional spacetime formalism developed by Minkowski. In their own work, Einstein and Laub avoided this formalism, the value of which Einstein only gradually learned to appreciate. Specific heats The present collection also documents Einstein's early efforts to further explore the consequences of his revolutionary interpretation of Planck's formula for black-body radiation as hinting at a non-classical foundation of physics. Such an exploration was needed all the more since Einstein's interpretation - in particular the light quantum hypothesis - met, in contrast to his other 1905 achievements, with little sympathy from his established colleagues. A first milestone of this exploration was Einstein's 1907 paper on the specific heat of solid bodies, which exploited the insight into the non-classical behavior of atomic oscillators for a new understanding of the thermal properties of solid bodies, in particular at lower temperatures. The experimental confirmation in Nernst's laboratory of the prediction of the decrease of specific heats with temperature turned out to be crucial for Einstein's career and his eventual move to Berlin in 1914. Elastic behavior of solids This line of research is continued in a paper of 1911 about the relation between molecular vibrations and optical wavelengths in the infrared region, which exploits the connection that Einstein had established between molecular vibrations and specific heats. He thus succeeded in propagating the quantum discontinuity from its original locus in radiation theory to yet another range of physical phenomena, identifying, very much in the vein of his early atomistic speculations, a link between the thermal and mechanical properties of a solid. Collaboration with Hopf Planck and others remained skeptical of Einstein's claim that a newradiation theorywas required. Challenged by this skepticism, Einstein in 1910 published two papers together with Ludwig Hopf on the statistical properties of the radiation field. Their main purpose was to provide support for the claim that classical radiation theory leads to unacceptable implications for heat radiation and that Planck's radiation formula does imply a break with classical physics.
Critical opalescence Einstein's 1910work on critical opalescencewas both a direct continuation of his earlierwork on fluctuations and a reaction to a contemporary issue raised by the Polish physicist, Marian von Smoluchowski, who in 1905 had analyzed independently from Einstein the statistical properties of Brownian motion. In 1908 Smoluchowski published a paper on critical opalescence in the Annalen, which dealt with the optical effects occurring near the critical point of a gas and near the critical point of a binary mixture of liquids. In his paper, Einstein provided a quantitative derivation of the effect from a treatment of density fluctuations. His key insight was that both critical opalescence and the blue color of the sky can be explained with the help of such density fluctuations, which originate from the atomistic constitution of matter. Photochemical equivalence law Another contribution illustrating Einstein's attempts to explore the quantum hypothesis at a time when he had already begun to despair about ever capturing it in a coherent theory is his influential 1912 paper about the photochemical equivalence law, the beginning of a line of research that would lead him in 1916 to his ground-breaking rederivation of Planck's law based on the concepts of spontaneous and induced emission. Zero-point energy The 1913 paper by Einstein and Otto Stern also testifies to the early struggle to understand the status of Planck's radiation law and its implications for applying the quantum hypothesis to the atomistic conception of matter. Einstein and Stern attempted to develop a quantum theory of rotating diatomic molecules, which show that the notion of zero-point energy - first introduced by Planck in his "second quantum theory" - could be used to interpret measurements of the specific heat of hydrogen at low temperatures.
But Einstein soon became skeptical of some of the arguments in this paper and considered zero-point energy, as he put it in a letter to his friend Paul Ehrenfest, "as dead as a doornail." Light deflection While ever more desperate about the quantum, Einstein became increasingly involved with the idea of formulating a relativistic field theory of gravitation, modeled on electromagnetic field theory. As early as 1907, whileworking on a reviewof special relativity, he had realized that, if such a theory were to incorporate Galileo's principle that all bodies fall with the same acceleration, it would require yet another fundamental revision of our concepts of space and time. This led Einstein to formulate his famous equivalence principle, by which gravitation and inertia ultimately became as intertwined as the electric and the magnetic field in the first relativity revolution. This collection contains some of the early papers marking Einstein's path from special to general relativity such as his 1911 paper predicting the deflection of light by the gravitational field of the sun. Static gravitational fields The collection also includes a number of papers illustrating some of the heuristic strategies Einstein adopted as well as some of the obstacles he had to overcome in his search for a relativistic field theory of gravitation. As documented by the papers in this volume, he started in 1912 by treating the special case of a static gravitational field with the help of the equivalence principle, which allowed him to use knowledge about acceleration in the absence of gravity to draw conclusions about physical effects in the presence of a gravitational field.
