BOOKS

THE MEANING OF RELATIVITY (Third Edition)

by Albert Einstein
Princeton University Press, N.J.,
150 pp. $2.50

Reviewed by H. P. Robertson
Professor of Mathematical Physics

THIS THIRD EDITION of Einstein's 1921 Stafford Little Lectures at Princeton again makes available a concise treatment of his relativity theories—a treatment of the fundamental principles which has never been surpassed for brevity and clarity. The present edition retains the appendix on the cosmological problem, which was prepared for the 1945 edition, and adds a second appendix containing a brief fifteen page account of the author's current investigations on the generalized theory of gravitation.

The scope and content of the original lectures are adequately indicated by their titles and a brief mention of their subject matter:

"Space and Time in Pre-relativity Physics" reviews the basic concepts of the Newtonian theory of mechanics and the Maxwellian theory of electromagnetism, in a tensorial form appropriate for extension to the relativity theories.

"The Special Theory of Relativity" deals with the removal of the discrepancy between these two classical theories, in terms of the four dimensional space - time framework based upon the experimental work of Michelson and Morley and the theoretical investigations of Lorentz, Einstein and Minkowski.

The last two of the original lectures are devoted to "The General Theory of Relativity," a theory of gravitation which achieves the identification of gravitational and inertial mass. An account is given of the well-known observational tests of this theory, with their minute deviations from the Newtonian predictions, in the solar gravitational field.

The appendix for the second edition mentions briefly some of the advances made in the interim: the verification by Adams at Mount Wilson of the "mass red-shift" in light from the dwarf companion of Sirius; Einstein, Infeld and Hoffman's proof that the equations of motion of the field-producing matter are implied by the field equations; and finally, the derivation of a suitable space-time background for the universe as a whole, into which may be incorporated the observations by Hubble and others on the distribution and motions of extra-galactic nebulae.

Einstein elects to devote almost the whole of this appendix to an exposition of this cosmological problem, and to the at least partially satisfactory solution offered by the theory of the expanding universe. It is to be regretted that the author has not expanded his brief remarks on the derivation of the equations of motion from the non-linear field equations, for this extremely important but difficult advance in principle has received but little expository treatment since its inception more than a decade ago.

The general theory of relativity,

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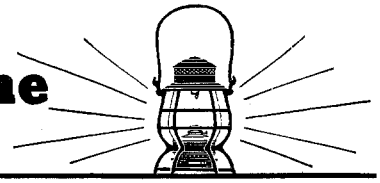
The Main Line



MARCH, 1950

March, traditionally, comes in like a lion and goes out like a lamb.

Accordingly, this is one of the best months of the year to go places by train. (The other eleven are Jan., Feb., Apr., May etc.)

Southern Pacific has fine, fast trains going practically everywhere. Steel rails are the safest highway ever built. So when weather is uncertain, relax and let the engineer do the driving. Next time, try the train.

What Else?

Every now and then we invite you to drop us a card in return for which we'll send you one of our folders to help you plan a trip. One of our friends has apparently been saving up these invitations, and recently decided to cash the whole kit and kaboodle in one fell swoop. Look!

"Dear Sir: Please send me free 3 new 1950 wall calendars, 200 pocket-size calendars, large & small memo pads, blotters, souvenirs, brochures, booklets, folders, menus, vacation suggestions, scenic picture wall posters & post cards, stationery, tiny gummed stickers, U. S. and world pictorial map, periodicals, list of publications, handbook, pencils, etc., also place me on your regular mailing list. Thank you!

Very respectfully yours,"

We are in some doubt as to the meaning of that "etc." About all we have left are the new, streamlined chair cars on the *Golden State*.

Stick Around

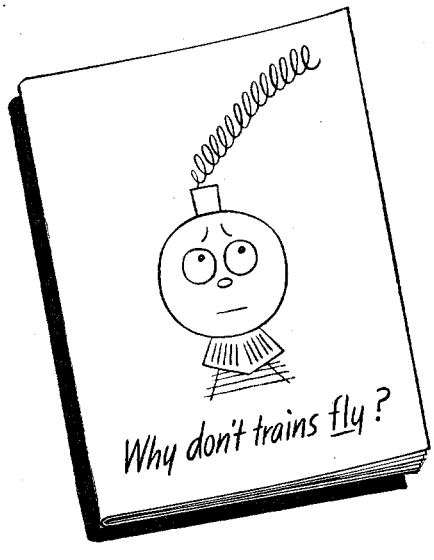
We've been meaning to tell you about a recent development in the round-trip ticket business. It used to be that you had to use up the return part of your ticket within 90 days. Now, however, on all tickets that formerly had a 90-day limit, you have six months in which to get back where you started.

