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The Road to Relativity: The History and Meaning of Einstein's "The Foundations of General Relativity." **FREE**

The Road to Relativity: The History and Meaning of Einstein's "The Foundations of General Relativity.". Hanoch GutfreundJürgen Renn255 pp. Princeton U.P., Princeton, NJ, 2015. Price: \$36 (hardcover). ISBN 978-0-691-16253-9.

Allen I. Janis



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The Road to Relativity: The History and Meaning of Einstein's "The Foundations of General Relativity."

Hanoch Gutfreund and Jürgen Renn. 255 pp. Princeton U.P., Princeton, NJ, 2015. Price: \$36 (hardcover). ISBN 978-0-691-16253-9. (Allen I. Janis, Reviewer.)

If you have any interest in the history of general relativity, this book is for you. It is a gem. And in this day of exorbitantly priced books, at \$36 it is a steal.

The *Road to Relativity* features the original manuscript of Einstein's theory of general relativity. There is something in the human psyche that is attracted to original manuscripts. Some bring millions of dollars at auctions. One thing that immediately strikes the reader is the difference between this manuscript and what is demanded by modern journals by way of preparation. Einstein's manuscript is handwritten and full of passages crossed out and things inserted. But aside from such trivialities, it is fascinating to read (an English translation is provided) how Einstein leads his readers step by step through the details of how to deal with tensors so that they will be able to follow his arguments when he gets to the physics.

The somewhat convoluted history of this particular manuscript is traced in the book's first chapter, "The Charm of a Manuscript." Following this chapter is the annotated manuscript. The annotators are well qualified and their annotations are clear, concise, and interesting. I thoroughly enjoyed reading them. Each manuscript page appears on the left page with the annotations on the right in three different type styles to differentiate their content. We are told that the first contains material referring to the content of the facing manuscript page, the second refers to contextual background material, and the third explains a specific idea or concept. These categorizations are to be interpreted broadly; for example, we learn in an instance of the third type that in a letter Einstein wrote to his son Hans Albert, Einstein said, "I am often so engrossed in my work that I forget to eat lunch."

The main textual material concludes with a short post-script chapter, which deals with cosmology and other matters

that followed the publication of the manuscript. It even brings us into modern times by pointing out that GPS systems would not work without taking both special and general relativity into account. I remember hearing a colloquium talk many years ago by someone connected with the development of this technology. He said that the military brass (who were paying for its development) didn't believe that general relativistic corrections would matter. The speaker said they proved their point by turning those corrections off; it wasn't long before the GPS readings were wildly wrong. An interesting sideline in this chapter has to do with the frequently heard story that Einstein called his introduction of the cosmological constant the biggest mistake of his life. It seems there is no evidence that Einstein ever said or wrote this, and that it is in fact an invention of George Gamow.

There are two nice listings at the end of the book (actually not quite the end, for the English translations are at the end). The first is "A Chronology of the Genesis of General Relativity and Its Formative Years," and the other is "Physicists, Mathematicians, and Philosophers Relevant to Einstein's Thinking." Each entry in the latter list is accompanied by a picture and a short paragraph.

It is also worth noting that the charm of this book is greatly aided by the fanciful drawings of Laurent Taurent, which appear sporadically throughout the book.

I've asked myself what background a reader would need to understand this book. It seems to me that it can be read at more than one level. Someone who is familiar with general relativity will certainly get the most from the book. But a novice can read the annotation pages and still get a great deal of value from it. So to paraphrase what I said at the outset, if you have any interest in the history of general relativity—whoever you are and whether or not you know anything about tensors—this book is for you.

Allen I. Janis is Professor Emeritus in the Department of Physics and Astronomy and Fellow Emeritus in the Center for Philosophy of Science at the University of Pittsburgh. He does research in general relativity and the philosophy of science.

BOOKS RECEIVED

From Molecules to Living Organisms: An Interplay between Biology and Physics. Eva Pebay-Peyroula, Hugues Nury, François Parey, Rob W. H. Ruigrok, Christine Ziegler and Leticia F. Cugliandolo (Eds.). 461 pp. Oxford U.P., New York, 2016. Price: \$69.95 (hardcover) ISBN 978-0-19-875295-0.

Practical Quantum Mechanics: Modern Tools and Applications. Efstratios Manousakis. 347 pp. Oxford

U.P., New York, 2016. Price: \$69.95 (hardcover) ISBN 978-0-19-874934-9.

Statistical Physics, Optimization, Inference, and Message-Passing Algorithms. Florent Krzakala, Federico Ricci-Tersenghi, Lenka Zdeborová, Riccardo Zecchina, Eric W. Tramel and Leticia F. Cugliandolo (Eds.). 358 pp. Oxford U.P., New York, 2016. Price: \$69.95 (hardcover) ISBN 978-0-19-874373-6.

