There were two quantum revolutions, in both of which Einstein played an important role. The first was quantum mechanics itself, in particular the aspect of wave–particle duality, as developed during the first three decades or so of the 20th Century. The second can be defined to start with John Bell's publication of his famous inequalities; measurements on entangled particles more correlated than the upper limit set by Bell's inequality demonstrate that quantum mechanics is not compatible with local realism, though the latter was the hope of Einstein, Schrödinger, and Bell himself. Einstein had laid the groundwork for the second quantum revolution in his famous paper[3] with Podolsky and Rosen (EPR) almost thirty years earlier, though their hope was that a hidden-variable theory could be constructed in order to avoid spooky action at a distance. Bohr is famous for rebutting Einstein's arguments about Bohr's view of quantum mechanics, and most physicists agree with Bohr in that respect. Aspect makes the point that Bohr's rebuttal of the EPR arguments is much less convincing, but nevertheless there was little further debate during the next thirty years or so due to the practical successes of quantum mechanics, which are independent of its philosophical interpretation.

There is a bit more material on the second quantum revolution, also covering topics such as the manipulation of quantum objects (*e.g.*, single ions), quantum cryptography, and the question whether experiments similar to those discussed will show a limitation to quantum theory. I haven't read the original, but it all seems to have been translated well. There are a few black-and-white figures, but no notes, bibliography, or index; the book is very well produced and would make a nice gift. Those wanting to explore the themes of this book in more detail should read *Quantum Drama*[4] (reviewed in these pages[5]), which is a bit longer and more technical than a typical popular-science book, while this book is a bit shorter and less technical, but provides an easily digestible summary of the topic, in keeping with Einstein's dictum to make everything as simple as possible but not simpler. — Phillip Helbig.

References

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Parallel Lives of Astronomers: Percival Lowell and Edward Emerson Barnard, by William Sheehan (Springer), 2024. Pp. 687, 24 × 16 cm. Price £44·99 (hardbound; ISBN 978 3 031 68799 0).

In this massive and copiously illustrated biography, William Sheehan constructs a meticulous comparison of the lives of two very different personalities. Percival Lowell (1855–1916) was born with the proverbial silver spoon in his mouth into a Boston family that had grown rich upon the textile industry, and for whose education no expense was spared, whereas E. E. Barnard (1857–1923) had an extremely humble origin in Nashville, with almost no schooling, and he would become a self-made man through sheer necessity. His employment as a photographer's assistant was to prove fortuitous.

Lowell started his career as an Orientalist, but after reading Flammarion's monumental Mars book, turned his attention to the heavens. A born wordsmith and superb mathematician, yet hampered by his preconceived ideas about the

Red Planet, he extended the existing Schiaparellian canal network far beyond its credible limits, and thereby came into conflict with many leading scientific figures. But Lowell won lasting popular acclaim through his compelling and voluminous writings, which would continue to influence gullible American (and other) readers decades after the canal question had been settled in 1909.

Starting off as an amateur astronomer, Barnard began his professional career at Lick Observatory, where he used his considerable experience in photography and visual observation to good effect. His visual discovery of Amalthea and his comet and Milky Way photographs soon won him scientific acclaim. Barnard never saw canals upon Mars, but with the Lick 36-inch refractor under excellent seeing he had a glimpse of the true nature of its irregular surface.

Neither he nor Lowell had any children, and both were completely devoted to their Muse, often at the expense of their health. Spending entire sub-zero nights in the dome at Yerkes took their toll upon Barnard, while Lowell had a complete nervous breakdown from overwork only a few years after his observatory had opened.

Barnard could never get on with E. S. Holden at Lick, the Director being more of an antiquarian than an astronomer. His move to the new Yerkes Observatory was timely, even if he would never again enjoy excellent seeing for his planetary work. Instead he obtained access to state-of-the-art facilities for wide-field deep-sky photography. Lowell of course never had to work for anybody. Some of his assistants at Flagstaff had very short careers there, unable to deal with their autocratic master's bouts of bad temper, or for being unable to see the planets in the approved Lowellian manner.

All of this detail and far more is described in a story in which the parallel lives of the two great astronomers are cleverly woven together and critically examined. Sheehan has previously given us a biography of Barnard, and has written extensively about Lowell and the history of Mars observations generally, and so is well placed to have produced such a comprehensive study. But still it must have required a monumental amount of research.

