approaches while at the same time a new generation (Weisskopf, Wheeler, von Neumann, Wigner, *etc.*) took over*: Bohr died in 1962, Einstein in 1955, Fermi in 1954, Schrödinger in 1961, Pauli in 1958. (Interestingly, some of the earlier generation died much later, *e.g.*, de Broglie in 1987, Dirac in 1984, Born in 1970, Jordan in 1980, von Weizsäcker in 2007, but in their last decades they were no longer leading the discussion in the field.) There is also a good discussion of attitudes in the field as expressed at conferences (where opinions are often more clearly on display than in journal articles). The last part introduces John Bell and the current importance of his work, *e.g.*, the experiments by the winners of the 2022 Nobel Prize in Physics (Clauser, Aspect, and Zeilinger), quantum cryptography, and quantum effects observable in (almost) macroscopic objects. In between is an interesting discussion of popular-level mysticism in connection with quantum mechanics (Capra[4], Sarfatti, Zukav[5], *etc.*). While that is often (correctly, in my view) looked down upon, it is important to remember that Schrödinger was very interested in eastern mysticism, Pauli in the psychological theories of Jung, Bohr put yin and yang on his coat of arms, and so on. (At least Schrödinger's 'mystical side' might be more akin to the religion of Lemaître, who was a Catholic priest yet seemed to be able to separate that from his work in cosmology, which has also been the case among some more modern openly religious cosmologists such as John Barrow and George Ellis.)

While there are few equations in the book, the fourth part goes into more detail than one might expect in explaining the ideas of Bell and the experiments of Clauser, Aspect, and Zeilinger. While the book can't cover everything — and doesn't attempt to — all the same, many readers will probably come across concepts and people usually not mentioned in overviews of (the history of) quantum mechanics, such as Grete Hermann. As such, it is complementary to many other books broadly covering similar ground. It is also better written than most books I've reviewed in these pages. There are black-and-white figures scattered throughout the book. Twenty-five pages of endnotes are mostly references to the sources listed on twenty-seven pages. The thirteen-page small-print index is especially thorough, especially for a 'popular' book, and demonstrates again that this book is a cut above most broadly similar books, both in terms of content and in terms of presentation. It should appeal to a relatively wide readership, especially due to its combination of detail and readability, including, despite the lack of astronomy, readers of this *Magazine*. — Phillip Helbig.

References

(1) P. Helbig, *The Observatory*, **139**, 128, 2019.
(2) J. Baggott, *Quantum Space: Loop Quantum Gravity and the Search for the Structure of Space, Time, and the Universe* (Oxford University Press), 2018.
(3) J. L. Heilbron, *Niels Bohr: A Very Short Introduction* (Oxford University Press), 2020.
(4) F. Capra, *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism* (Shambhala Publications), 1975.
(5) G. Zukav, *The Dancing Wu Li Masters: An Overview of the New Physics* (William Morrow), 1979.

Splinters of Infinity, by Mark Wolverton (MIT Press), 2024. Pp. 271, 23·5 × 16 cm. Price $29·95 (about £24) (hardbound; ISBN 978 0 262 04882 8).

While the title *Splinters of Infinity* might suggest otherwise, this book is a history of the debate between Robert Millikan and Arthur Compton about

*I use 'generation' here less in relation to the year of birth and more in relation to the period in which the person in question was an active participant in the field.

the nature of cosmic rays and the fate of the Universe. The book tells a chronological story roughly from 1930 to 1937, with some backstory of each of the main characters and of the study of cosmic rays.

Known for their Nobel prizes in quantum physics, Millikan and Compton both shifted their careers to studying cosmic rays, then the cutting-edge physics of their day. Millikan, despite his prior work on electrons, believed cosmic rays were gamma rays. Compton, despite his prior work on X-rays and gamma rays, argued that they were charged particles. What's more is that Millikan, an openly religious man, claimed that cosmic rays were the "birth cries" of atoms being continuously formed and were proof that God's act of creation was still on-going. Following the Scopes trial of 1925, newspapers across the country, including the *New York Times* and the *Los Angeles Times*, revelled in reporting the most prominent American physicist pronouncing the harmony of religion and science and evidence that "the Creator is still on the job", in stark contrast to the prevailing theory even then that the Universe would end in heat death as it slowly disintegrates. Arthur Compton, rising in prominence, confidence, and funding, took up the challenge to align with the growing consensus, especially in Europe, that cosmic rays were charged particles. Articles chronicling the on-going dispute appeared in dozens of newspaper articles — sometimes on the front page — for years.

It may be hard to believe, even for experts in the field, that "cosmic ray" was once a household buzzword, front-page material, and the precursor to modern particle physics. Thought to be a possible source of free energy, cosmic rays attracted charlatans, crackpots, and 'healers' trying to sell their products with the buzzword of the day, much like one might find 'nano' and 'quantum' attached to modern-day equivalents. Cosmic-ray research was the biggest and most cutting-edge science around, and this book recounts the record-setting global expeditions by land, air, and sea to settle the debate.

