Einstein's 1917 paper 'Cosmological considerations in the general theory of relativity', rightly regarded as the first step in modern theoretical cosmology. Perhaps the most striking novelty introduced by Einstein was the very idea of a cosmological model, an exact solution to his new gravitational-field equations that gives a global description of the universe in its entirety. Einstein's foray into cosmology was a final attempt to guarantee that a version of 'Mach's principle' holds.

In the following chapter, 'Einstein, gravitational waves, and the theoretician's regress', Daniel J. Kennefick indicates that perhaps Einstein thought that general relativity was a 'difficult' theory, because all of his early calculations of the theory's predictions involved approximate, rather than exact, solutions. This sort of approximation technique presents a particular problem in physics, by forcing us to ask how we know that the solution to a set of approximate equations is actually numerically close to a genuine solution of the full theory. Kennefick examines how Einstein struggled with this problem, as well as pointing out certain ways in which his solutions gave rise to further controversy and debate in the decades after his death. Tilman Sauer's chapter is entitled 'Einstein's unified field theory program'. His contribution is an attempt to characterize Einstein's work on a unified field theory from four perspectives, by looking at its conceptual, representational, biographical and philosophical dimensions. Christoph Lehner tackles 'Einstein's realism and his critique of quantum mechanics'. He explains that Einstein's reservations were increasingly seen as the stubborn metaphysical prejudice of an old man who could not adapt any more to the demands of modern physics.

Don Howard's chapter addresses 'Einstein and the development of twentieth-century philosophy of science'. He notes that the special and general theories of relativity, through their challenge to both scientific and philosophical orthodoxy, made vivid the need for a new kind of empiricism whereby one could defend the empirical integrity of the theory of relativity against challenges, which came mainly from the defenders of Kant. Philipp Frank – a dissenter from central points of right-wing Vienna circle doctrine – deserves particular mention for his more accurate reading of Einstein's position on such issues as the place of convention in scientific theory. Thomas Ryckman searches for the relationship between belief and science in his chapter, 'A believing rationalist'. As he notes, Einstein's philosophical method started on the historic ground of positivism, heavily under the influence of Mach. The end point of Einstein's philosophical odyssey lay in his conversion to a 'rationalistic realism'.

Michael Friedman's chapter is entitled 'Space, time, and geometry'. He argues that Einstein's theories of relativity – especially the general theory – exerted a profound influence on twentieth-century philosophy of geometry, and that this story began (as do so many episodes in twentieth-century thought) with the refutation of Kant. Robert Schulmann closes the book with his chapter, 'Einstein's politics'. He confirms that, as a political figure, Einstein is very difficult to assess. He never engaged systematically in the activities of any political party and remained throughout his life above the political fray. The idiosyncratic cast of his political thinking further complicates the issue.

Overall, the book is an important work of reference, and discusses Einstein as seen through multiple lenses: scientific, philosophical and historical. It is indispensable for anyone who wants to discover more about Einstein.

Rawaa Mahmoud Hussain
Rochester, New York

Milena Wazeck, **Einstein's Opponents: The Public Controversy about the Theory of Relativity in the 1920s**. Translated by Geoffrey S. Koby. Cambridge: Cambridge University Press, 2014. ISBN 978-1-107-01744-3. £65.00/$99.00 (hardback).
doi:10.1017/S0007087415000187

Who is a real, genuine scientist? For reasons that have been studied in depth, Albert Einstein became and still partly remains the icon of science itself. Opposing Einstein is, to a large extent, the same as opposing science, and rejecting the theory of relativity has become synonymous

with obsolescence. Nevertheless, the time for Einstein-centred accounts in which the failure to understand and accept the revolutionary truths of relativity has to be blamed on the contestants' stubbornness, arrogance or simply ineptitude is largely gone. Philosophical reasons, mathematical interpretations, pedagogical traditions, political and ideological settings and so on coalesce in giving a complex picture of the many ways relativity was early on understood, accepted or rejected.

First published in German in 2009, *Einstein's Opponents* is the outcome of a doctoral dissertation in which Milena Wazeck succeeds in applying new brush strokes to the canvas depicting the hostility to Einstein and the theory of relativity. At the core of her thesis we find the debate over what counted as authentic science, as professional or academic work and illegitimate charlatanry or amateurism. Her main characters are people who saw themselves as 'real' scientists – as opposed to 'academic' physicists – whose mission in the world was to rescue knowledge from the bigotry of academia. Members of the latter were, according to the former, narrow-minded, excessively mathematical and esoteric, blind to the big questions, and constitutive of an exclusivist group. The proponents of 'real' science were a heterogeneous mix of engineers and professional scientists (physicians, chemists, experimental physicists) together with schoolteachers, philosophers, journalists and many other self-appointed men of science. The term Wazeck coins to encompass them is the German construction *Welträtsellöser*, which becomes the less appealing 'world riddle solver' in the English translation.

The book unveils the loose network of people united by the common goal of opposing relativity. At the centre of this network were two key people: Ernst Gehrcke, an established physicist working mostly in optics at the Reich Institute of Physics and Technology in Berlin, and Arvid Reuterdahl, a Swedish-born engineer with academic and civil positions in America. The archival material from them both, so far hardly delved into by historians, is sufficient for this network to be reconstructed. But this web was often neither explicit nor easily held together. Many of the people the book talks about hardly knew each other, and they only had in common the fact of exchanging letters with one of the two central characters. Furthermore, opposition to Einstein's relativity proved to be an insufficient motive to hold people together, due to the diversity of reasons for their hostility.