This means you get six leisurely months for any train trip to the east, as well as on many local trips. Incidentally, it doesn't cost you a cent extra for this extension (unless, of course, your mother-in-law moves in for twice as long).

Contact

Lately we railroads have been taking something of a lambasting from the advertising of another form of transportation. In fact, we feel that somebody has been getting away off base ethically and factually.

We don't want to get into a quarrel with anyone. But we do want the record straight. So to get it straight in our own minds, we prepared a little booklet on the subject entitled:



Originally we prepared the booklet for our own amusement as much as anything. But we ran off some extra copies too. If you'd like to have one, drop a card to Mr. F. Q. Tredway, Room 735, Southern Pacific, 65 Market St., San Francisco 5. He'll mail it right out to you.

S·P The friendly Southern Pacific

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as accepted in the present body of science, truly incorporates the gravitational field into the metrical structure of space-time; matter and curvature are alternative aspects of the unified whole. But so far the electromagnetic field is merely tied formally into this structure from without—even as the gravitational field was tied into the Newtonian space and time or the Minkowski space-time in the older theories.

The problem of combining the metrical, gravitational and electromagnetic fields in a *unified field theory* is one which has challenged theoretical physicists for almost four decades. Noteworthy attempts to solve this problem have been made by Weyl, Eddington, O. Klein, Schrödinger and a host of others, in addition to Einstein himself; none of them, however, has proven ultimately satisfactory. That of Weyl has, on the other hand, found its expression in the concept of gauge invariance in quantum theory, and others of them have given a fruitful impetus to research in pure mathematics. But the challenge of incorporating both the gravitational and electromagnetic fields into a more universal structure, a more ultimate field of which both the former are but ideal limiting cases, is still a powerful incentive to research—and one which has again attracted the attention and the genius of Einstein.

Progress Report

The new appendix to the third edition, on "The Generalized Theory of Gravitation," is in the nature of a progress report by Einstein on his present search for a unified field theory—the background of which is admirably dealt with in his autobiographical sketch in the recent Einstein volume of *The Library of Living Philosophers*.

In this attack, which is in some respects similar to but more specific than the recent attempts of E. Schrödinger, Einstein proposes to broaden the metric field by adding an antisymmetric term a_{ij} to the symmetric tensor s_{ij}, which in the older theory specifies the metrical-gravitational field. The sum g_{ij} of these two parts is to encompass the metrical-gravitational-electromagnetic field in one entity, a structure which is to degenerate for weak electromagnetic fields into the case handled by the general theory of relativity, and to

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1940

Francis Morse is practicing architecture in Westport, Conn., and "devoting an increasing amount of time to the cause of World Federation." The Morses have two daughters and a son.

Frank Dessel and his father have just sold their drug store in San Francisco, which was established 41 years ago. Frank is now working as a pharmacist for the new owners but hopes to locate a drug business in the Los Angeles area in the next year or two.

1941

Roy Acker is employed as a designer in the Engineering Department of the Hughes Aircraft Co. at Culver City. He is now serving as group leader in charge of controls and hydraulics design on the world's largest helicopter.

H. G. Stever, Ph.D., is Executive Assistant to the Chairman of the Guided Missiles Committee at M.I.T.

1942

Fred M. Ashbrook's second son, Donald, was born on December 17. Fred is head of the Missile Instrumentation Unit at the Naval Ordnance Test Station in Inyokern. He has been elected Chairman of the Inyokern IRE section for 1950.

Willar P. Fuller, M.S., is the father of a daughter, Frances Elizabeth, born Dec. 27 in Salt Lake City. He has been with Anaconda Copper since 1942 and is now chief geologist at their North Lily mine in Eureka, Utah.

Charles B. Metz, Ph.D., a member of the zoology department at Yale, returned to the Caltech campus last month for three months' work as a Gosney Fellow in the Biology Division.

Robert E. MacKenzie received a Ph.D. in Mathematics, and *Warren S. Torgerson* an M.A. in Psychology from Princeton in January.

1943

Robert M. Francis has been an equipment design engineer for Pacific Airmotive Corp. in Burbank for the past year and a half. His family consists of Leslie Louise, 2 years old, and Raymond Warren, 13 months—"plus a new home in Sherman Oaks which keeps us busy and broke!"

Robert L. Bennett (Bob Francis' brother-in-law) and his wife are proud parents of a son, Charles Laurence, born January 24. Bob is with the Telephone Co. and has a new home in Chapman Woods, Pasadena.

