EINSTEIN
THOMAS RYCKMAN

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Einstein
Thomas Ryckman
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Ryckman's work derives its generic title from its being part of the series *Routledge Philosophers*, which features monographs on philosophers from Plato to Heidegger. His opening statement that 'Einstein was a theoretical physicist, not a philosopher in any customary sense' (p. 1) seems an unnecessarily apologetic start since, among the Routledge philosophers, we also find Sigmund Freud and Charles Darwin, neither of whom would count as 'philosophers in any customary sense'. But their work, like Einstein's, has profoundly transformed our understanding of the world and, like Einstein, they have articulated explicit reflections that might well be classified as philosophical.

During his own lifetime, Einstein's work was introduced to the academic world of philosophy by Paul Arthur Schilpp, who edited a volume entitled *Albert Einstein: Philosopher–Scientist* ([1949]) as part of the series 'The Library of Living Philosophers'. In it, Schilpp assembled a number of essays by physicists and philosophers, colleagues and friends of Einstein, that engaged with various aspects of his work. The volume also contained Einstein's 'Autobiographical Notes' and his 'Reply to Criticisms'. Writing his 'own obituary' on the occasion of this book and reflecting on his life's work, Einstein ([1949], p. 33) emphasized

> […] the essential in the being of a man of my type lies precisely in what he thinks and how he thinks, not in what he does or suffers. Consequently, the obituary can limit itself in the main to the communicating of thoughts which have played a considerable role in my endeavors.

All the same, there are difficulties in conceiving of Einstein as a philosopher, even more so as one with a coherent worldview. But Ryckman is well aware of these challenges. He cites, somewhat approvingly, Abraham Pais, author of the only scientific biography of Einstein to date, who maintained that calling Einstein a philosopher sheds as much light as calling him a musician. Ryckman also takes Einstein's characterization of the modern scientist as 'a type of unscrupulous opportunist' to apply to Einstein himself. Citing Einstein's own words, Ryckman shows Einstein present himself variously as 'realist […] as idealist […] as positivist […] as Platonist or Pythagorean' (p. 3). Finally, the task is made only more difficult by the fact that Einstein never wrote a specific, coherent account of his philosophical outlook; all we have to go on are scattered and rarely explicit remarks.

In response to these challenges, Ryckman (p. 4) takes a clue from another Einstein quote: 'If you wish to learn from the theoretical physicist anything about the methods which he uses, I would give you the following piece of advice: Don't listen to his words, examine his achievements'. This admonition provides Ryckman with a plan of his book. He discusses Einstein's significant theoretical preoccupations in physics, his lasting achievements, and how Einstein reflected on his practice. The three parts of the volume deal with quantum theory, the theory of relativity (both special and general), and the relationship between geometry and philosophy.

The first part begins with a chapter that does not feature Einstein; rather, it provides historical background for Einstein's early work on the quantum, up to the introduction of Planck's theory of black-body radiation in 1900. It is only his work on the quantum that is given this treatment, and the impression is that Ryckman intended to write with more of a history of physics perspective, but gave up when discussing Einstein's later theories. In any case, the point Ryckman emphasizes in his discussion of Einstein's early papers is the highly innovative and productive reversal of what Einstein called 'Boltzmann's principle'—that is, the proportionality of entropy S and probability W in the famous equation—found on Boltzmann's tomb stone but first introduced in this form by Planck, $S = k\log W$, where k is Boltzmann's constant. Instead of going from the *a priori* probability of physical states to the entropy of the system, Einstein went the other way: he took information about the entropy from thermodynamics and reasoned from there about the probability. This key move underlies much of his early work and insights, including the trilogy of statistical papers published between 1902–04, the light quantum hypothesis, the explanation of Brownian motion in his famous miracle year of 1905, and his explanation in 1907 of the deviations from the Dulong–Petit rule in the specific heat of solids at very low temperatures.

Having thus set the stage, Ryckman works through a fairly comprehensive list of relevant topics and themes that includes Einstein's 1916 quantum derivation of Planck's law, in which he introduced the notion of stimulated emission of radiation, and his application in 1924 of the statistics of indistinguishable particles from Bose's derivation of Planck's law of black-body radiation to the case of ideal gases. In the third chapter of the first part, Ryckman discusses Einstein's involvement in the debates around quantum mechanics proper. He emphasizes the historical and systematic relevance of the completeness of physical theory for Einstein's reaction to the new quantum mechanics. He discusses at some length the Einstein–Bohr debate at the 1927 Solvay congress on complementarity and the interpretation of the uncertainty relations, as well as his famous EPR argument of 1935. This chapter also touches on the quantum measurement problem, the problem of the quantum–classical divide, and the notion of entanglement.

The second part of the book is devoted to the theories of relativity, both special and general. The chapter on special relativity begins with the history of the notion of the luminiferous ether, the Michelson–Morley interference experiment, and Lorentz's theory, and moves on to Einstein's 1905 paper, 'Electrodynamics of Moving Bodies'. Key points included here are the classical issues of the relativity of simultaneity, the clock paradox, and the dropping of the superfluous ether hypothesis.