While making impressive advances in this way, such as the prediction of light deflection and his recognition of the need for non-Euclidean geometry, these early successes consolidated a framework of expectations rooted in classical physics, many of which had to be abandoned or seriously modified before general relativity could be established. Controversy with Abraham One can argue that, unlike special relativity, general relativity was essentially the achievement of a single man. As a matter of fact, most of Einstein's established colleagues were skeptical about his attempt to build a new theory of gravitation on the idea of curved spacetime described by a ten-component metric tensor rather than the familiar scalar potential of Newton's theory. It is important to realize, however, that Einstein was not only supported by some friends and collaborators such as his Swiss companions Marcel Grossmann and Michele Besso and by the astronomer Erwin Freundlich, but that he also had to face competitors and opponents who provided his endeavor with a scientific context that was crucial for the emergence of general relativity. It was Max Abraham, for instance, and not Einstein, who first formulated a comprehensive gravitational field theory in 1912, thus challenging Einstein to integrate his own considerations based on the equivalence principle into a coherent theory as well.
Our collection contains the papers resulting from these efforts while offering some glimpses of the heated controversy in which this early competition resulted. Nordström's special relativistic theory of gravitation While Einstein was initially convinced that the problem of gravitation could not successfully be addressed within the framework of special relativity,Abraham's failed attempt to provide such a theorywas followed by a more convincing theory developed by Gunnar Nordströmin the years between 1912 and 1913. Nordström's theory was a serious competitor of nascent general relativity. It might well have become the dominating relativistic theory of gravitation for some time had it not been for Einstein's philosophically motivated quest to combine such a theory with the attempt to generalize the principle of relativity. This collection features a paper resulting from a collaboration with Adriaan Fokker and showing how Nordström's theory can be reformulated in terms of the absolute differential calculus, the mathematical language Einstein had adopted in his own search for a field theory of gravitation.
In this way, it became possible to compare the two approaches more directly and to reveal the assumptions underlying Nordström's theory. At the same time it suggested that Nordström's theory, like Einstein's, went beyond special relativity and would likewise involve curved space-time. Foundations of general relativity It took Einstein eight years, from 1907 to 1915, to attain his goal of a relativistic field theory of gravitation that preserved both the heritage of mechanics and that of field theory. The drama of this struggle with the conceptual foundations of classical and special relativistic physics is documented by Einstein's research manuscripts, by his correspondence, by several intermediary publications, and in particular by the famous sequence of communications to the Prussian Academy of November 1915. A comprehensive reconstruction of this drama including key sources appears elsewhere (The Genesis of General Relativity, Kluwer Academic Publishers, edited by J. Renn). The present collection features the outcome of this quest - the general theory of relativity - in the form of Einstein's first masterful exposition of the finished theory in his famous 1916 contribution to the Annalen. This paper bears clear traces of the gestation period of the theory, as is demonstrated in the historical essay of Michel Janssen. Cosmology Einstein's subsequent work on general relativity is no longer extensively documented in the Annalen.
As a newly minted member of the Prussian Academy in Berlin, his outlet of choice in this period are the Academy's own Sitzungsberichte. Both the four celebrated papers of November 1915 documenting the final breakthrough in Einstein's search for a relativistic field theory of gravity and the famous paper on cosmology of 1917 appeared in the Sitzungsberichte. This volume, however, does contain a short but important paper of 1918 on the foundations of general relativity, in which Einstein formally introduced what he called "Mach's Principle," the requirement that matter fully determines the metric field. The volume ends with a short paper of 1922 providing at least a hint at the fate of general relativity, which was subsequently turned from a philosophically motivated integration of the classical knowledge about gravitation with the kinematics of relativity into the theoretical foundation of modern cosmology describing an expanding universe. In this 1922 paper, Einstein reacted to a proposal by Franz Selety for resolving Einstein's objections to Newtonian cosmology of 1917 by what he called a "hierarchical molecular world." Einstein rejected this proposal because it did not, in his view, comply with Mach's principle.