Ed Wheeler, Ex '43, writes that he is still running station WEAW in Evanston, Illinois. Also that he is President of Storebroadcasting Service, Inc. and has just bought WOKZ-AM-FM in Alton, Illinois.

1944

Howard Chang has been on the faculty of Clarkson College, Malone, N.Y., since September as a physics instructor.

Harrison Sigworth says his best news is a new baby—their second boy. He has been working for the past four years for the California Research Corporation in Richmond, Calif., in the Engine Fuels Research Laboratory.

J. Ben Earl is working for O. K. Earl, Jr., General Contractor, in Pasadena. Ben is married and has two daughters—ages 3 and 1.

1945

George Fenn, M.S. '46, is employed at Northrup Aircraft as Supervisor of Theoretical and Analytical Work in the Special Weapons Department. He writes that Northrup is well populated with Tech men, including *L. D. Hindall*, M.S. '46, *F. Stevens*, M.S. '47, *R. V. Rhoades* '43, *K. M. Stevenson* '45, and *I. S. Reed* '44 in his department.

1946

Edwin Gould is at UCLA working on organo-selenium compounds. He expects to receive his Ph.D. in June.

Rexford R. Cherryman, Lt. (jg.) USN, will be married this spring to Beatrice Wishard of San Francisco. He is now serving aboard the USS Fletcher.

Howard Morgan has left his government position in Washington to go into the Allis-Chalmers training program. Now in the New York District Office, he expects to go to Milwaukee soon.

James Densmore, M.S. '48, Eng. '49, was married this winter in Phoenix to Linda Mae Hardesty. They are living in Claremont where she is studying at Scripps. He is working at the Jet Propulsion Lab in the Design and Development Section.

1947

Harold Kuhn received a Ph.D. in Mathematics from Princeton University in January.

Dean Watkins, M.S., is working for a Ph.D. at Stanford in Electrical Engineering.

Lt. Cdr. A. H. Wellman is on aeronautical duty in Hawaii with the Fleet All Weather Training Unit, Pacific. After leaving school he was stationed at the Bureau of Aeronautics Office at Lockheed until his assignment to Hawaii last February.

1948

Vincent Honnold is in his second year of graduate study at the University of Notre Dame, working towards a Ph.D. in Physics. He and his wife have a ten-months-old baby girl, Maryanne.

Donald and Mary Wilkinson announce the arrival on January 30 of their first child—a boy, Ronald James Wilkinson. Don is still with Boeing in Seattle.

Rupert M. Bayley, who claims the longest continuous attendance at Caltech for a B.S. degree—continuous 1928 to 1948 except for a short leave of absence from 1929 to 1946 (!)—writes that he is an electrical engineer for the Department of Water and Power, City of Los Angeles, in Transmission Design and Research. He has three children, ages 14, 10, and 4.

Frank J. Wolf has been working since graduation for the Allis-Chalmers Mfg. Co. Last month he was graduated from the Graduate Training Course. During his 18 months on the course he saw a considerable number of the various shops and offices which are offered as training locations. Just recently he was transferred to the company's Norwood Works, in Cincinnati, for a closer view of the products manufactured there—small pumps and small motors. Towards the end of the year he hopes to be in one of the company's sales offices as a "peddler".

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something which will include the Maxwellian field on ignoring the gravitational effects.

Here he finds encouragement for the fact that he is indeed able to find a set of field equations which have the requisite formal property of reducing to those of the previous theories in the two limiting cases. For those who wish a more extended account of this development, reference may be made to Einstein's paper in the January issue of the *Canadian Journal of Mathematics*. But the question of whether the further development of this unified field theory will grant a deeper understanding of the relation between gravitational and electromagnetic phenomena is one which only the future can answer; of it, Einstein only asserts, "I have not yet found a practicable way to confront the results of the theory with experimental evidence."

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Reviewer's Note. The above rather factual (and possibly rather dull) review of the content of Einstein's excellent *The Meaning of Relativity* may seem anticlimactic to some, in view of the frenetic journalistic reception of the publisher's announcement of the book some weeks ago. To such I would only say that it is disappointing to note that there are yet those among the reporters and literary critics who seize upon such an announcement to inflict upon the general public their untrained judgement in matters scientific—and this in spite of the patent reluctance, in this case at least, of their principal victim! But science reporting is growing up, in pace with the increasing public interest in matters scientific: perhaps we should most charitably write off its present excesses as a transitory kind of intellectual growing pains.