This chapter is followed by the often-told story of Einstein's tortuous seven-year-long search for a generalization of special relativity based on the hypothesis of equivalence. In late 1915, he achieved his breakthrough, finding generally covariant field equations of gravitation, in a competitive race against Göttingen mathematician David Hilbert. Einstein replaced his infamous 'hole argument, which had convinced him of the impossibility of giving generally covariant field equations a meaningful physical interpretation, with the point-coincidence argument, which in turn justifies the necessity of general covariance in the mathematical formulation. In line with many other accounts of the episode, Ryckman emphasizes the role of principled convictions guiding Einstein's search. Most prominent among these, in addition to the equivalence principle, was the principle of general relativity or covariance—that is, a problematic assumption about the link between the mathematical property of covariance and the physical realization of a generalized principle of relativity. Equally problematic was Mach's principle that postulates the causal role of real physical masses to account for any effect of dynamical inertia.

The third part of the book is the most interesting and original. It begins with an interpretation of Einstein's 1921 paper 'Geometry and Experience', which features an often discussed statement of Einstein's understanding of geometric conventionalism. The subsequent chapters then provide a careful and nuanced account of the sense in which Einstein might be called a realist. Ryckman's historical perspective is helpful here, charting the profound changes that the notion of realism underwent over the last century, partly in response to interpretations of rapidly changing physical theories. He endorses the view that Einstein is a paradigmatic realist, but he immediately cautions the reader:

> [...] a case is made that Einstein is legitimately considered a realist, though not a scientific realist in the contemporary sense, largely because of constructivist and empiricist tendencies that remain anathema to scientific realism. (p. 284)

Ryckman's argument runs like this: First, he presents Einstein's realism as having two distinct components: metaphysical, 'affirming the existence of an external mind-independent world', and motivational, 'affirming the aim of fundamental physical theory to provide a model of this world' (p. 303). In the following chapter on constructivism, Ryckman describes how the mature Einstein, at least, relied on constructivist conceptions that set him in opposition to today's scientific realism. Ryckman identifies two traditions that are relevant here. One is the belief in the freedom of concept formation, largely in the realm of mathematics, a position he links to Georg Cantor and Richard Dedekind. The other is a holistic version of instrumentalism, epitomized in Heinrich Hertz's image theory, which is expressed most concisely in Hertz's statement (cited on p. 326):

> We form for ourselves apparent mental images of external objects; and the form we give them is such that the necessary consequents in thought of the pictures are always the necessary consequents in nature of the objects pictured.

It is by taking account of these traditions, as well as Einstein's Kantian views, that Ryckman proposes to understand Einstein's metaphysical talk of 'grasping reality'. To round off his argument, Ryckman then addresses Einstein's rationalism. The most pertinent quotations here are from Einstein's 1933 Spencer Lecture at Oxford, where he argued that 'Our experience up to date justifies us in feeling sure that in Nature is actualized the ideal of mathematical simplicity', and expressed his belief 'that the truly creative principle resides in mathematics'. Perhaps not coincidentally it was this lecture that began with the earlier advice from Einstein to observe a physicist's deeds rather than proclamations if one wants to understand the methodology. The case has often been made that Einstein's rationalist position in the Spencer lecture reflected his own experiences during his breakthrough to general relativity in late 1915. This achievement had been made possible by a return to a mathematical strategy of exploiting the well-defined mathematics of Riemannian geometry after a largely physically motivated precursor theory had run afoul. Just how decisive mathematical strategy was in 1915 is a source of disagreement among Einstein scholars, but Ryckman stays clear of this controversy. Instead, he proposes a Kantian interpretation of Einstein's self-characterization as a 'tamed metaphysician', going back to the 'transcendental dialects' of the *Critique of Pure Reason*. Viewing mathematical speculation guided by logical simplicity as regulative ideas, Ryckman (pp. 361f.) writes:

> The ‘believing rationalist’ holds that this cognitive aspiration cannot be forsworn without opening the door to philistinism, i.e., to an unsophisticated positivist or pragmatic results-driven conception of science. Nonetheless, it can and must be ‘tamed’ by what Einstein had come to regard as the ‘truly valuable in Kant’. In choosing to identify this lesson in the cryptic catechism *nicht gegeben, sondern aufgegeben*, he sought to underscore the purely regulative use that is the principal message of the ‘Transcendental Dialectic’.

Ryckman’s book provides a readable, highly informative, and up-to-date characterization of Einstein the philosopher–scientist, drawing on a large body of existing Einstein scholarship. With its historical perspective and detailed arguments, it gives a comprehensive review of the philosophy of science associated with Einstein’s thought. While the book does include a timeline and a biographical overview in an introductory chapter, this a book about Einstein’s philosophy of science; the discussion of Einstein’s ideas and theories is subordinated to this overall concern. While this focus is to be lauded in view of much irrelevant, if not frivolous, Einstein literature, Ryckman’s concentration on the philosophy of science lets him ignore other relevant aspects of Einstein’s intellectual persona: his own self-understanding, and his broader impact and influence. Einstein’s interests in physics were broader and more diverse than this focus on principled physics suggests, and it extended to problems of engineering and technology as well. More importantly, nothing is said about Einstein’s political philosophy and his various interventions, many of them forced by historical circumstances, in the cultural, social, and political affairs of his time.

For readers without training in physics, the book provides a glossary of technical terms. Ryckman also makes some effort to explain the physics of the issues at hand. But this can only go so far, and no serious study of Einstein as a philosopher–scientist can really succeed without some physics training. On the other hand, for anyone seriously interested in Einstein’s philosophy of science, Ryckman’s book will be a welcome entry point to the literature, as well as an informed interpretation of Einstein’s work.

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References

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Notes

[1] This first part treats purely quantum processes, whereas the second part includes classical data and its interaction with quantum data, and the third part treats the concepts of observables and complementarity by means of ‘internal’ Frobenius and Hopf algebras.