Mark Wolverton, a science journalist and author of several books blending science and history, adopts a narrative approach to focus on this lesser-known story of scientific history. He is meticulous, evidenced by 22 pages of endnotes that are almost entirely references to books, newspaper articles, and personal correspondence among the main and supporting characters. The book is filled with biographical and historical details. For example, amid the "cosmic ray health centers" and comic-book stories about infinite free energy from the nucleus and from cosmic rays, Albert Einstein told reporters in 1934 that atomic energy was unlikely, giving a sense of the *zeitgeist* of the 1930s.

This book is not technical and would appeal to any reader interested in the historical details that led to our current understanding of cosmic rays and physics more broadly. *TIME* magazine described the Millikan–Compton debate as "one of the most reverberating scientific controversies of the century", more famous in its day than the Great Debate between Shapley and Curtis, but it is nonetheless a MacGuffin, a device to draw the reader in to a case study of science and of scientists, who, as always, are human. In their hunt for the secrets of cosmic radiation, they set hot-air-balloon altitude records, argue over primacy, invent the AND digital circuit, jump to faulty conclusions, drop their equipment to the bottom of a lake, and fall to their deaths in a crevasse — but save the data book. The story shows how science is a messy enterprise, full of ego and dead ends — literally! One also reads about how scientists of that time dealt with the press and public perception, in contrast to scientists of today.

For anyone working on cosmic rays, this book is a must-read. While *Splinters of Infinity* doesn't focus on physics that revolutionized modern technology, like atomic power or lasers, it will, however, interest readers who enjoy the personal and historical sides of science. The reader may also find this lesser-known area of physics interesting in its own right. As Mark Wolverton writes, "Cosmic rays remain one of the most intractable scientific puzzles of all time." — Paul Simeon.

At the Crossroads of Astrophysics and Cosmology: Period–Luminosity Relations in the 2020s, edited by Richard de Grijs, Patricia A. Whitelock & Márcio Catelan (Cambridge University Press), 2024. Pp. 333, 25·5 × 18 cm. Price £120/$155 (hardbound; ISBN 978 1 009 35304 5).

The best-known period–luminosity (P–L) relation in astronomy is undoubtedly that for Cepheid variables, discovered (as several of the chapters in this volume tell us) by Henrietta Swan Leavitt, though the powers-that-be have not (yet?) persuaded most practitioners to call it the Leavitt Law. Actually there are many such laws for many kinds of Cepheid variable stars and many other categories. The volume and the symposium it reports address only stellar sources (including binaries), though reverberation mapping of active galaxies (AGN) has a bit of the same flavour.

Did the SOC manage to corral a presentation touching on every known variable category? Not quite. Only the editors' preface mentions ZZ Ceti, V777 Herculis, and GW Virginis, pulsating white dwarfs of spectral types DA, DB, and DOther, which have their own instability strips, but were presumably declared not relevant to cosmology. I am not quite sure this is true, given potential implications for the ages of various stellar populations. But beta Cep, roAp, delta Sct, and gamma Dor do appear among the less-famous classes, not to mention BL Her and SX Phe. And yes, binaries, because the Roche geometry forces a period-separation–stellar-size limit that leads to a correlation of period and absolute brightness.

The front matter lists names of 126 participants, with no affiliations or countries of residence given (those appear only for first authors of the 27 articles). The conference photo, in glorious black and white like all the rest of the volume, is compressed onto a standard single page in portrait format and probably includes a comparable number of people, about whom it can be said that most paid the registration fee (name badges displayed) and at least those in the front row appear to have two legs each and shoes.

Wendy Freedman and Barry Madore are given the first word, on past, present, and future of the Cepheid extragalactic distance scale, and several other papers look specifically at Cepheids (including Type II's and anomalous Cepheids). Stars at the tip of the red-giant branch also get a fair amount of attention. In comparison to earlier studies of variable stars, the dominant impression here is MORE. Data on very many variables have recently come — or are coming — from the *Kepler* mission, OGLE, and *Gaia*. *JWST* is proving its worth both by extending P–Ls into the infrared and also by angular resolution much improved from *HST*. Cepheids in double-lined eclipsing binaries and in open clusters have become routine sources of extra information, though they were, once upon a time, thought not to exist.

Several things left me puzzled. There is a map of Japan (p. 164) showing the location of four 20-metre antennae spread somehow across the country, but the outline is an oval, and no islands are shown. The array is being used to measure parallaxes and circumstellar masers of massive AGB stars. The first author is A. Nakagawa of Kagoshima University, who undoubtedly knows where the