With the benefit of hindsight, we might ask why Lowell blindly accepted the diagrammatic Mars of Schiaparelli and not the natural-looking world sketched by other astronomers. But Lowell was always sure of himself, and his version of the Solar System was a hierarchical one in terms of age. Mars must have cooled faster than the Earth, and its civilisation must therefore be older and wiser, and had of course become canal-builders out of necessity. We might ask many questions about Lowell. What if he had discarded social norms of his day to marry his devoted Secretary and assistant Wrexie Louise Leonard, rather than the lady who would prove such a financial disaster to the Observatory after his death? Despite all of Lowell's wealth and education, in the end it was the poor boy from Nashville who not only found the perfect life partner in Rhoda Calvert, but who would better comprehend the true nature of the Martian surface.

Under Lowell's directorship Flagstaff became a centre of excellence in the fledgling field of planetary photography. And he conducted a serious search for a trans-Neptunian planet. Pluto, discovered years after his death at his own observatory, would bear his initials, PL. And the radial-velocity work upon extragalactic nebulae conducted at Flagstaff by V. M. Slipher would pave the way towards an understanding of the expanding Universe. For his part, Barnard produced the most accurate micrometrical measures of the bodies of the Solar System, made several cometary discoveries, gave accurate descriptions of planetary features, and undertook important contributions to stellar astronomy with his numerous papers and Milky Way photography which mapped out so clearly its structure, and the intricate dark patches and lanes of interstellar dust. We also remember him for the discovery of Barnard's Star, with its record-breaking proper motion.

Parallel Lives is always fascinating, and is a real work of reference. There are plenty of striking illustrations, including many not previously seen. Just in a few instances the publisher has slipped up with the placing of an illustration, or has left an unexplained gap, on part of a page. Nor has the publisher provided an index; given the enormous number of names (let alone events) scattered throughout the text, I would have considered one essential. Apart from its coverage of the lives of Lowell and Barnard, this book addresses so many aspects and personalities of the astronomy of a century ago that it must have a wide appeal to institutions and individuals. I can warmly recommend it. — Richard McKim.

Origins: The Cosmos in Verse, by Joseph Conlon (Oneworld), 2024. Pp. 158, 19·7 × 13 cm. Price £11·99 (hardbound; ISBN 978 086154 911 5).

At the 2024 Moriond cosmology meeting, Joseph Conlon, professor of theoretical physics at the University of Oxford, gave an invited talk on string theory, a topic rather far removed from the work of most of those at the conference. My impression, and that of many others, was that it was the best talk of the conference. Still looking much younger than his forty-three years and sometimes mistaken for a student, before a rather traditional career with BA and PhD from Cambridge then moving to Oxford as a Royal Society Research Fellow and moving up the ranks, Conlon had obtained a BSc in mathematics from the University of Reading (part-time alongside schoolwork). His popular-science book *Why String Theory?*[1] (near the top of my pile of books to read) was the *Physics World* Book of the Year in 2016. I was thus intrigued when I learned that he had written a book of poetry. The book contains two long poems about physics. Although currently out of fashion (though Max Tegmark does have an *ApJ* paper with the abstract in couplets[2]), poetry about science has a long tradition, going back at least to Lucretius's *On the Nature of Things*. Both Dante and Kepler wrote poetry about astronomy and cosmology[3,4], and Milton visited Galileo; Maxwell and Lovelace wrote poetry, and Keats was a licensed surgeon[5].

So what do we get? The first, somewhat longer, poem is 'Elements', which covers Big-Bang nucleosynthesis, star formation, basics of stars, Cecilia Payne (-Gaposchkin), B^2FH (ref. 6), the production of elements heavier than iron, life, and the author himself. 'Galaxies' starts off with some history of astronomy (especially the homogeneity of the Universe on large scales) before moving to inflation, General Relativity, and the cosmological constant, then moves down the scale to the subatomic realm and a discussion of quantum mechanics (important for inflation, spectroscopy, and X-rays, among other things) and its history, followed by a coda ("an extended simile") covering everything from Oxfordshire pubs to social networks to galaxies. Each poem is preceded by a preface of a page or so describing the structure and contents. The poems are followed by twenty-eight pages of notes adding more conventional scientific detail to the pages indicated (except for the coda in 'Galaxies'). Of course, like jokes, most poetry works best when nothing has to be explained, though some will find the notes helpful. A four-paragraph note on the formation of elements heavier than iron reads in part "...there are two possible ways the r-process can occur, both associated with exploding stars, and it is not yet fully known how each contributes to the formation of heavy elements in the present universe."