- Holograms: A Cultural History.** Sean F. Johnston. 268 pp. Oxford U.P., New York, 2016. Price: \$64.95 (hardcover) ISBN 978-0-19-871276-3.
- Geophysics, Realism, and Industry: How Commercial Interests Shaped Geophysical Conceptions, 1900–1960.** Aitor Anduaga. 357 pp. Oxford U.P., New York, 2016. Price: \$75 (hardcover) ISBN 978-0-19-875515-9.
- Images of Time: Mind, Science, Reality.** George Jaroszkiewicz. 321 pp. Oxford U.P., New York, 2016. Price: \$44.95 (hardcover) ISBN 978-0-19-871806-2.
- Effective Medium Theory: Principles and Applications (2nd ed.).** Tuck C. Choy. 255 pp. Oxford U.P., New York, 2016. Price: \$110 (hardcover) ISBN 978-0-19-870509-3.
- Introduction to Many-Body Physics.** Piers Coleman. 810 pp. Cambridge U.P., New York, 2015. Price: \$84.95 (hardcover) ISBN 978-0-521-86488-6.
- Why Quark Rhymes with Pork: And other Scientific Diversions.** N. David Mermin. 400 pp. Cambridge U.P., New York, 2016. Price: \$29.99 (hardcover) ISBN 978-1-107-02430-4.
- Brownian Ratchets: From Statistical Physics to Bio and Nano-motors.** David Cubero and Ferruccio Renzoni. 198 pp. Cambridge U.P., New York, 2016. Price: \$140 (hardcover) ISBN 978-1-107-06352-5.
- Learning the Art of Electronics: A Hands-On Lab Course.** Thomas C. Hayes (with the assistance of Paul Horowitz). 1165 pp. Cambridge U.P., New York, 2016. Price: \$79.99 (paper) ISBN 978-0-521-17723-8.
- Molecular Beam Epitaxy: A Short History.** John Orton and Tom Foxtan. 528 pp. Oxford U.P., New York, 2015. Price: \$79.95 (hardcover) ISBN 978-0-19-969582-9.
- Particle Physics in the LHC Era.** Giles Barr, Robin Devenish, Roman Walczak, and Tony Weidberg. 421 pp. Oxford U.P., New York, 2016. Price: \$64.95 (paper) ISBN 978-0-19-874856-4.
- Doing Global Science: A Guide to Responsible Conduct in the Global Research Enterprise.** Interacademy Partnership. 172 pp. Princeton U.P., Princeton, NJ, 2016. Price: \$14.95 (hardcover) ISBN 978-0-691-17075-6.
- A Student's Guide to Python for Physical Modeling.** Jesse M. Kinder and Philip Nelson. 150 pp. Princeton U.P., Princeton, NJ, 2016. Price: \$24.95 (paper) ISBN 978-0-691-17050-3.
- Half-Earth: Our Planet's Fight for Life.** Edward O. Wilson. 259 pp. W. W. Norton, New York, 2016. Price: \$25.95 (hardcover) ISBN 978-1-63149-082-8.
- Wave Optics: Basic Concepts and Contemporary Trends.** Subhasish Dutta Gupta, Nirmalya Ghosh, and Ayan Banerjee. 380 pp. CRC Press, Boca Raton, FL, 2016. Price: \$89.95 (hardcover) ISBN 978-1-4822-3773-3.
- Structural and Morphological Evolution in Metal-Organic Films and Multilayers.** Alkomay Datta and Smita Mukherjee. 218 pp. CRC Press, Boca Raton, FL, 2016. Price: \$129.95 (hardcover) ISBN 978-1-4822-3270-7.
- Electroweak Interactions.** Luciano Maiani. 214 pp. CRC Press, Boca Raton, FL, 2016. Price: \$79.95 (hardcover) ISBN 978-1-4987-2275-4.
- Quantum Mechanics, 6th ed.** Alistair I. M. Rae and Jim Napolitano. 437 pp. CRC Press, Boca Raton, FL, 2016. Price: \$79.95 (hardcover) ISBN 978-1-4822-9918-2.
- Introduction to Solid State Ionics: Phenomenology and Applications.** C. S. Sunandana. 542 pp. CRC Press, Boca Raton, FL, 2016. Price: \$129.95 (hardcover) ISBN 978-1-4822-2970-7.
- Bananaworld: Quantum Mechanics for Primates.** Jeffrey Bub. 286 pp. Oxford U.P., New York, 2016. Price: \$44.95 (hardcover) ISBN 978-0-19-871853-6.
- Bose-Einstein Condensation and Superfluidity.** Lev Pitaevskii and Sandro Stringari. 564 pp. Oxford U.P., New York, 2016. Price: \$110 (hardcover) ISBN 978-0-19-875888-4.
- Organic Electro-Optics and Photonics: Molecules, Polymers, and Crystals.** Larry R. Dalton, Peter Günter, Mojca Jazbinsek, O-Pil Kwon, and Philip A. Sullivan. 302 pp. Cambridge U.P., New York, 2016. Price: \$79.99 (hardcover) ISBN 978-0-521-44965-6.

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