This diversity is the core of the long third chapter. From metaphysical conceptions of time, space or light to prejudices in favour of or against the ether; from occult conceptions of gravitation to complaints against mathematical physics – those who opposed Einstein often did so because they saw their own global theories threatened by one aspect of relativity. For instance, advocates of some variant of philosophical vitalism could not agree to the relativity of time, since the intricate relationship between life and time meant that both had to be either absolute or relative, and the second option was, from their point of view, tantamount to materialism. Rejection of Einstein's relativity in full was normally based on the denial either of a basic principle or, more often than not, of one specific consequence of the theory. It also happened that the theory was dismissed on the basis of priority claims over some such consequences, as in the case of those *Welträtsellösern* whose all-embracing theories had already done away with the ether before Einstein and, on their own view, with better foundations.

Chapter 4 discusses the efforts and techniques used to create a community of Einstein's opponents. In one way or another, they all shared the sense that a conspiracy was at the origin of the success of relativity: on the part of the editors of journals, of university leaders, or of a supposed Jewish lobby. Similarly, the strategy of people like Gehrcke and Reuterdahl was to attempt to exploit their publication niches, not so much in specialized journals but rather in the popular press. They also formed associations like the well-known Association of German Natural Scientists for the Preservation of Pure Science, the lesser-known and short-lived Academy of Nations, and the German Society for Universal Ether Research and Comprehensible Physics.

The geographical scope of the book is mainly Germany and Central Europe, with some episodes in the United States, especially due to Reuterdahl. The reader is left wanting treatment of the relationship with anti-relativity movements in France and, most especially, in Britain. The internal analysis of these anti-Einstein networks is the great contribution of this research, while the

actual influence of these groups among professional scientists and in public opinion is left largely unscrutinized. Although the book is largely Einstein-centred, the core of the argument is to prove that opponents to relativity had no particular hatred of Einstein, but rather objected to the academic and popular success of a theory that they regarded as only the main example of a trend they thought of as anti-scientific. Thus the book is more about what Wazeck calls *Welträtsellösern* than about Einstein himself, or even relativity.

Jaume Navarro
Universidad del País Vasco/Euskal Herriko Unibertsitatea

Maurizio Esposito, **Romantic Biology, 1890–1945.** London: Pickering & Chatto, 2013. Pp. viii + 257. ISBN 978-1-84893-430-7. £60.00 (hardback).
doi:10.1017/S0007087415000199

Studies of the relationship between philosophy and biology in the twentieth century have tended to focus on the more dominant reductionist trends in the subject/science. Although there is a body of work examining alternative positions in biology, it is still somewhat small. Within this work it is acknowledged that, although in a minority, biologists in these alternative positions were often very influential in their chosen field and their impact can still be seen today. Common issues at stake for these biologists were the status of reductionism, holism, neo-idealism, materialism and the relationship of the whole to the parts. This work by Esposito is a welcome addition to the corpus of such literature.

Esposito identifies the impact of Kantian thought on various influential biologists in the United Kingdom and the USA from 1890 to 1945. To reconstruct this Kantian tradition he draws connections between and within these generations through their philosophical inclinations, the influence of Kantian/neo-Kantian mentors in their chosen field, the practical traditions in which they were taught in their formative years, and the role some played in setting up institutions. As a comparative study he highlights, where relevant, the various conceptual, epistemological and methodological differences that delineate both various biologists' uses of the Kantian tradition and their consequent objections to the major trend of mechanistic materialism (perceived as reductionism).

During the nineteenth century the influence of Kant in biology in Britain often came via K.E. von Baer and Georges Cuvier. Esposito traces these connections through such figures as the physician and comparative anatomist Joseph H. Green, the comparative anatomist Richard Owen (whose Kantian influences included Cuvier and Green), and the physiologist W.B. Carpenter. This Kantian community produced an organismic and teleological biology that represented the conservative orthodoxy in Britain. By the late nineteenth century this tradition was increasingly eclipsed by Darwinian biology and Lamarckian materialism, so much so that there was no direct transmission of it from the British Kantians to the next generation of British biologists. However, the idea persisted that to do good biology required familiarity with German biology. This influenced, for example, the embryologist Francis Maitland Balfour and the physiologist Michael Foster. Through their teaching and publications it is likely that the Kantian embryological tradition was absorbed by a number of the new generation (examples include Gavin de Beer, James Gray, E.W. MacBride, E.S. Russell and D'Arcy Wentworth Thompson). John Scott Haldane, a prominent neo-Kantian biologist, arrived at his position by a different route that nonetheless involved German biology. For the United States, Esposito examines the roles of Charles Otis Whitman, F.R. Lillie, E.E. Just, W.E. Ritter and C.M. Child. Both Whitman and Ritter are examples of how the transmission and diffusion of the Kantian organicist tradition was less complex. An important part of their influence lay in running institutions (and in Whitman's case scientific journals) that fostered an organismal approach to biology.

This brings us to Esposito's choice of the term 'Romantic biology' to label this movement. Although obviously attempting to place his study in a wider historical context, he struggles to define Romanticism, admitting that this has been problematic for a long time; the definition in his