

because of the lack of sufficient readership. Although a generic problem, it also applies here: those interested in more details have few if any options other than delving into the (sometimes very) technical literature. As it is a generic problem, the author is not to blame, but it is something which the reader should keep in mind.

Despite my reservations, the book succeeds in its goal of presenting the basic idea of top-down cosmology for a more general readership and can be a first step for those interested in the topic — it just shouldn't be the last step as well, but a big jump will be needed between the first and last steps. Other modern ideas such as the holographic principle and the black-hole information paradox are explained well, so it can be a jumping-off point for those interested in modern ideas in quantum cosmology and related fields. — PHILLIP HELBIG.

References

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The Einsteinian Revolution. The Historical Roots of His Breakthroughs, by Hanoch Gutfreund & Jürgen Renn (Princeton University Press), 2024. Pp. 249, 23 × 15 cm. Price £28/\$32 (hardbound; ISBN 978 0 691 16876 0).

The Einstein industry marches on, almost 70 years since it was begun by the sorting of the mass of papers he left in Princeton at the time of his death in 1955. Those papers and the rest of Einstein's estate were left to the Hebrew University of Jerusalem, which still owns copyrights and such, though the on-going 'publications of everything' (the Einstein Papers Project) is now headquartered at Caltech, under the general editorship of Diana Kormos Buchwald. This enables the present authors to cite everything he wrote in the form CPAE* Vol. Number, Document Number, Page Number. We thereby gain access to the actual texts of letters he wrote to his first wife, to his friends Michele Besso and Marcel Grossman, and to very many of the other physicists and mathematicians who were his contemporaries. An unfortunate result is that the published Einstein papers also end up being cited in the form CPAE 2, Doc. 3 and CPAE 6, Doc. 21, rather than by year, volume, and page number

*CPAE is the Collected Papers of Albert Einstein

in *Annalen der Physik*. Those two are *Zur Elektrodynamik bewegter Körper* (from the wonder-year of 1905) and *Die Grundlage der allgemeinen Relativitätstheorie* (published in 1916).

Authors Hanno Gutfreund and Jurgen Renn have already made, jointly and severally, major contributions to the Einstein industry. What new insights are they now providing? Their major claim is that, for all the 1905 contributions and GR, Einstein adopted a new point of view to existing data and ideas, in the way that Copernicus had revolutionized astronomy in 1543 by adopting a Sun-centred rather than Earth-centred point of view. The authors describe such revolutions as “Copernican”. The contrast is with “Galilean Revolutions,” which arise from new data. At least that was true for Galileo’s influence on astronomy, though his pioneering thoughts about motion were of the Copernican type, and these two sorts, the authors conclude, are a better match to what has happened in science than are the “paradigm shifts” of Thomas Kuhn. Einstein himself is quoted as saying that “A theory can be tested by experience [that is experiments and observations], but there is no way from experience to the construction of a theory.”

I found particularly interesting the 1905 Einsteinian advances, for each of which the authors point out (p. 135) someone else who formulated some of the same physics, but without the very broad range of knowledge (scientific and philosophic) that AE brought to bear: for statistical mechanics, Josiah Willard Gibbs (of Yale); for the light quantum hypothesis, Paul Ehrenfest; for relativity theory, Henri Poincaré (who dispersed his insights among several papers, without managing to bring them together as Einstein did); and for Brownian motion, Marian von Smoluchowski*. This left to Einstein the tasks of formulating these four topics (as well as some earlier arguments for the reality of atoms) in more or less the way we now understand them.

Gutfreund and Renn also look backward to the Newtonian revolution (the establishment of classical physics), which they regard as also of the Copernican form, for which the shift in point of view was to regard motion on Earth and motion in the cosmos as the same sort of thing, rather than distinguishing ‘forced’ and ‘natural’ motion. They mention in passing other past revolutions: the chemical (periodic table); the Darwinian (evolution by natural selection); the geological (mantle convection, plate tectonics, and continental drift) in the past; and more recently the molecular-biology revolution and the artificial-intelligence (AI) revolution.

Many more insights and examples are to be found in *The Einsteinian Revolution*, but I want to use the AI revolution as an excuse to focus for a paragraph or so on a prime mover in Einstein scholarship — Gerald Holton, Mallinckrodt Professor Emeritus of Physics and History of Science at Harvard. He was there at the beginning, having been sent to Princeton to help Helen Dukas sort through that wilderness of papers in Einstein’s home and office. He has written (to paraphrase) “only Einstein, only there, only then”. And just last week, when I e-complained that a new computer was being fractious, he e-warned me to stay on good terms with it, because this might be the first warning that machines are going to take over the world. — VIRGINIA TRIMBLE.

*Marian von Smoluchowski (1872–1917), the person you are least likely to have heard of before, of those mentioned here, remained an Einstein correspondent up to the time of his death.