He also rejected the interpretation of the spiral nebulae as galaxies similar to our own milky way, referring to the evidence of contemporary observations. The cosmological mission of general relativity was yet to be accomplished. Perspective The present collection offers a first entry point into Einstein's work, which is being published comprehensively in an annotated documentary edition by the Collected Papers of Albert Einstein (Princeton University Press). Here the reader will find more extensive commentaries and annotations that offer insights into the genesis and historical context of Einstein's papers. In line with Einstein's legacy and spirit of broadly sharing scientific knowledge, the Editor-in-Chief of the Annalen, Ulrich Eckern, and WILEY-VCH have consented, in agreement with the Albert Einstein Archives at the Hebrew University Jerusalem and the Collected Papers, and in collaboration with the Max Planck Society, to make the papers in this collection freely accessible on the Internet. Acknowledgements I would like to thank Lindy Divarci for her role as editorial assistant in the preparation of this volume. Jürgen Renn (Berlin) This text is taken from "Einstein's Annalen Papers", WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2005 Annalen der Physik (AdP) & Albert Einstein Special Issue & Supplement: Commemorating Albert Einstein ► Special Issue, vol. 14, issue 1-3 (2005) ► Supplement, vol.
14, issue S1 (2005): Einstein's Annalen Papers (EAP); also available as: Einstein's Annalen Papers, edited by J. Renn, WILEY-VCH, Weinheim, 2005, ISBN 3-527-40564-X, ca. 585 pp. See also: ● The Collected Papers of Albert Einstein @ Princeton University Press (CPE) Annalen der Physik, 4th series, 1900-1928, vol. 1-87 (resp. vol. 306-392) 1. A. Einstein, AdP 4, 513 (1901) [11 pp.] (EAP, 87; CPE 2, 9) Folgerungen aus den Capillaritätserscheinungen Table of Contents, vol. 4 2. A. Einstein, AdP 8, 798 (1902) [17 pp.] (EAP, 99; CPE 2, 22) Ueber die thermodynamische Theorie der Potentialdifferenz zwischen Metallen und vollständig dissociirten Lösungen ihrer Salze und über eine electrische Methode zur Erforschung der Molecularkräfte Table of Contents, vol. 8 3. A. Einstein, AdP 9, 417 (1902) [17 pp.] (EAP, 117; CPE 2. 56) Kinetische Theorie des Wärmegleichgewichtes und des zweiten Hauptsatzes der Thermodynamik Table of Contents, vol. 9 4. A. Einstein, AdP 11, 170 (1903) [18 pp.] (EAP, 135; CPE 2, 76) Eine Theorie der Grundlagen der Thermodynamik Table of Contents, vol. 11 5. A. Einstein, AdP 14, 354 (1904) [9 pp.] (EAP, 154; CPE 2, 98) Zur allgemeinen molekularen Theorie der Wärme Table of Contents, vol. 14 6. A. Einstein, AdP 17, 132 (1905) [17 pp.] (EAP, 164; CPE 2, 149) Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt Table of Contents, vol. 17 7. A. Einstein, AdP 17, 549 (1905) [12 pp.] (EAP, 182; CPE 2, 223) Über die von der molekularkinetischen Theorie der Wärme geforderte Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen 8. A. Einstein, AdP 17, 891 (1905) [31 pp.] (EAP, 194; CPE 2, 275) Zur Elektrodynamik bewegter Körper 9. A. Einstein, AdP 18, 639 (1905) [3 pp.] (EAP, 225; CPE 2, 311) Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig? Table of Contents, vol. 18 10. A. Einstein, AdP 19, 289 (1906) [18 pp.] (EAP, 229; CPE 2, 346) Eine neue Bestimmung der Moleküldimensionen Table of Contents, vol. 19 11. A. Einstein, AdP 19, 371 (1906) [11 pp.] (EAP, 248; CPE 2, 333) Zur Theorie der Brownschen Bewegung 12. A. Einstein, AdP 20, 199 (1906) [8 pp.] (EAP, 259; CPE 2, 349) Zur Theorie der Lichterzeugung und Lichtabsorption Table of Contents, vol. 20 13. A. Einstein, AdP 20, 627 (1906) [7 pp.] (EAP, 268; CPE 2, 359) Das Prinzip von der Erhaltung der Schwerpunktsbewegung und die Trägheit der Energie 14.
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